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Natural Disaster, Environmental Concerns, Well-Being and Policy Action

The Case of Fukushima

Imprint

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Abstract

We study the impact of the Fukushima disaster on environmental concerns and well-being in Germany and other industrialized countries, more than 5,000 miles distant. While we do not find evidence that subjective well-being was significantly affected – not in Germany, Switzerland, or the UK – the disaster significantly increased environmental concerns by about 20% among Germans. Empirical evidence suggests that the operating channel through which the disaster affected environmental concerns was primarily through the perceived risk of a similar meltdown of domestic reactors. Additionally, more Germans considered themselves as very risk averse after Fukushima. Drastic policy action in Germany permanently shut down the oldest reactors, implemented the phase-out of the remaining ones, and proclaimed the transition to renewables. This energy policy turnaround was largely supported by the German population and contributed to the subsequent significant decrease in environmental concerns, particularly among women, Green Party supporters, and people living close to the oldest reactors.

JEL Classification: I18, I31, Z13, Q54.

Keywords: Fukushima, meltdown, well-being, environmental concerns, SOEP

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1. Introduction

On March 11, 2011, seemingly the worst-case scenario in the history of the civil use of nuclear energy occurred: a natural disaster triggered the Fukushima Daiichi nuclear accident. At about 3pm JST, the Tohoku earthquake, magnitude 9.0, struck off the east coast of Japan at an underwater depth of about 30km (19mi). It was the strongest earthquake to hit Japan since record-keeping began, triggering a gigantic tsunami with waves up to 40m (133ft). The tsunami's dimensions far exceeded the safety measures of the Fukushima Daiichi nuclear power plant, whose 5.7m (19ft) sea walls were easily topped by the up to 15m (49ft) high waves hitting the plant. Although the safety measures met regulatory requirements, in total, three of the six reactors fully melted down, leading to a major release of radioactive material into the environment.

In the subsequent days, the dimensions of the catastrophe became apparent. Within two days, nearly 200,000 people were evacuated, an estimated 4.5 million were without electricity, and 1.5 million without water. In September 2011, the *Japanese Policy Agency* concluded that the entire disaster, inclusive of the earthquake, tsunami, and meltdown, resulted in 16,000 deaths, thousands of injured or missing people, and 400,000 collapsed or partially collapsed buildings (INPO, 2011). However, no short-term physical health damages from radiation were observed as of 2013 (WHO, 2013).

While physical damages were mainly limited to Japan and its surrounding sea areas, the disaster triggered political action in a country more than 5,000 miles distant: Germany. In response to the meltdown, the conservative government of Chancellor Angela Merkel made a sharp U-turn in its energy policy. Fukushima "made [Angela Merkel] change her mind about the risks of nuclear energy" (Bundesregierung, 2011a). In consensus with the liberal opposition, immediately after the disaster, the oldest reactors in Germany were *temporarily* shut down (the so-called *"Atommoratorium"*)—despite their reputation of being among the safest in the world and despite the marginal tsunami risk in Germany. On May 30, 2011, the government put forward a law that would *permanently* shut down these reactors (the so-called "*Atomausstieg"*). In addition, it implemented the staggered phase-out of the remaining ones. This law will lead to a complete shut-down of all nuclear power plants in Germany by 2022. It represents a direct and immediate response to the unexpected and exogenous Fukushima catastrophe.

As a first contribution, this paper estimates the impact of the Fukushima catastrophe on environmental concerns and subjective well-being in distant Germany. While we do not find much evidence that subjective well-being was significantly affected in Germany, we do find that environmental concerns significantly increased among the German population in the weeks after the meltdown. These findings demonstrate that disasters not only have local impacts, but can also have external effects on other, distant, countries, even if those countries are presumably not directly affected. This paper adds to the literature on such external effects by showing that they may even exist when a disaster in country A does not increase the risk of a similar disaster in country B (as is the case for nuclear disasters triggered by tsunamis); suggesting that while the objective risk may not change, subjective risk perception or tolerance may. Indeed, we find that the share of Germans who consider themselves very risk averse increased significantly after Fukushima. The empirical evidence also shows that people who live close to the oldest reactors, which were immediately shut down in the aftermath of the disaster, reacted differently, implying that the perception of concrete local risk factors outweigh potential risk factors further away in other countries.

As a second contribution, this paper empirically assesses whether policymakers can alleviate, or even reverse, concerns in the population through immediate policy action. A representative survey conducted on March 14, 2011, found that 70% of all Germans believed that a nuclear catastrophe similar to Fukushima could also happen in Germany. Accordingly, 71% were in favor of a complete nuclear phase-out, up from 62% in August 2010 (Infratest, 2010, 2011a, b). In line with these survey data, after the passing of the nuclear phase-out bill, we find that environmental concerns significantly decreased—by approximately the same share that they had increased after Fukushima. Again, a representative survey conducted in June 2011 underlines these findings, showing that 54% of all Germans support the bill and also the quick political decision process (Infratest, 2011c).

As a final contribution, using the same empirical approach as for Germany, we assess the impact of the Fukushima disaster on subjective well-being and attitudes in Switzerland and the UK. The findings for the UK and Switzerland confirm the findings for Germany, showing zero effects on subjective well-being, but a significant increase in valuing environmental protection in Switzerland.

This study focuses on Germany for two reasons. The first, technical, reason is that we are able to exploit the German Socio-Economic Panel (SOEP), which is a representative long-running household panel with a rich set of concern and well-being questions. As such, we can net out individual unobserved heterogeneity in our combined Difference-in-Differences (DID) and Regression Discontinuity (RD) models. In Germany, we are able to exploit the exact interview date with respect to the Fukushima disaster and the fact that about 50% of all respondents were surveyed before and after the accident. Established in 1984, the SOEP also allows us to directly compare the Fukushima and Chernobyl disasters, using the same data and variables, as well as the same institutional and cultural setting. Chernobyl also provides a counterfactual when evaluating the effect of the Atomausstieg.

Second, the German *Atomausstieg* as a reaction to the Fukushima disaster is unique. Debates about nuclear energy, especially its risks and benefits, have been an integral part of the political debate in Germany for decades. A complete nuclear phase-out has always been one of the key objectives of the Greens. The Greens have been part of the German parliament since 1982 and they were even the junior partner in the Red-Green Coalition with the Social-Democrats from 1998 to 2005. In one empirical specification we indeed find that Fukushima significantly increased the share of people who sympathizes with the Green party by 1.7ppt.

However, at the same time, the findings of this paper are of general interest. As in Germany, there have been debates and referenda about nuclear energy in various industrialized countries. Massive protests prevented the *Carnsore Point* nuclear power plant in Ireland from starting operations in the 1970s. Austria decided to mothball the already finished *Zwentendorf* nuclear power plant after a negative referendum in 1978. As a reaction to the 1986 Chernobyl disaster, the Philippines decided against operating a new nuclear power plant, while Italy shut down its four operating ones. There are 435 nuclear power plants in 30 countries; half of them are located in the US where nuclear energy is less controversial than in European countries. New reactors are planned for 21 of these 30 countries. Eleven countries that currently do not operate nuclear power plants are planning to use nuclear energy in the future, including Turkey, Poland, Indonesia, and Vietnam. On the contrary, in addition to Germany, nuclear energy is being phased out by Switzerland, Belgium, and Spain. Thus, although population attitudes and cultures differ widely across countries, the German example is informative for a wider set of countries.

The remainder of this article is structured as follows. Section 2 provides a literature review. Section 3 briefly describes the events around the Fukushima disaster and the political reactions in Germany. Section 4 describes the data, while Section 5 presents and discusses the empirical model and results. Section 6 concludes.

2. Literature Review

This paper contributes to several strands in the economic literature. It directly relates to the small, but growing, field that assesses the effects of terrorism, natural disasters, and nuclear accidents. Several papers in this field study negative externalities and spillover effects on other, presumably unaffected, countries. Such negative externalities and spillover effects provide an economic justification for a supra-national regulation of terrorism, climate change, and nuclear energy.

For example, Luechinger and Raschky (2009) use subjective well-being measures to economically value the costs of flood disasters. Pesko (2014) assesses the impact of Hurricane Katrina on stress, smoking, and binge drinking in presumably unaffected US counties, whereas Pesko and Baum (2014) study the impact of 9/11 on risky behaviors.[1] Draca et al. (2011) analyze the impact of the 2005 terror attacks in London on crime.

While the papers cited above directly study affected populations of disasters, using a similar approach as this paper, Metcalfe et al. (2011) show that 9/11 also negatively affected the subjective well-being of residents in the UK and Schüller (2012) shows that negative attitudes towards immigration increased in Germany. In the context of Chernobyl, four papers assess the impact of the disaster on a variety of well-being, health, and labor market outcomes, mostly for individuals in countries other than the Ukraine: *(i)* Danzer and Danzer (2011) find negative long-term effects on subjective well-being and mental health in the Ukraine. *(ii)* Almond et al. (2009) find negative long-term effects of prenatal exposure to the disaster on cognitive ability in Sweden. *(iii)* Halla and Zweimüller (2014) find negative long-term effects of prenatal exposure to the disaster on labor market outcomes in Austria. *(iv)* Berger (2010) finds that environmental concerns increased in West Germany immediately after the disaster.[2]

There are several studies on the consequences of the Fukushima catastrophe. However, almost all focus on Japan (Glaser, 2011; Hippel, 2011; Hommerich, 2012; Huenteler et al. 2012; Ishino et al. 2012; Kawashima and Takeda, 2012; Thomas, 2012; Uchida et al., 2014; Vivoda, 2012; Yamamura, 2012; Aoki and Rothwell, 2013; Bauer et al. 2013; Csereklyei, 2013; Buesseler et al. 2013; Ohtake and Yamada, 2013; Richter et al., 2013; Rieu, 2013; Rehdanz et al. 2013; Tiefenbach and Kohlbacher, 2013, 2014; Wang et al.,

[1] Frey et al. (2011) show that, when assessing the total costs of terrorism, using the life satisfaction approach, the total costs by far exceed the direct economic costs. Other studies assess the indirect effects of the War Against Terrorism by showing that combat exposure increases *(i)* risky behaviors, such as smoking or drug use, among affected soldiers (Cesur at al., 2014a), as well as *(ii)* sleep disorders, psychological problems, and the risk of migraine headache (Cesur et al., 2014b).

[2] Since Berger (2010) uses the same data set as the current study and since the current study also assesses the impact of the Chernobyl disaster on environmental concerns as a counterfactual approach to provide additional evidence on the policy reaction, it is worthwhile to highlight some methodological differences: First, despite the panel structure, Berger (2010) focuses only on the year of the disaster and therewith does not net out individual unobserved heterogeneity. Second, most interviews took place in the first quarter of the year, which is why 80% of all interviews were carried out before April 26, 1986, the day of the Chernobyl disaster. Therefore, it seems important to consider persistent differences between pre- and post-interviewees by including several years and time-invariant interview date indicators.

2013). Specifically, three (unpublished) studies focus on well-being.[3] Rehdanz et al. (2013) use KHPS Japanese household panel data and find that, post-Fukushima, people living closer to the site of the disaster report lower levels of subjective well-being than people living further away. Hanaoka et al. (2014) use the *Japan Household Panel Survey on Consumer Preferences and Satisfaction* and find that, when using variation in the degree to which regions in Japan are affected by the disaster, the respondents in more affected regions became *more* risk tolerant. Richter et al. (2013) use the same data set and outcomes variables as this study. However, the two studies differ substantially with respect to the methodological approach. First, Richter et al. (2013) use the year 2011 only and abstain from exploiting the panel structure of the data set. As such, their estimates do not net out individual unobserved heterogeneity through individual fixed effects. Second, Richter et al. (2013) use a simple before-after approach, whereas this study uses a combined Difference-in-Differences (DID) and Regression Discontinuity (RD) approach. As such, they do not consider the fact that respondents interviewed before and after March 11, 2011, may systematically differ in their observables (and potentially also in their environmental concerns and subjective well-being). In our approach, where the unexpected and exogenous disaster determines treatment status, this issue is dealt with by including a treatment group dummy variable. Third, this study uses additional concern and well-being measures, as well as provides several robustness checks and heterogeneity analayses. Finally, this study also analyzes the effects of the Fukushima disaster in the UK and Switzerland, while providing evidence on the operating channels through which the disaster affected environmental concerns.

More generally, this paper adds to the literature on well-being. Events studied in this field and shown to affect well-being include economic growth (Oswald 1997, Oswald and Wu 2011, Deaton 2012), unemployment (Winkelmann and Winkelmann 1998, Kassenboehmer and Haisken-DeNew 2009, Knabe et al. 2010, Luechinger et al. 2010, Marcus 2013), (relative) income (Frijters et al. 2004, Senik 2009, Clark et al. 2009, Clark and Senik, 2010), spousal characteristics (Clark and Etilé 2011, Cahit et al. 2011), and pollution (Luechinger 2009).

Moreover, it adds to the literature on energy economics (Deschênes and Greenstone 2007, Greenstone and Gayer 2009; Strielkowski et al. 2013, Cesur at al. 2013), political economy (Anderson et al. 2013), and their interplay (Ockwell 2008, Büscher 2009, Acemoglu et al. 2011, Wangler 2012). The latter is a growing field that deals primarily with the policies and consequences of renewables and climate change (Pindyck, 2013; Cullen, 2013; Murray et al. 2014; Marron and Toder, 2014). Finally, the paper adds to the literature on the determinants and impacts of environmental concerns. Studies in this field find that females and

[3] In addition to these three studies focusing on well-being, Bauer et al. (2010) study the impact of the shut-down of reactors in Germany on housing prices. They find that housing prices *de*creased by between 6% to 12%.

higher educated people are more concerned about the environment (Tatic and Cinjarevic, 2010; Czap and Czap, 2010; Urban and Ščasný, 2012; Aklin et al. 2013). Interestingly, income itself does not seem to play a big role (Tatic and Cinjarevic, 2010; Aklin et al. 2013), but pecuniary incentives obviously matter (Czap and Czap, 2010). Owen at al. (2012) show that personal experiences with extreme weather events positively affect preferences for environmental regulation.[4]

3. The Fukushima Disaster and Political Reactions in Germany

3.1 The Fukushima Daiichi Nuclear Disaster

On March 11, 2011, at 3pm local time, a giant earthquake shook the ocean bed about 72km (45mi) off the Japanese east coast. Measuring 9.0 on the Richter scale, this earthquake was the largest in Japan since the beginning of record keeping, even shaking skyscrapers in 370 km (230mi) distant Tokyo. It triggered a giant tsunami with waves reaching up to 40m (133ft) that hit the coast just 30 minutes later, wiping out cities, villages, and property up to 10km (6mi) inland. The tsunami left behind massive destruction, killing more than 16,000 people (Okada et al., 2011).

The Fukushima Daiichi nuclear power plant is located 163km (102mi) southwest of the epicentre of the earthquake. Shortly after the earthquake, the plant lost its electricity supply and switched to emergency power supply through its diesel generators in order to enable the emergency cooling of the three, out of six, reactors that were in operation at that time, all of which were immediately scrammed. However, the plant's sea walls, although meeting regulatory requirements, were easily topped by the tsunami waves, which destroyed the diesel generators and, as such, the emergency cooling system. As a result, the three reactors in operation fully melted down, with radioactive particles being released into the environment (IAEA, 2011). Everybody within a radius of 10km (6mi) around the plant was evacuated immediately on the days following the disaster; it was later extended, creating a 20km (13mi) radius permanent exclusion zone.

The Fukushima meltdown was the second largest accident in the history of the peaceful use of nuclear energy to date. It was classified 7 on the International Nuclear and Radiological Event Scale (INES) of the International Atomic Energy Agency (IAEA), meaning that there was a major release of radioactive material

[4] In the Online Appendix in Table A1, we show simple correlates between environmental concerns and socio-demographic characteristics. The findings largely confirm the previous literature: Relative to the mean share of environmentally concerned people in the population, which is 30%, environmental concerns increase *(i)* by 7ppt for females and *(ii)* by 4ppt for disabled individuals, whereas they decrease *(iii)* by 0.5ppt for each child in the household and *(iv)* by 2ppt for individuals with the lowest educational degree (less than secondary) relative to the highest educational degree (tertiary).

with widespread health and environmental effects that required implementation of planned and extended countermeasures (IAEA, 2011b). The scope of the disaster was exceeded only by the 1986 Chernobyl meltdown, which released even more radioactive particles into the environment.

3.2 The Political Reactions in Germany: "Atomausstieg" and "Energiewende"

Shortly after the Fukushima meltdown, on March 14, 2011, a safety assessment of all 17 remaining operational nuclear power plants in Germany was announced by the government, including the *temporary* shutdown of the eight oldest reactors.[5] This policy reaction has become known as the *"Atommoratorium"* (Bundesregierung, 2011b). The safety assessment was conducted by the Reactor Safety Commission (the so-called "*Reaktorsicherheitskommission*"). At the same time, an ethics commission (the so-called "*Ethikkommission für eine sichere Energieversorgung*") was appointed to evaluate the future of nuclear energy in Germany in a broader societal context.

The safety assessment concluded that the 17 remaining operational nuclear power plants in Germany were at least as safe as Fukushima Daiichi and that it was virtually impossible for the same accident scenario to occur in Germany. However, it also suggested certain improvements, in particular for older plants, be made. The ethics commission, on the contrary, unequivocally recommended exiting nuclear energy within a decade (Reaktorsicherheitskommission, 2011; Ethikkommission für eine sichere Energieversorgung, 2011).

Following the recommendation of the ethics commission and taking into account the final report of the Reactor Safety Commission, on May 30, 2011, the government announced that it would introduce a *Nuclear Phase-Out Bill* (the so-called "*13. Gesetz zur Änderung des Atomgesetzes*"), which provided for the *permanent* shutdown of the eight oldest reactors in Germany and a reversal of the lifetime extension for the remainder (Bundesregierung, 2011c). The reversal of the lifetime extension takes back a lifetime extension of seven years for older and 14 years for newer nuclear power plants in Germany. This extension was initially granted on September 5, 2010, just shortly after the federal elections that were won by Christian-Democrats (CDU) and the free-market liberal "Free Democratic Party" (FDP).

The new bill imposes a fixed date for a nuclear phase-out for the first time in history. It passed the *Bundestag*, the "lower" legislative house, with a great majority of 513/600 of the votes on June 30, 2011 (Deutscher Bundestag, 2011). It also passed the *Bundesrat*, the "upper" legislative house, just over a week later, on July 8, 2011. The law became effective, alongside a number of other bills that promote a change in

[5] At that time, the "*Krümmel*" nuclear power plant was already off grid due to technical problems.

energy sources from fossils to renewables (the so-called "*Energiewende*"), on August 6, 2011 (Bundesregierung, 2011d; Bundesregierung, 2011e).

[Insert Figure 1 about here]

4. Data

4.1 Data Set

The study primarily uses individual-level data provided by the German Socio-Economic Panel (SOEP). The SOEP is a representative panel study of private households in Germany, conducted annually since 1984. About 20,000 individuals from more than 10,000 households are surveyed every year. All respondents aged 17 and older answer an individual questionnaire, covering about 150 questions on different topics, such as demographic, educational, and labor market characteristics, health, worries, attitudes, and perceptions. Additionally, a household questionnaire is completed by the head of the household. For further details about survey content and design, see Wagner et al. (2007).

For our main analyses and baseline specifications, we exploit the panel dimension of the SOEP and focus on respondents who were interviewed in both 2010 and 2011. In total, we obtain 26,369 person-year observations from 16,280 different individuals of which 10,089 were interviewed in both years and have no missings on their observables. In 2011, roughly half of those 10,089 individuals were interviewed before and after the Fukushima catastrophe, respectively.

For extended analyses and to measure medium-term effects, we focus on respondents who were interviewed between 2009 and 2012, obtaining 57,492 person-year observations. In a falsification test, we compare Fukushima to Chernobyl. To do so, we select the same data on respondents who were interviewed between 1984 and 1989, obtaining 62,540 person-year observations. In extended analyses, we also use the data sets Understanding Society for the UK and the Swiss Household Panel (SHP) for Switzerland (University of Essex; Budowski et al. 2001).

4.2 Dependent Variables on Environmental Concerns and Subjective Well-Being

We exploit several environmental concern and subjective well-being measures that are routinely surveyed by the SOEP. Our main dependent variable is based on the question: "*What is your attitude toward environmental protection? Are you concerned about it? (a) Very concerned, (b) Somewhat concerned, (c) Not concerned at all*". We collapsed the answers to this questions into a binary measure that is one when respondents are "very concerned" about ***environmental protection***, and zero otherwise. As seen in the

Appendix, on average, 30% of all respondents are "very concerned" about environmental protection. Analogously, we generate binary measures for the share of respondents who are "very concerned" about ***climate change*** and, for placebo tests, ***job security, crime, health***, and the ***economy***. Between 10% and 30% of all Germans are, on average, very concerned about these topics.

In addition to these measures of concern, we exploit the standard 11 categorical life satisfaction measure. It has its mass point between the values 5 and 9. Of all respondents, 86% fall into these categories.

The SOEP also measures affective well-being, asking respondents to rate how often they felt happy or sad during the four weeks prior to the interview. Five answer categories range from "very seldom" to "very often". We collapse the two highest categories, "often" and "very often", and, accordingly, generate two dichotomous variables. The Appendix shows that, interestingly, (only) 14% of all Germans are "often" or "very often" happy, whereas 54% are "often" or "very often" sad.[6]

Covariates

The ***demographic factors*** that we use are *age, age squared*, a *female* gender dummy, and dummies for being *married, single*, and *disabled*. In addition, we include a dummy indicating those without *German nationality*. The Appendix shows that the average age of the respondents is 51 years and that slightly more than 52% of them are female. Two-thirds of all respondents are married and 5% are not German.

In terms of ***education and labor market characteristics,*** we control, among others, for the school degree, as well as whether respondents are *full-time employed* (39%), *part-time employed* (12%), *out of the labor force* (42%), on *maternity leave* (2%), or *unemployed* (5%).

For ***heterogeneity analyses***, we use people's political opinions and self-rated risk aversion. The dummy variable *Green* indicates that respondents lean toward the Green Party (14.8%), which was in the opposition at the time of the disaster.[7] We also employ indicators for respondents who supported one of the opposition (45%) or governmental parties (44%). *RiskAverse* indicates risk aversion and is the collapsed version of the 11 categorical risk aversion measure (Dohmen et al., 2011), whereby we define categories 0 to 4

[6] In the empirical models, we take the retrospective nature of these questions into account and use the date four weeks after Fukushima as the cut-off date, i.e., April 11 instead of March 11, 2011. The assumption is that respondents convert "four weeks" mentally into "one month".

[7] At the time of the disaster, Germany's parliament comprised five political parties. With 44% of votes, the Christian-Democrats (CDU/CSU) and the Free Democratic Party (FDP) formed the government. The Social Democrats and the Greens were in the opposition, with approximately 45% of the vote, along with the left-wing party "*Die Linke*".

as risk averse. 50% of all Germans are, on average, risk averse. We also use the dummy variable "very risk averse", which collapses the lowest two categories only. On average, 11% of all Germans are very risk averse.

Finally, by using geo coordinates at the street block level, we exploit the distance from respondents' places of residences to the nearest nuclear power plant in and around Germany to additionally stratify on this measure. Figure 2 shows those nuclear power plants, including different radii around them. We generate three distance-dependent dummy variables. The first dummy variable, *Within50kmRadius*, indicates whether respondents live within a 50km (31mi) distance to a nuclear power plant. Almost 30% of all Germans do.[8] The second dummy variable, *Within50-80km*, indicates whether respondents live between 50km and 80km to a nuclear power plant. Almost 20% of all Germans do. The third dummy variable, *Atommoratorium*, indicates whether the closest nuclear power plant is one of the eight oldest plants that were shut down immediately following Fukushima on March 14, 2011. Moreover, to take potential endogenous residential sorting into different regions based on environmental concerns into account, we also exploit the distance of the respondents' place of birth to the next nuclear power plant.

[Insert Figure 2 about here]

All variables used for the extended analyses and heterogeneity tests are lagged by one year to exclude that reverse causality plays a role.

5. Empirical Method and Results

5.1 Empirical Approach and Identification

To the extent that our dependent variables are binary, we run Linear Probability Models (LPM). Specifically, we employ models of the following structure:

$$\begin{aligned} y_{it} = \beta_0 + \beta_1 PostMarch11_{i,2011} \times 2011_t + \beta_2 PostMay30_{i,2011} \times 2011_t \\ + \beta_3 PostMarch11_{i,2011} + \beta_4 PostMay30_{i,2011} + \mathrm{X}_{it}'\gamma + \delta_t + t + \phi_m + \mu_i + \varepsilon_{it} \end{aligned} \quad (1)$$

where y_{it} is a dependent variable that measures individual *i*'s environmental concerns or subjective well-being, respectively, at time *t*. $PostMarch11_{i,2011}$ is a dummy variable that indicates whether a re-

[8] Traditionally, (inter-generational) geographic mobility is very low in Germany. In a given year, only about 1% of SOEP respondents move (not shown).

spondent's 2011 interview occurred after or on March 11—the day of the Fukushima catastrophe. Note that this dummy variable is time-invariant, i.e., all 2011 respondents who were interviewed after or on March 11 always have a one on this variable regardless of when they were interviewed in the other years. In other words, this variable nets out potentially existing systematic differences between respondents who were interviewed before and after or on March 11, 2011. $PostMay30_{i,2011}$ is similarly constructed and represents the day when the government officially announced the *Atomausstieg*, permanently shutting-down the eight oldest reactors in Germany and phasing out the remainder.

The coefficients of the interaction terms between, respectively, $PostMarch11_{i,2011}$ and $PostMay30_{i,2011}$, and the year 2011, β_1 and β_2, are the Average Treatment Effects on the Treated (ATOT) of the disaster and the policy action.

Unconfoundedness of Interview Date. The main identifying assumption is that, conditional on the vector of observables X_{it}, year and month fixed effects, $\delta_t + \phi_m$, a linear time trend *t*, and conditional on netting out individual unobserved heterogeneity, μ_i, the interview date is random and unrelated to the Fukushima catastrophe. It is very likely that the main identifying assumption holds since:

(i) The nuclear meltdown happened on March 11, 2011. Most SOEP interviews are carried out during the first six months of the year.[9] Roughly half of all respondents in 2011, i.e., 5,000, completed their interview before and after this date, respectively. In Table 1, we plot the mean values of all covariates along with their scale-free normalized differences.[10] Imbens and Wooldridge (2009) suggest that a normalized difference above 0.25 indicates covariate imbalance. This is not the case for any of our covariates. Thus, we conclude that the sample is well-balanced on observables.[11] Note that systematic structural

[9] In practice, the fieldwork company that carries out the interviews assigns each interviewer two to three tranches of respondents with addresses over a defined time period of a couple of months. Within that time period, each interviewer coordinates the specific interview independently with the respondent. This approach guarantees a relative balancedness of interviewee characteristics over the year.

[10] In particular, Imbens and Wooldridge (2009) argue, "The reason for focusing on the normalized difference, …, rather than on the t- statistic, … as a measure of the degree of difficulty in the statistical problem of adjusting for differences in covariates, comes from their relation to the sample size. Clearly, simply increasing the sample size does not make the problem of inference for the average treatment effect inherently more difficult. However, quadrupling the sample size leads, in expectation, to a doubling of the t-statistic. In contrast, increasing the sample size does not systematically affect the normalized difference (p. 24)."

[11] We also checked the covariate imbalances with respect to the May 30 and June 30, 2011, cut-off dates for the policy effects. Again, none of the normalized differences exceed the threshold of 0.25. The results are available upon request. In addition, we calculated the normalized difference and means for the important outcome variable "environmental concerns" by the policy dates May 30 and June 30 for 20*10*. We find that, if any, respondents interviewed later

differences in observables and even unobservables with respect to the interview dates would not necessarily be a threat to our estimation strategy for three reasons: First, we correct for observables. Second, we employ time-invariant $PostMarch11_{i,2011}$ and $PostMay30_{i,2011}$ indicator variables in our OLS models that net out persistent structural differences between respondents before and after these dates. Third, since we use panel data and focus on short time periods, our FE models net out individual unobserved heterogeneity. Our models below show that the estimates barely vary depending on the approach employed, which is reassuring. It is hard to think of an unobservable that is systematically correlated with both respondents' characteristics before and after March 11, 2011, which also affected environmental concerns in 2011 but not in 2010. Basically, that would need to be an event that is unrelated to but strongly correlated with Fukushima.

(ii) What is really important, though, is that self-administered interviews were not systematically postponed due to Fukushima. Fukushima happened on a Friday at 7:45am CEST. Interviews where an interviewer is physically present are scheduled at least several days in advance. It is conceivable, though unlikely, that some (environmentally sensitive) respondents postponed their interviews that were scheduled in the course of the day. However, even if this had happened, it would not bias our estimate of the disaster since interviews on March 11, 2011, fall into the treatment group as do interviews that were carried out on subsequent days. Looking at the distribution of interviews (excluding self-administered interviews) carried out on Fridays, we find no systematic decrease in interviews on Friday March 11, 2011.[12] Additionally, in robustness checks, we exclude all non pre-scheduled interviews where a trained interviewer was not present (see Table 3a and Table A2 in the Online Appendix).[13] In

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in the year have a higher degree of environmental concerns. For the May 30 cut-off date, the mean levels are 0.29 (pre) vs. 0.32 (post) and, for the June 30 cut-off date, they are 0.30 (pre) and 0.32 (post). The differences are, however, not statistically significant and the normalized differences are below 0.05 in both cases.

[12] On March 11, 2011, 80 interviews were carried out, the week before 81, the week after 64, and on the last Friday of March, 78 interviews were conducted.

[13] There are ten different categories of interviews but only four are of quantitative relevance. *(a)* Oral interviews, pre-scheduled and carried out by a professional interviewer at the respondent's home (19%), *(b)* self-administered interviews filled out by the respondent without the help of the interviewer (29%), *(c)* written interviews sent in by mail (20%)—the difference to (b) is that here respondents fill out and send in the questionnaires themselves, whereas in (b) the interviewer is present and sends in the questionnaire, and *(d)* CAPI interviews which are also pre-scheduled and carried out by a professional interviewer at the respondent's home with a computer (25%). Our robustness check in Column (4) of Table 3a excludes category (b) and (c). In further robustness checks in Table A2, we confirm that the results are robust to the exclusion of (d) (Column (2), (c) and (d) (Column (3)), as well as (a), (b), and (c) (Column (4)).

another robustness check, we delete observations where the interview date was March 11, 2011, from our sample, which does not affect the estimates either (results not shown).

[Insert Table 1 about here]

Since the Fukushima disaster is exogenous to the German SOEP interview dates, in principle, no adjustment for pre-post differences in sample compositions is necessary.[14] Basically, in a totally randomized setting, we could even rely on cross-sections to estimate the Fukushima effects. However, we are in the fortunate position to rely on panel data. This allows us to compare *(i)* LPM treatment effects unadjusted for observables with *(ii)* LPM treatment effects adjusted for observables, as well as *(iii)* simple pooled LPM-OLS estimates not exploiting the panel structure with *(iv)* LPM-Fixed Effects (FE) estimates that eliminate individual unobserved heterogeneity. Since, in our preferred specifications, we focus on a short time horizon and compare survey responses in 2010 to those in 2011, it is unlikely that time-*varying* unobservables confound the FE estimates. Comparing *(i)* with *(iv)* also serves as a test for the March 11 exogeneity assumption, yielding information on potentially confounding impacts of observables and unobservables.

Identification of Nuclear Phase-Out Effect. Compared to the identification of the disaster effect, the identification of the policy effect hinges on more assumptions and is more challenging for several reasons: First, there were a series of policy actions rather than a single event (see Section 3.2 and Figure 1). The initial action, the *Atommoratorium,* which temporarily shut down the eight oldest reactors, was announced and implemented on March 14, three days after Fukushima. Empirically, it is difficult to separately assess the impact of this policy action and one could hypothesize that its impact may have operated in both directions—either reinforced or reduced environmental concerns. When estimating the models with March 14 as the relevant policy date, the coefficients barely change, which may suggest that the *Atommoratorium* had little impact on Germans' perception in general.[15]

We consider the second policy action—the unexpected and widely covered announcement of the *Nuclear Phase-Out Bill*—as the crucial policy action, using May 30 as the relevant policy date. Recall that our baseline specifications net out individual unobserved heterogeneity and focus on changes in the outcome

[14] As a referee correctly pointed out, there may be unobserved third factors that vary systematically across seasons and may affect environmental concerns, e.g. air pollution. Ziebarth et al. (2014) show that between 1999 and 2008 pollution patterns follow very regular seasonal patterns in Germany. Unless there was an unusual and longer-term spike in air pollution exactly at the time of Fukushima, monthly fixed effects should net out seasonal pollution effects.

[15] We also test whether the release of the report of the Reactor Safety Commission ("*Reaktorsicherheitskommission*"), which gave a rather negative safety outlook for German reactors, on May 17, had any impact on people's environmental concerns, but do not find any evidence that this was the case.

variables between two years where the policy date serves as cut-off. Also, we do not find strong imbalances in covariates with respect to the policy dates (see Footnote 11).

Second, a decrease in media coverage and thus disaster-related consciousness in the population may have reduced environmental concerns. We provide the following robustness checks that support our view that the unexpected and drastic turnaround in energy policy contributed significantly to the decrease in environmental concerns:

(i) Figure 3a plots the results of a Google trend search using the three German keywords *Energy Transition* ("*Energiewende*"), *Alternative Energies* ("*Alternative Energien*"), and *Renewable Energies* ("*Erneuerbare Energien*"). Figure 3b shows the relative search volume for the *Solar Energy* ("*Solarenergy*"), *Wind Energy* ("*Windenergie*"), *Photovoltaics* ("*Photovoltaic*"), and *Water Power* ("*Wasserkraft*"). Google search is shown to have good predictive power for economic indicators (Askitas and Zimmermann 2012; D'Amuri and Marcucci, 2012). The graphs clearly show two main developments: *(a)* Immediately after Fukushima, search volume spiked. *(b)* In the subsequent week(s), it sharply decreased, but remained relatively stable at a level evidently higher than before Fukushima. The latter point is crucial and shows, in our opinion, that it is extremely unlikely that the entire decrease in environmental concerns can be traced back to a decrease in media coverage and thus disaster-related consciousness in the population. Moreover, recall that due to the incompetent management of the catastrophe by *Tokyo Electric Power Company (TEPCO)*, the operating firm of the Fukushima Daiichi nuclear power plant, the topic remained in the media spotlight for a very long time.

[Insert Figure 3 about here]

(ii) Figure 5 shows that the decrease in environmental concerns starts to kick in about six weeks after the disaster, before the announcement of the *Nuclear Phase-Out Bill*. This may be attributed to or reflected by the decrease in search volume observed in Figure 3. However, Figure 5 also shows a clear, structural, and additional decrease in environmental concerns below the zero y-axis line immediately after May 30, which is of similar magnitude as the increase after March 11.

(iii) Note that in our baseline specifications, we routinely control for a rich set of covariates, month fixed effects, linear time trends, net out individual unobserved heterogeneity, and run many placebo regressions with alternative policy dates in 2011 and 2010. In Table 3b, we show that the findings are robust to the inclusion of separate linear time trends after *(a)* the disaster and *(b)* the policy action, as well as *(c)* to the inclusion of quadratic time polynomials. A "return-to-the-baseline" effect would be captured by these specifications.

(iv) In Section 5.3.8, we show that there was also a significant increase in environmental concerns in Switzerland in 2011, which—however—did not level off in the course of the year.

(v) In Section 5.3.5, we use the same data set and variables to assess the medium to long-run effects of the Chernobyl disaster in 1986 as a counterfactual. We find that *(a)* environmental concerns were still significantly elevated at the end of 1986, *(b)* no significantly negative effect for a placebo policy date for a nuclear phase-out on July 15, 1986, e.g., 81 days after the catastrophe. Concerns that Chernobyl and Fukushima cannot be compared as they would have received different media coverage and exposure can be dismissed by Figure 4. Figure 4 shows the number of newspaper articles with the keywords *"Fukushima"* and *"Chernobyl"* in one of the leading (internationally available) German newspapers Frankfurter Allgemeine Zeitung (FAZ). The normalized graph impressively shows that the spike and subsequent decrease in media coverage was almost perfectly identical in 2011 and 1986. Hence, we consider Chernobyl as a valid counterfactual comparison.

[Insert Figure 4 about here]

To summarize, one can say that the identification of the policy effect is more challenging and likely confounded by a decrease in media coverage. However, we provide a series of robustness checks that strongly suggest that at least part of the significant and surprisingly large decrease in environmental concerns can be explained by the unexpected and drastic policy action following Fukushima.

5.2 Descriptive Results

Figures A1, 5, and 6 anticipate and illustrate our main findings. Figure A1 in the Online Appendix represents our OLS model and Figure 5 represents our FE-model. The x-axis displays the interview date in 2011. The first black vertical bar indicates the Fukushima catastrophe and the second vertical black bar the announcement of the *Nuclear Phase-Out Bill*.

Figures 5 and 6 plot daily averages in responses for *environmental concerns* and *life satisfaction.* The difference to Figure A1 is the y-axis. In Figure A1, it simply illustrates the *share* of respondents, on a given day, who reported being very concerned about environmental protection. As seen, we observe a distinct jump in that share after the Fukushima catastrophe. After the announcement of the *Nuclear Phase-Out Bill*, the share of environmentally concerned citizens went down again. Note that the grey underlined confidence intervals widen toward the end of the year as only about 1,100 interviews were carried out after August 1, roughly 10% of all interviews.

In Figure 5, in contrast, the y-axis makes use of the panel structure of the data and displays the individual-level *change* in responses between the 2011 and 2010 interview, where the 2011 interview determines the location on the y-axis. In other words, Figure 5 plots the change in the daily share of people who are very concerned about environmental protection by their 2011 interview date, relative to their 2010 answers.

[Insert Figures 5 and 6 about here]

Figure 5 illustrates that, while there was zero change in environmental concerns before the Fukushima catastrophe, environmental concerns significantly increased by 5 to 10ppt after Fukushima. After about six weeks, they started to decline smoothly. However, after the conservative government announced the *Nuclear Phase-Out Bill*, making a sharp and unexpected U-turn in their energy policy, environmental concerns significantly and sharply decreased once more, now falling below the horizontal zero-change line on the y-axis where they started before the Fukushima catastrophe.

Figure 6 is set up analogously to Figure 5, but plots changes in *life satisfaction*. It is easy to see that the curve is flat around the zero-change line on the y-axis. No changes in life satisfaction that could be attributed to the disaster or the policy action are observable.

5.3 Regression Results

5.3.1 Baseline Specifications

Table 2 gives the results of the baseline specifications as outlined in equation (1). In our baseline specifications, we focus on 2010 and 2011. The first two columns of Table 2 estimate OLS-LPM and the next two columns FE-LPM models.[16] Thus, the first two columns are the (covariate-adjusted) regression equivalent to Figure A1 and the last two columns are the (covariate-adjusted) regression equivalent to Figure 5. The binary dependent variable is e*nvironmental concerns* and indicates whether respondents are "very concerned" about environmental protection. For the sake of clarity and brevity, we suppress the coefficient estimates of those covariates that are not of principle interest; these can be found in Table A1 of the Online Appendix. As shown in the bottom of Table 2, in the even numbered columns, covariates, X_{it}, are included in the regressions, whereas they are excluded in the odd numbered columns.

[Insert Table 2 about here]

[16] We routinely cluster standard errors at the interview date level (Bertrand et al., 2004, Lee and Card, 2008). However, clustering at the household or state level does not alter the results. The results are available upon request.

We learn the following from Table 2: First, across all four models, we consistently find that environmental concerns significantly increased by 6 to 7ppt immediately after the Fukushima disaster. Relative to the baseline level of environmental concerns before Fukushima, this represents an increase of about 20%.[17]

Second, after the shap and unexpected U-turn in energy policy—the permanent shut-down of the eight oldest reactors and the announcement of the *Nuclear Phase-Out Bill*—environmental concerns decreased significantly by between 8 and 9ppt. Relative to the baseline level of environmental concerns between March 11 and May 30, which was 34%, this represents a decrease by about 25%, i.e., a decrease that roughly equals the increase immediately after Fukushima. Obviously, the *Nuclear Phase-Out Bill* helped to counterbalance environmental concerns triggered by the Fukushima catastrophe. Note that, in our preferred specification, we routinely employ year fixed effects, month fixed effects, a linear time trend, and individual fixed effects.

Third, we find no evidence that *(i)* respondents differ in their observables pre vs. post the March 11 and May 30 interview dates, *(ii)* the correction for observables matters, and *(iii)* the correction for unobservables matters. Across all models, the estimates remain almost identical whether or not we include covariates, X_{it}. The OLS vs. FE estimates are likewise almost identical. Note that the small variation between OLS vs. FE estimates are due to the fact that the FE models are identified by a two-year balanced panel resulting from individual-level changes in the variable of interest, whereas the OLS models are identified by a two-year unbalanced panel. Thus, the OLS and FE samples are not identical; the OLS sample includes 6,500 observations more from individuals who only participated in one of the two surveys waves.[18] This is confirmed in a robustness check that balances the sample, which yields exactly the same estimates as the FE models (see Table 3b Column (4)).

5.3.2 Robustness Checks

Tables 3a to 3c provide a series of robustness checks, always employing our preferred specification, which is the fixed effects model in Column (4) of Table 2.

In our baseline specifications, we chose the date when the *Nuclear Phase-Out Bill* was unexpectedly announced by the hitherto pro-nuclear conservative government, May 30, 2011. However, the parliament

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[17] When using March 14 as disaster date, the results remain largely robust. The results are available upon request.

[18] This holds despite the fact that the number of observations included in the sample, as indicated in the bottom of Table 2, is identical. Note that we apply FE models to *un*balanced panel data. However, the coefficients in the FE models are solely identified by respondents with at least two interviews and for whom the variable of interest changes over time. Therefore, in case of two-year panels, FE models are *de-facto* balanced.

in Germany formally passed the bill with a great majority of 513/600 votes on June 30, 2011. In Column (1) of Table 3a, we employ this alternative policy date. As seen, our findings are robust to using the passing instead of the announcement date.

Column (2) excludes individuals who live outside a 50km radius of their birthplace and Column (3) excludes individuals who moved in the previous time period. Excluding movers, in particular those individuals who moved away from their birthplace, eliminates potential endogenous residential sorting into different regions based on environmental concerns. As seen, the results are robust.

In Column (4), we focus on pre-scheduled interviews only. Self-completed interviews without the presence of a trained interviewer may induce measurement error in the interview date. In addition, respondents may have postponed the completion of the questionnaire due to the Fukushima catastrophe. Excluding almost half of all interviews does not alter the results. In Table A2, we demonstrate the robustness of the results using three additional interview mode specifications.

[Insert Tables 3a and b about here]

The first two columns of Table 3b add *(i)* a linear time trend that starts after the disaster, March 11, as well as *(ii)* a monthly time trend that starts after the policy action, May 30, in addition to the linear time trend over the entire observation period. In Column (3), we include a quadratic time polynomial in addition to the linear time trend. One concern with the identification of the policy action may be that, after the sharp increase in environmental concerns, they would have decreased even without the announcement of the *Nuclear Phase-Out Bill* due to a decrease in media coverage and thus disaster-related consciousness in the population (see Section 5.1 for further discussions). All three specifications show that the identification of the policy action is largely robust to the inclusion of split and linear time trends, as well as quadratic time polynomials in addition to year, month, and individual fixed effects.

Balancing the panel in Column (4) of Table 3b does not affect the results either. Note that this estimation is identical to the last column in Table 2. We also checked whether environmental concerns significantly affect panel attrition over the two years. This is not the case and panel attrition between 2010 and 2011 accounts only for 5% of the 2010 sample.

Finally, we estimate a pure Regression Discontinuity (RD) model, using only the year 2011 and cut-off dates of 45 days around the disaster and the policy action. Table A6 in the Online Appendix shows the results. Both effects are robust to this specification.

5.3.3 Placebo Regressions

We employ several placebo regressions in Table 3c. In Column (1), we use our baseline specification, but employ placebo disaster and policy action dates, March 11 and May 30, 20*10*. In Column (2), we do the same with placebo disaster and policy action dates for 20*12*, March 11 and May 30, 20*12*. All estimates are close to zero in size and statistically insignificant.

[Insert Table 3c about here]

In Columns (3) to (6) of Table 3c, we employ alternative placebo regressions using dependent variables that are arguably unrelated to the Fukushima catastrophe. To be precise, we use questions about concerns that are arguably unrelated to environmental protection, including concerns about *(i)* job security, *(ii)* health, *(iii)* the economy, and *(iv)* crime. Otherwise, the specifications are identical to our baseline specifications. All estimates are small in size and statistically insignificant.

Finally, in Table A3 in the Online Appendix, we show the results of a series of placebo regressions for 2011 using May 15, June 15, and July 15 as alternative policy action dates. All of the estimates are small in size and statistically insignificant.

5.3.4 Medium-Run Effects

Table 4 tests medium to long-run effects and compares the identified effects of the Fukushima disaster to those of the Chernobyl disaster using the same data set, variables, and estimation techniques.

In Columns (1) and (2), we test whether environmental concerns increased significantly in the medium-run due to the Fukushima catastrophe. For this purpose, we use the years 2009 to 2012 and estimate (unbalanced) OLS and (balanced) FE models. When estimating effects over a longer time period, we face a trade-off between considering unobservables through individual fixed effects and considering marginal populations who did not participate in the survey at least once pre- and post-Fukushima. For example, for the years 2009 to 2012, we have a total of 57,492 person-year observations, but only 7,935 individuals participated in all four waves from 2009 through 2012.

Note that the 2012 dummy variable identifies the general change in environmental concerns in 2012 and assumes that there were no other events that could have affected them in 2012. The estimated 2012 effect is small in size and statistically insignificant. The same is true for the 2011 effect, which we obtain when adding up the 2011 estimate and the disaster and policy action estimates.

[Insert Table 4 about here]

5.3.5 Comparison to Long-Run Effects of the Chernobyl Disaster

Next, we replicate our baseline specification using the Chernobyl disaster to assess its medium to long-term effects on environmental worries in the German population. This also serves as a falsification test for the identified effect of the policy action.

Columns (3) and (4) of Table 4 basically replicate Columns (1) and (2), but use the years 1984 to 1989 and April 28, 1986, as the disaster date of the Chernobyl catastrophe.[19] As seen, after Chernobyl, the share of respondents who were “very concerned about environmental protection” increased by a highly significant 10 to 12ppt. Relative to the baseline level of environmental concerns before Chernobyl, this represents an increase of about 25%—almost exactly the same increase that we find after Fukushima.[20] Thus, we argue that the two disasters are comparable in terms of their effects, particularly since we focus on Germany and use the same data set, variable definitions, and estimation techniques. However, the maybe more important point is that the estimate for the placebo policy action in 1986, which would have occurred on July 15—exactly 81 days after the disaster when the *Nuclear Phase-Out Bill* was announced in 2011—is small in size and statistically insignificant. Moreover, the coefficients for 1987, 1988, and 1989 have a size of 4 to 10ppt and are highly significant. This means that—in contrast to post-Fukushima—we seem to observe a *persistent* jump in environmental concerns post-Chernobyl.

[Insert Figure 7 about here]

In Figure 7, we non-parametrically illustrate this persistent increase in environmental concerns.[21] In the visual analogue to Column (3) of Table 4, it is easy to see that environmental concerns substantially increased after Chernobyl and remained at their elevated level. Figure A2 in the Online Appendix is a normalized scatterplot that directly compares Fukushima to Chernobyl on a common time scale.

[19] Although the Chernobyl catastrophe happened on the evening of April 26, it took two days, until April 28, before the media started reporting about it.

[20] The baseline level of environmental concern before Chernobyl (40%) was higher than before Fukushima (28%).

[21] As in Figure 5, we report daily averages. However, since we plot the daily averages over several years and since most respondents are interviewed in the first months of a year, we observe jumps in the graph. To smooth them out, we disregard days with fewer than five interviews.

This visual evidence, along with the estimates for the placebo policy action in 1986, reinforces one of the main findings of this paper: the announcement of the *Nuclear Phase-Out Bill* obviously significantly reduced elevated environmental concerns due to the Fukushima disaster.[22]

5.3.6 Operating Channels and Effect Heterogeneity

We run more flexible specifications that investigate effect heterogeneity and provide evidence on operating channels in Table 5. Technically, we add the regressor we would like to stratify on, both in levels and in interactions with the $PostMarch11_{i,2011} \times 2011_t$ and the $PostMay30_{i,2011} \times 2011_t$ covariates of interest. In addition to these three-way interaction terms, we add the according two-way interaction terms to the model, i.e., the *variable of interest* $\times 2011_t$, the *variable of interest* $\times PostMarch11_{i,2011}$, and the *variable of interest* $\times May30_{i,2011}$. We test effect heterogeneity with respect to *(a)* the distance to the next nuclear power plant, *(b)* risk aversion, *(c)* gender, *(d)* age, and *(e)* political preferences. Note that we use the lagged value for (a), (b) and (e) to eliminate reverse causality.

Exploiting Distances to Reactors and Effects on Risk Aversion

We formalize econometrically what we see in Figure 2, the distance of the respondents to the next nuclear power plant in and around Germany, and present the results in Table 5. Note that while it is likely that individuals sort into geographical regions based on their preferences, one can assume that the place of residence in 2010 is exogenous to the Fukushima disaster in 2011, which is why stratifying the effects based on the distance to the next nuclear power plant can provide interesting insights into the operating channels of environmental concerns.[23] *A priori,* one could hypothesize that the Fukushima disaster changed respondents' risk perceptions, and therewith environmental concerns, about

(i) the probability of a nuclear disaster outside of Germany, or
(ii) the probability of a nuclear disaster inside of Germany.

Finally, one could hypothesize that:

[22] Also note that Metcalfe et al. (2011), who study the impact of 9/11 on mental well-being in the UK, still report a relatively large coefficient of 0.18 (which is significant at the 10% level) one year after the attacks. Since the immediate effect was 0.24, this implicitly means that we do not observe a "return-to-the baseline" effect for 9/11 in the UK.

[23] Note that, in addition, in Table 3a, we exclude individuals who live outside a 50km radius of their birthplace and individuals who moved in the previous time period.

(iii) perceived risks remain stable, but people adjust the degree to which they are willing to tolerate these risks due to the Fukushima disaster, e.g., they become more or less risk averse.

Empirically, it is very challenging to unambiguously discriminate between these channels as there is evidence that concern and risk perception may be distinct phenomena–especially in case of concerns about nuclear accidents (Slovic, 1987; Sjöberg, 1998). Setting aside this kind of methodological problems, we provide the following empirical evidence:

In the first specification, we stratify on respondents who live within 50km (31mi) distance to the next nuclear power plant in and around Germany.[24] As seen in the Appendix, 28% of all Germans do. In the second specification, we stratify on respondents who live between 50 (31) and 80km (50mi) distance to the next nuclear power plant in and around Germany where sorting based on (un)observables might be less of an issue.[25] In the third specification, we stratify on respondents whose closest reactor is one of the eight oldest reactors that were immediately (but at that time only temporarily) shut down on March 14, and later permanently shut down on May 30, 2011.

[Insert Table 5 about here]

Table 5 shows that the plain $PostMarch11_{i,2011} \times 2011_t$ coefficient remains robust in size and significance. Its interactions with "*within50kmRadius*" and "*Atommoratorium*" (closest reactor is one of the eight oldest reactors) are small in size and statistically insignificant. However, its interaction with "*within50-80kmRadius*" is large in size and highly significant at the 1% level, implying that those individuals who live relative close to reactors, but not very close, were significantly more concerned after the disaster.[26]

Moreover, the plain $PostMay30_{i,2011} \times 2011_t$ coefficient also remains robust in size and significance. Its interactions show that respondents who live between 50 (31) and 80km (50mi) distance to the next nuclear power plant in and around Germany or close to one of the eight oldest reactors were twice as relieved

[24] The results are robust to alternate cut-off radii.

[25] Note, however, that our baseline specifications net out individual unobserved heterogeneity over a short time horizon anyways. Since the place of residence could be endogenous to the Fukushima disaster, we always exploit the place of residence in 2010.

[26] The interaction term for individuals living close to one of the eight oldest reactors ("*Atommoratorium*") is close to zero in size and statistically insignificant. This may be due to the fact that the *Atommoratorium* on March 14, 2011—only three days after Fukushima—immediately shut down these reactors, which may have alleviated the environmental concern of those individuals living closest to them.

after the political decision to keep the oldest reactors shut down and entirely phase-out of nuclear energy by 2022 (see Section 3.2).[27]

As such, these differential scaring and relieving effects, which are not only a function of the distance to the next nuclear power plant, but also of the shutdown of the eight oldest reactors in Germany, strongly speak in favor of hypothesis *(ii)* above. Further evidence is provided by representative polls which indicate that, immediately after the Fukushima disaster, 70% of Germans believed that Fukushima could also happen in Germany, whereas, in July 2009, some 44% indicated "trust" or "big trust" in the safety of reactors in Germany (Infratest, 2009, 2011b).

In addition, we also show below that, unlike in Germany, environmental concerns in Switzerland did not return to their previous level until the end of 2011, which speaks against hypothesis *(i)* above*.* Along with the differential human response by distance to the differentially affected nuclear power plants in Germany, this suggests that local policies and perceived risk of local threats matter most. This finding is in line with Huang et al. (2014) for China.

Finally, we test hypothesis *(iii)* and whether respondents became more or less risk averse after the Fukushima disaster. The last column of Table 5 shows the result when using the *share of very risk averse* respondents as a binary dependent variable. As seen, the share of very risk averse respondents increased by 1.7ppt (15%) due to Fukushima. However, there is no evidence that it changed as a reaction to the permanent shut down of reactors in Germany.[28]

To summarize, the operating channels through which distant disasters affect individual's concerns appear to work primarily through mechanisms *(ii)* and *(iii)*, i.e., the (re-)evaluation of local risks and an adjustment in the willingness to tolerate small risks with high stakes.

Risk Aversion, Gender, and Age

In Table A4 in the Online Appendix, we stratify on respondents who are risk averse, female, above 40 years of age, and support the Green Party. Column (2) of Table A4 provides clear and strong evidence that

[27] In extended analyses not displayed, we stratify by the following three measures: *(a)* whether the closest nuclear power plant will be shut down before 2022 and *(b)* whether the closest nuclear power plant will not be shut down (exploiting the fact that some Germans live in close distance to nuclear power plants in France and Switzerland, which are not affected by the policy action in Germany). However, we do not find evidence for differential effects by *(a)* and *(b)*. The results are available upon request.

[28] We do not find evidence that the *share of risk averse* individuals increased after the Fukushima disaster.

women *(i)* incurred a 2.5ppt greater scaring effect after the disaster and *(i)* a 6ppt greater relieving effect after the policy action when compared to men. However, we fail to find differential treatment effects by risk aversion and for age (Columns (1) and (3)).

Next, we use questions about respondents' political opinions and party preferences. We group those together who indicate a strong preference for the Green Party (14%). The Green Party has been in strong favor of a nuclear phase-out since the beginning of the 1980s, long before Fukushima and Chernobyl. Interestingly, column (4) of Table A4 shows that environmental concerns did *not* increase for Green Party supporters after the Fukushima disaster.[29] However, interestingly, after the conservative government announced the *Nuclear Phase Out Bill*—a long-term objective of the Green Party—the environmental concerns of Green Party supports decreased over-proportionally by an additional 8ppt.

5.3.7 *Effects on Subjective Well-Being and Political Party Support*

Subjective Well-Being

Table 6 uses our baseline specification, as in equation (1), but with four subjective well-being measures as dependent variables. As such, we test the effects of the disaster and the policy action on these different outcome measures.

[Insert Table 6 about here]

Life Satisfaction. The model in the first column uses the standard 11 categorical life satisfaction measure as dependent variable. This model is the regression equivalent to Figure 6. As already suspected in Figure 6, we do not find any evidence that the disaster or the policy action had any effect on life satisfaction. Typically, studies consistently find that individual income or unemployment have strong effects on life satisfaction (Winkelmann and Winkelmann, 1998; Frijters et al., 2004; Kassenboehmer and Haisken-DeNew, 2009; Knabe et al., 2010). One may interpret our finding as evidence that disasters (in distant countries) may affect specific concern measures even in geographical regions that are far away, but not general satisfaction with life, at least as long as individuals are not directly affected. This is in line with Berger (2010) and with empirical evidence from the UK and Switzerland (see below).

[29] The reason for why we fail to find different treatment effects by risk aversion and by Green Party support might be the fact that most risk averse individuals and most Green Party supporters were already very concerned about the environment prior to the Fukushima disaster, such that they started from a higher baseline level. In fact, 49% of risk averse individuals and 53% of Green Party supporters stated that they are very concerned about the environment in the time period before the Fukushima disaster.

Happiness. The finding from Column (1) is reinforced in Column (2) where we make use of a collapsed version of the "happiness" affective well-being measure (see Section 4.2). We do not find evidence that the share of people who felt happy "very often" or "often" changed significantly due to the disaster or the policy action.[30]

Sadness. In contrast, after Fukushima, the share of respondents who felt "sad" increased by about 4ppt (Column (3)). Part of the reason why Fukushima has been considered so disastrous was the lack of, or inappropriate, catastrophe management by both politicians—officials underestimated dangers and knowingly concealed information—and *Tokyo Electric Power Company (TEPCO),* the operating firm of the Fukushima Daiichi nuclear power plant. Reports about these failures affected environmentally concerned individuals around the glove emotionally. This may be reflected in Column (3).

Concerns About Climate Change. The sharp and unexpected U-turn in the energy policy in Germany entailed a long-term and large-scale plan under which Germany would gradually replace nuclear with renewable energy. The conservative government of Chancellor Angela Merkel created its own term for this ambitious plan: "Energy Transition" (the so-called "*Energiewende"*). Since the *Energiewende* is inherently linked to climate change politics and was largely communicated to the public with that spin, we test whether concerns about climate change also changed. Indeed, Column (4) shows that concerns about climate change significantly increased after the Fukushima disaster, but significantly decreased after the policy action, which entailed the announcement of the *Energiewende*.[31]

Political Opinion

Finally, in Table A5 of the Online Appendix, we use political party preferences as outcome variables to test whether the disaster and the policy action shifted support for political parties. We find that there was a strong increase in the political support for the Green Party after the Fukushima disaster. Indeed, support for the Greens increased by 1.7ppt. Interestingly, after the announcement of the *Nuclear Phase-Out Bill*, by the conservative government, the governing coalition also gained 1.7ppt in political support, whereas the Social Democrats, who were in the opposition, lost 2ppt.

[30] Since the happiness and sadness affective well-being measures refer to the last 4 weeks, we use April 11, 2011, and June 30, 2011, as cut-off dates.

[31] There are several explanations for why climate change concerns significantly increased after Fukushima: *(1)* It could simply be that the environmental disaster raised people's awareness about environmental issues, *(2)* In the short run, shutting down nuclear power plans means replacing the energy production largely with climate-damaging fossil energy, and/or *(3)* Individuals might confuse that nuclear energy and emissions have not been linked to climate change.

5.3.8 Fukushima Effects in the UK and Switzerland

As a last exercise, we test whether and how residents in the United Kingdom and Switzerland reacted to the Fukushima disaster (there was no comparable policy action in any of these countries). To do so, we exploit the panel data sets *Understanding Society* and the *Swiss Household Panel (SHP)*. The results are presented in Table 7.

Columns (1) to (4) estimate the effects in Switzerland, which borders Germany and operates four nuclear power plants (see Figure 8). The first two columns exploit *life satisfaction* as an outcome variable and the last two columns a binary variable which indicates whether respondents value environmental protection higher than economic growth. While not perfectly comparable, the latter variable is similar to the one surveyed in Germany. In line with the findings from Germany, there is no evidence that life satisfaction was negatively affected by the disaster.

[Insert Table 7 and Figure 8 about here]

Contrarily, and in line with the findings from Germany, the share of respondents who value environmental protection higher than economic growth increased significantly by 1.8ppt over the entire year (Columns (3) and (4)). The latter finding reinforces that the policy action in Germany significantly contributed to the decrease in environmental concerns in 2011.[32] Recall that for Germany and 2011, we find a significant decrease in environmental concerns following the announcement of the *Nuclear Phase-Out Bill*, resulting in a level of environmental concerns at the end of 2011 (and in 2012) that was not significantly higher as the level of environmental concerns before Fukushima (see Figure 5 and Tables 2 and 5).

Finally, Columns (2) and (4) in Table 7 additionally assess whether changes in response rates differ by the respondents' distance to the next nuclear power plant in Switzerland. Figure 8 shows the residence of respondents in the *Swiss Household Panel (SHP)* and the nuclear power plants in Switzerland graphically. However, there is no empirical evidence that the increase in environmental concerns was larger for those respondents who lived closer to nuclear power plants.

[32] Note that the question on environmental concerns was solely surveyed in waves 11 and 13 of the *Swiss Household Panel (SHP)*. Since respondents of each wave are interviewed between September and February, this means that Columns (3) and (4) are essentially comparing individual responses between September 2009 and February 2010 to responses between September 2011 and February 2012. The employed fixed effects models net out individual unobserved heterogeneity and solely focus on changes in the responses between these two waves.

Columns (5) and (6) test the effects for the UK using *Understanding Society* and, again, our baseline specification as in equation (1). Column (5) uses a 7 categorical *life satisfaction* measure as dependent variable and Column (6) a 4 categorical *happiness* measures.[33] Both models reinforce the findings from above: neither general satisfaction with life nor happiness were significantly affected by the Fukushima disaster.

6 Discussion and Conclusion

This research shows that disasters can have significant negative spillover effects on the concerns of another countries' residents—even if these other countries are distant and the disaster does not directly affect their residents, nor does it objectively increase the likelihood that a similar disaster can occur in these other countries.

The Fukushima disaster in March 2011 significantly increased environmental concerns among the Germans and Swiss. However, there is no evidence that general satisfaction with life in the German, Swiss, or British population decreased as a result of the disaster. This finding is in line with established research in the field of well-being which shows that life satisfaction measures are surprisingly robust (Berger, 2010; Deaton, 2012; Benjamin et al., 2014a, b; Bond and Lang, 2014). Empirical checks on potential operating channels suggest that the effect on individuals' environmental concerns worked primarily through the (re-) evaluation of risks of domestic reactors. The share of Germans who consider themselves as very risk averse significantly increased following the Fukushima disaster, suggesting that people adjust their risk tolerance after such unexpected large-scale disasters. This is in line with recent research from China (Huang et al., 2014). However, when citizen's concerns are primarily driven by concrete domestic circumstances, it leaves opportunity and room for domestic policy action to influence their citizen's concerns.

In contrast to Switzerland, environmental concerns in Germany significantly decreased again after the hitherto pro-nuclear governing centre-right coalition made a drastic and sharp turnaround in its energy policy. On May 30, 2011, the conservative government under Chancellor Angela Merkel announced that it would permanently shut down the eight oldest reactors and implement the staggered phase-out of the remaining ones. On June 30, 2011, this announcement was carved into current legislation by the passage of the *Nuclear Phase-Out Bill*, which the German parliament voted almost unanimously for. This bill was combined with a large-scale government program supporting the transition to renewables. We show that this sharp U-turn in energy policy—supported by a large majority of Germans—was associated with a reduction in individuals' environmental concerns, which we did not observe in Switzerland or after Chernobyl in 1986.

[33] Note that *Understanding Society* does not survey environmental concerns or attitudes.

This reduction in individuals' environmental concerns was particularly strong for individuals who are living close to the eight oldest reactors, supporters of the Green Party, and women. We show that the disaster increased political support for the Green Party and that the unexpected passage of the *Nuclear Phase-Out Bill* by the hitherto pro-nuclear governing centre-right coalition significantly increased political support for the conservative government.

There is complementary evidence showing that Germans are actually willing to pay for nuclear-free energy production, most likely in return for a lower level of environmental concerns. In polls, 70% of German citizens say that they would be willing to pay higher energy prices as a consequence of the transition to renewables (Infratest Dimap, 2011b). Actually, part of the *Energiewende* is a fixed subsidy for every kilowatt hour (kWh) produced by renewables (the so-called "*Einspeisevergütung*").The total, €18bn annual cost of this policy is paid by all electricity consumers through a flexible absolute tax per kWh (the so-called "*EEG-Umlage*").[34] In 2013, this tax amounted to 5.3 Eurocent per kWh (Bundesregierung, 2013). The average household consumes about 3,500 kWh per year and thus, effectively, pays €185 or €15 per month for the transition to renewables (EnergieAgentur NRW, 2012). While this represents a mandatory tax which must be paid by all residents, a study by *Check24* (2012) finds that, before Fukushima, 37% of consumers switching their energy provider, chose electricity from renewables. Immediately after Fukushima, this share doubled to 74% and was still 64% one year after the disaster (Check24, 2013).

An obvious question is in how far these results have external validity and would carry over to other (non-European) countries. We provide evidence that the effects in Switzerland and the UK were similar. The German example suggests that disasters in general and nuclear catastrophes in particular may not only have local negative effects, but may also have significant negative spillover effects on the concerns of another countries' residents. How such concerns translate into changes in actual economic behavior is a promising field for future research.

[34] Meanwhile, the Energiewende is exemplary, with at least 65 countries—among them the US—copying the subsidy for renewables (REN21, 2013).

7 Literature

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Figures and Tables

Figure 1: Timeline of Policy Action Following Fukushima

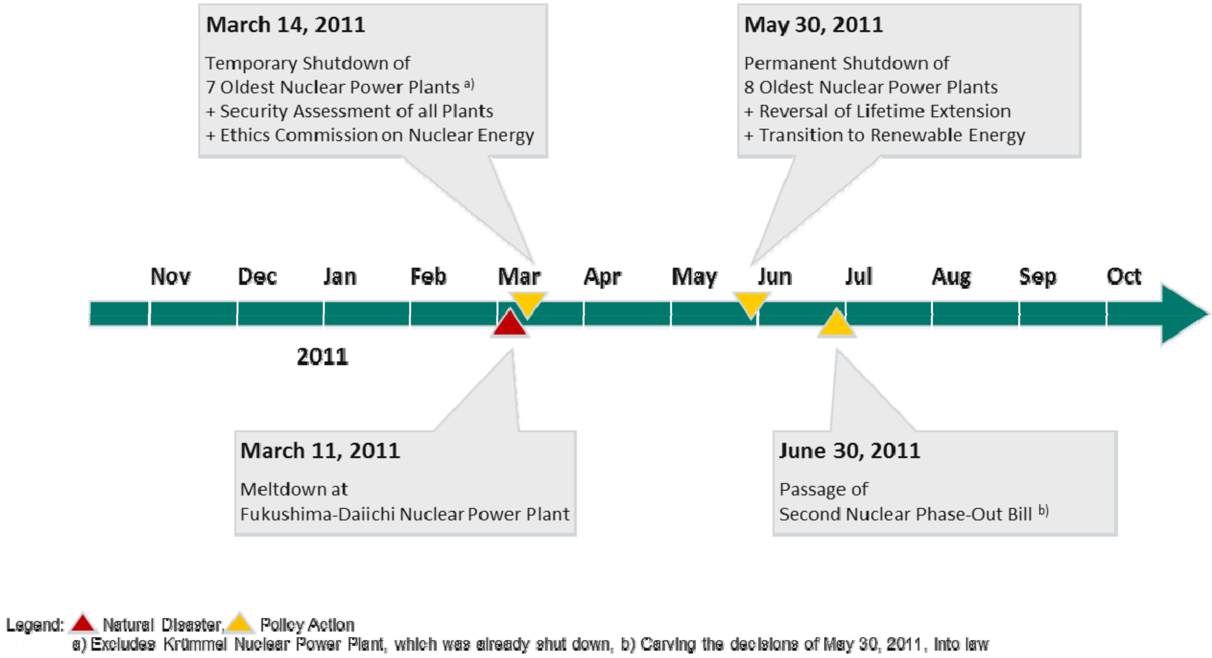
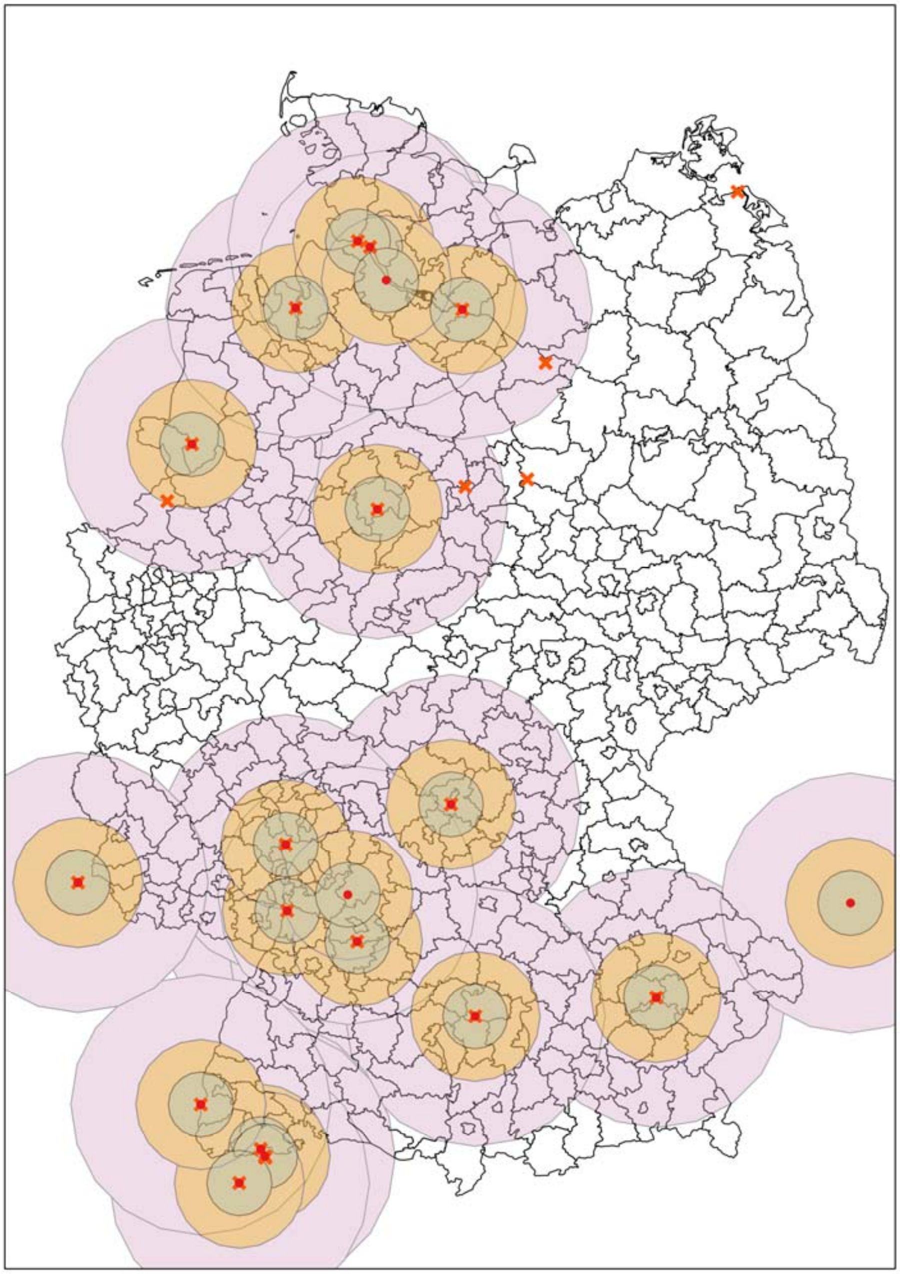


Figure 2: Nuclear Power Plants and (Temporary) Nuclear Waste Sites in Germany



Notes: Circles indicate 25, 50, and 100 km radii. Dots indicate nuclear power plants; crosses indicate (temporary) nuclear waste sites.

Figure 3: Google Trend Search Comparing Relative Search Volume of Several Keywords in 2011

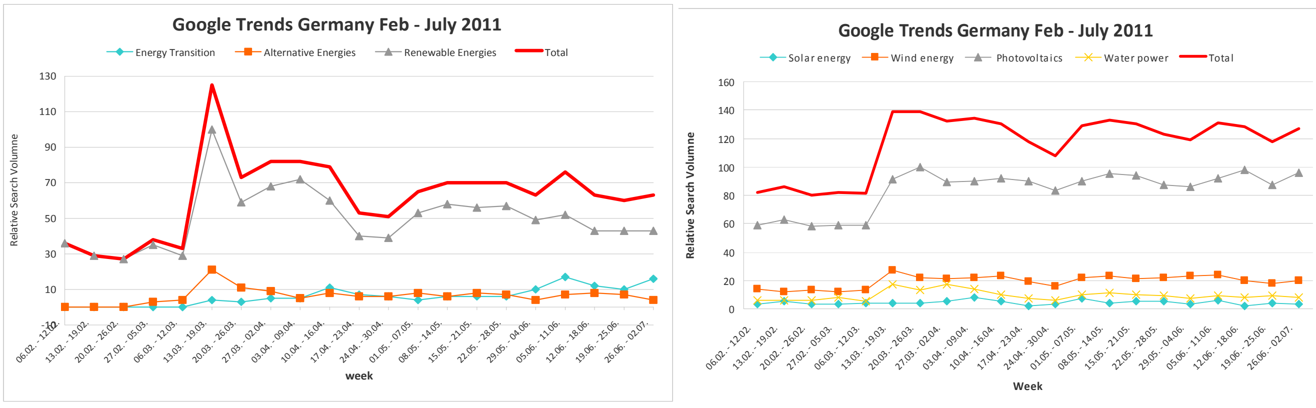


Figure 4: Normalized Newspaper Article Search in the FAZ (Fukushima vs. Chernobyl)

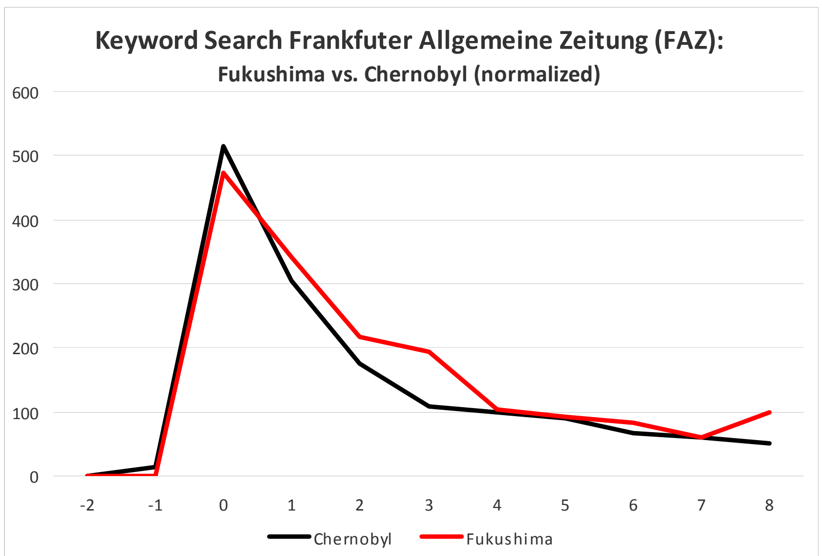


Figure 5: Change in SOEP Respondents Who Are Very Concerned About Environmental Protection *(first difference,2011 vs. 2010)*

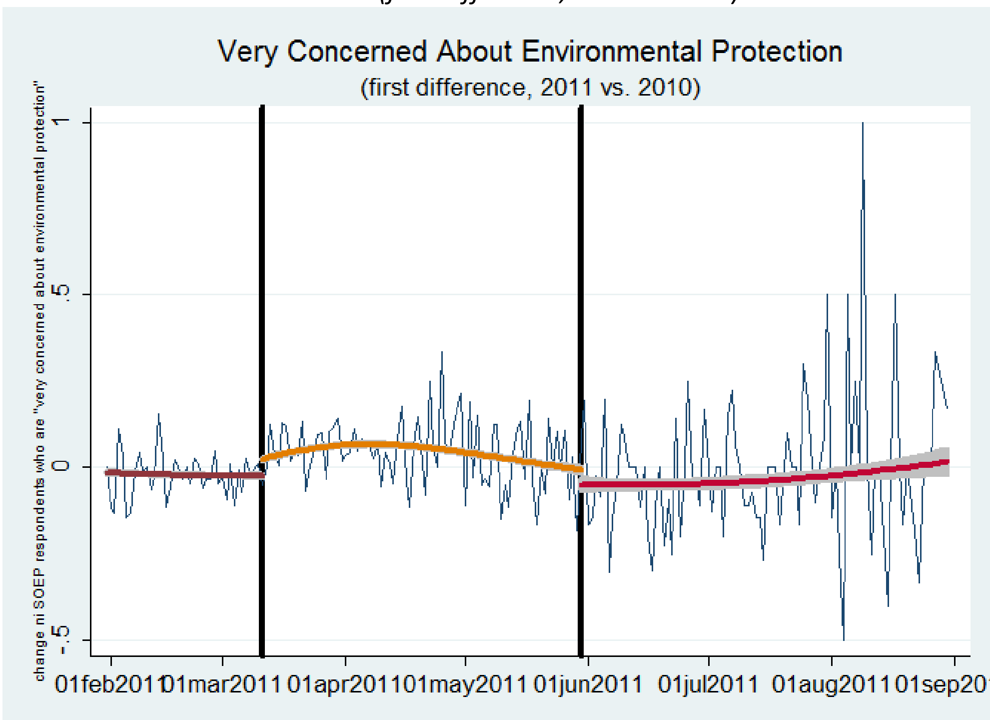


Figure 6: Change in Reported Life Satisfaction of SOEP Respondents *(first difference, 2011 vs. 2010)*

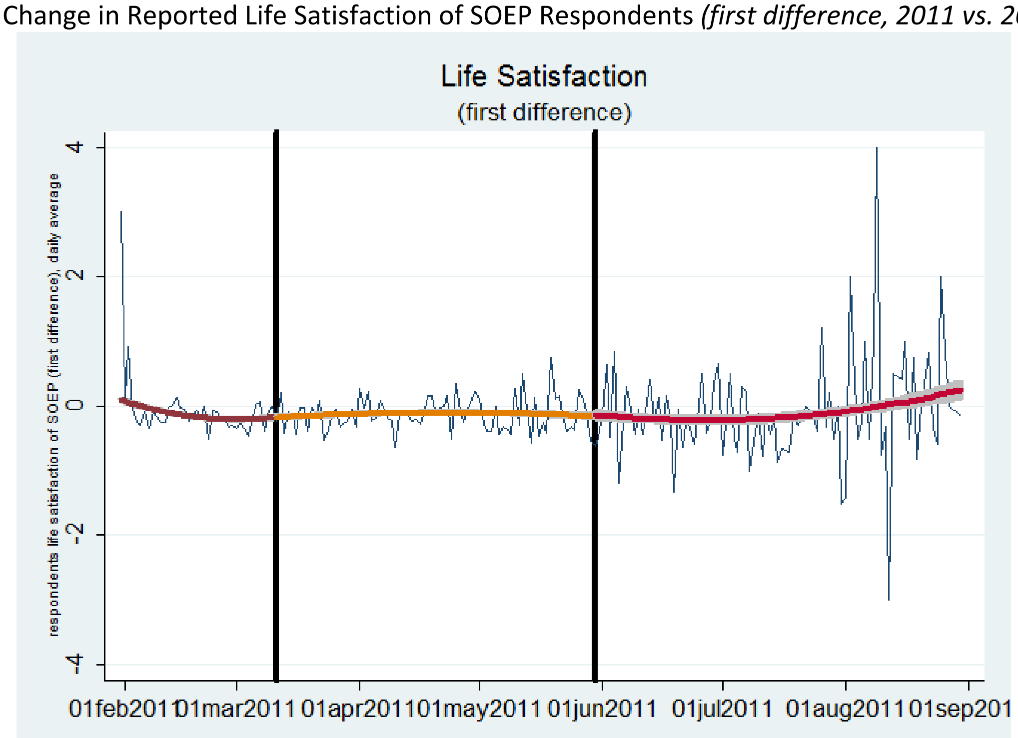
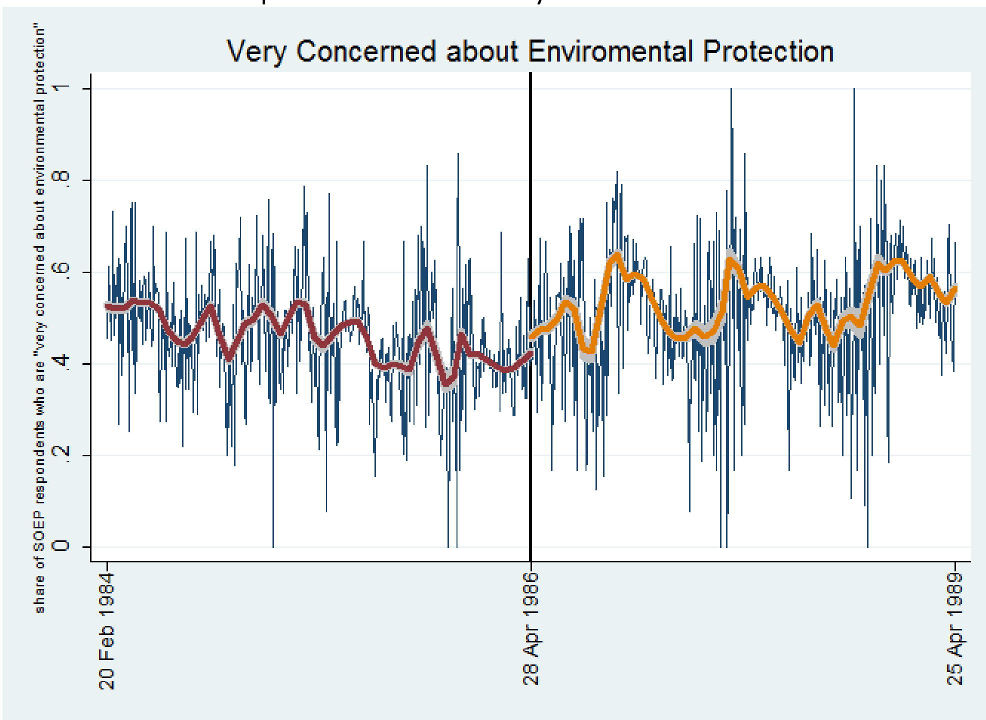
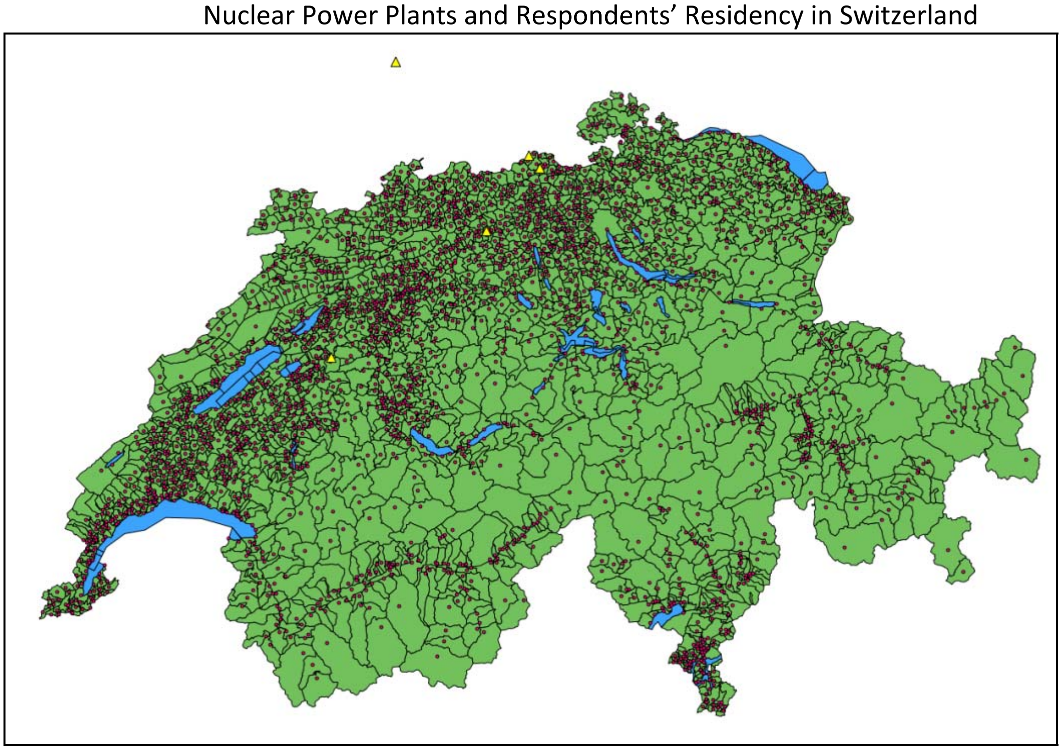


Figure 7: Comparison to the Chernobyl Disaster:
Share of SOEP Respondents Who Are Very Concerned About Environmental Protection



Note: Dates with less than six observations have been dropped from the sample.

Figure 8:
Nuclear Power Plants and Respondents' Residency in Switzerland



Note: Swiss communities are in green and lake districts in blue; the centroid of communities are in red and nuclear power plants represented by yellow triangles.

Table 1: **Balancing Properties Between Treatment and Control Group, 2010-2011**

Demographic Characteristics	***Interview after March 11, 2011 (treatment group) Mean***	***Interview before March 11, 2011 (control group) Mean***	***Normalized Difference***
Age	49.6360	53.4039	0.1536
Age Squared	2,755	3,162	0.1592
Female	0.5192	0.5312	0.0170
Married	0.6295	0.6271	0.0035
Single	0.2370	0.2029	0.0583
Disabled	0.1257	0.1581	0.0657
No German Nationality	0.0522	0.0384	0.0470
Number of Children in Household	0.7887	0.8571	0.0403
Educational Characteristics			
In School	0.0180	0.0111	0.0407
Lower Than Secondary Degree	0.1242	0.1533	0.0597
Secondary Degree	0.5334	0.5380	0.0066
Tertiary Degree	0.3245	0.2976	0.0411
Labor Market Characteristics			
Full-Time Employed	0.4199	0.3513	0.0999
Part-Time Employed	0.1251	0.1049	0.0447
Out of the Labor Force	0.3827	0.4782	0.1370
On Maternity Leave	0.0192	0.0163	0.0156
Unemployed	0.0489	0.0533	0.0139
Heterogeneity *(for Heterogeneity Tests, Tab A4-A6)*			
Within 50km Radius of Nuclear Plant (Lagged)	0.2378	0.1888	0.1802
Within 50-80km of Nuclear Plant (Lagged)	0.1693	0.1376	0.1460
Atommoratorium (*next Nuclear Plant Among Oldest 8, shut down on March 14*)(Lagged)	0.4564	0.4659	0.0553
Supports SPD (Lagged)	0.3005	0.3000	0.0129
Supports Greens (Lagged)	0.1179	0.1401	0.0499
Supports Opposition (Lagged)	0.4184	0.4402	0.0293
Supports Government (Lagged)	0.4731	0.4437	0.0113
Risk Averse [0-4 on scale to 10] (Lagged)	0.5628	0.4988	0.0129
N	***15,085***	***11,284***	**-**

Note: The last column shows the normalized difference which has been calculated according to

$\Delta s = (\bar{s}_1 - \bar{s}_0) / \sqrt{\sigma_1^2 + \sigma_0^2}$, with $\bar{s}_1$ and $\bar{s}_0$ denoting average covariate values for treatment and control group, respectively. σ denotes the variance. As a rule of thumb, normalized differences exceeding 0.25 indicate non-balanced observables that might lead to sensitive results (Imbens and Wooldridge, 2009).

Source: SOEP v29, 2010-2011, own calculations

Table 2: Standard

Effects of the Fukushima Meltdown and the Permanent Shutdown of Nuclear Power Plants in Germany on Environmental Concerns: Short-Term Impacts (2010-2011)

	Very Concerned About the Environment			
	OLS	**OLS**	**FE**	**FE**
	(1)	**(2)**	**(3)**	**(4)**
$PostMarch11_{i,2011}$*2011 *("After Meltdown")*	0.0644***	0.0639***	0.0713***	0.0713***
	(0.0147)	*(0.0147)*	*(0.0088)*	*(0.0088)*
$PostMay30_{i,2011}$ *2011 *("After Permanent Shutdown")*	-0.0753***	-0.0791***	-0.0984***	-0.0994***
	(0.0258)	*(0.0257)*	*(0.0159)*	*(0.0159)*
$PostMarch11_{i,2011}$	-0.0014	-0.0001		
	(0.0112)	*(0.0111)*		
$PostMay30_{i,2011}$	-0.0183	-0.0142		
	(0.0141)	*(0.0140)*		
2011	-0.0025***	-0.0024***	-0.0018***	-0.0018***
	(0.0008)	*(0.0008)*	*(0.0005)*	*(0.0005)*
Controls				
Demographic Characteristics	No	Yes	No	Yes
Educational Characteristics	No	Yes	No	Yes
Labor Market Characteristics	No	Yes	No	Yes
Year Fixed Effects	Yes	Yes	Yes	Yes
Month Fixed Effects	Yes	Yes	Yes	Yes
Linear Time Trend	Yes	Yes	Yes	Yes
R^2	*0.0036*	*0.0126*	*0.0061*	*0.0075*
N	***26,369***	***26,369***	***26,369***	***26,369***

Note: * p<0.1, ** p<0.05, *** p<0.01; standard errors are in parentheses and clustered at the interview date level. The treatment statuses are defined by $PostMarch11_{i,2011}$ and $PostMay30_{i,2011}$. The dependent variable is a dummy variable which equals one if the individual is very concerned about the environment. Each column stands for one regression model as in equation (1).
Source: SOEP v29, 2010-2011, unbalanced panel, own calculations.

Table 3a: Robustness Checks I

Effects of the Fukushima Meltdown and the Permanent Shutdown of Nuclear Power Plants in Germany on Environmental Concerns

	Very Concerned About the Environment			
	Uses Alternative Date for Phase-Out Bill	**Excludes Individuals That Moved Outside 50km Radius to Birth Place**	**Excludes Individ-uals That Moved in Previous Period**	**Only Pre-Scheduled Inter-views**
	(1)	**(2)**	**(3)**	**(4)**
$PostMarch11_{i,2011}$*2011 *("After Meltdown")*	0.0610***	0.0874***	0.0752***	0.0794***
	(0.0086)	*(0.0121)*	*(0.0090)*	*(0.0149)*
$PostMay30_{i,2011}$ *2011 *("After Permanent Shutdown")*		-0.1338***	-0.1114***	-0.1203***
		(0.0213)	*(0.0163)*	*(0.0246)*
$PostJune30_{i,2011}$ *2011	-0.0959***			
	(0.0213)			
Controls				
Demographic and Educational Characteristics	Yes	Yes	Yes	Yes
Labor Market Characteristics	Yes	Yes	Yes	Yes
Year and Month Fixed Effects	Yes	Yes	Yes	Yes
Linear Time Trend	Yes	Yes	Yes	Yes
R^2	*0.0061*	*0.0130*	*0.0082*	*0.0144*
N	***26,369***	***12,375***	***25,974***	***13,356***

Note: * p<0.1, ** p<0.05, *** p<0.01; standard errors are in parentheses and clustered at the interview date level. The treatment statuses are defined by $PostMarch11_{i,2011}$ and $PostMay30_{i,2011}$. To save space, they are not displayed. The dependent variable is a dummy variable which equals one if the individual is very concerned about the environment. Column (1) uses June 30 as the relevant date for the Phase-Out Bill since the law was formally passed by the parliament on that date. Column (2) excludes individuals that moved outside a 50km radius to their birth place, whereas column (3) excludes individuals that moved in the previous period. Column (4) only includes pre-scheduled interviews (see footnote #13) and Table A2. Each column stands for one FE model as in equation (1).
Source: SOEP v29, 2010-2011, unbalanced panel, own calculations.

Table 3b: Robustness Checks II

Effects of the Fukushima Meltdown and the Permanent Shutdown of Nuclear Power Plants in Germany on Environmental Concerns

	Very Concerned About the Environment			
	Adds Linear Time Trend After Meltdown	**Adds Linear Time Trend After Policy**	**Adds Quadratic Time Polynomial**	**Uses Balanced Panel**
	(1)	**(2)**	**(3)**	**(4)**
$PostMarch11_{i,2011}$*2011 *("After Meltdown")*	0.0717***	0.0733***	0.0880***	0.0713***
	(0.0094)	*(0.0088)*	*(0.0140)*	*(0.0088)*
$PostMay30_{i,2011}$ *2011 *("After Permanent Shutdown")*	-0.0997***	-0.1144***	-0.0587***	-0.0994***
	(0.0159)	*(0.0154)*	*(0.0277)*	*(0.0159)*
Controls				
Demographic Characteristics	Yes	Yes	Yes	Yes
Educational Characteristics	Yes	Yes	Yes	Yes
Labor Market Characteristics	Yes	Yes	Yes	Yes
Year Fixed Effects	Yes	Yes	Yes	Yes
Month Fixed Effects	Yes	Yes	Yes	Yes
Linear Time Trend	Yes	Yes	Yes	Yes
R^2	*0.0075*	*0.0086*	*0.0078*	*0.0075*
N	***26,369***	***26,369***	***26,369***	***20,178***

Note: * p<0.1, ** p<0.05, *** p<0.01; standard errors are in parentheses and clustered at the interview date level. The treatment statuses are defined by $PostMarch11_{i,2011}$ and $PostMay30_{i,2011}$. To save space, they are not displayed. The dependent variable is a dummy variable which equals one if the individual is very concerned about the environment. Column (1) adds a linear time trend which starts after the meltdown, whereas column (2) adds a linear time trend which starts after the implementation of the policy. Column (3) adds a quadratic time polynomial. Column (4) uses a balanced rather than unbalanced panel and is equivalent to column (4) of Table 2. Each column stands for one FE model as in equation (1).

Source: SOEP v29, 2010-2011, unbalanced panel, own calculations.

Table 3c: Placebo Regressions

Placebo Effects of the Fukushima Meltdown and the Permanent Shutdown of Nuclear Power Plants in Germany on Environmental Concerns

	Placebo Years		**Placebo Dependent Variables: *Very Concerned About***			
	Very Concerned About the Environment		***Job Security***	***Health***	***the Economy***	***Crime***
	2010	**2012**	**2011**	**2011**	**2011**	**2011**
	(1)	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**
$PostMarch11_{i,2010}$*2010	0.0105					
	(0.0077)					
$PostMay30_{i,2010}$ *2010	0.0060					
	(0.0133)					
$PostMarch11_{i,2012}$*2012		-0.0035				
		(0.0262)				
$PostMay30_{i,2012}$ *2012		0.0649				
		(0.0500)				
$PostMarch11_{i,2011}$*2011 *("After Meltdown")*			-0.0088	0.0078	0.0087	-0.0075
			(0.0141)	*(0.0091)*	*(0.0146)*	*(0.0133)*
$PostMay30_{i,2011}$ *2011 *("After Permanent Shutdown")*			0.0277	-0.0114	0.0386	0.0328
			(0.0215)	*(0.0174)*	*(0.0267)*	*(0.0222)*
Controls						
Demographic, Educational, and Labor Characteristics	Yes	Yes	Yes	Yes	Yes	Yes
Year and Month Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Linear Time Trend	Yes	Yes	Yes	Yes	Yes	Yes
R^2	*0.0041*	*0.0126*	*0.0281*	*0.0043*	*0.0979*	*0.0125*
N	***31,221***	***26,818***	***14,871***	***26,324***	***26,336***	***26,312***

Note: * p<0.1, ** p<0.05, *** p<0.01; standard errors are in parentheses and clustered at the interview date level. The treatment statuses are defined by $PostMarch11_{i,2011}$ and Post-$May30_{i,2011}$. To save space, they are not displayed. The dependent variable is a dummy variable which equals one if the individual is very concerned about the environment. Columns (1) and (2) make use of the placebo years 2010 and 2012. Columns (3) to (6) use placebo dependent variables, which are dummy variables that equal one if the individual is very concerned about job security, health, the economy, and crime. Each column stands for one FE model as in equation (1).

Source: SOEP v29, 2009-2012, unbalanced panel, own calculations.

Table 4: Long-Term Impact Fukushima vs. Chernobyl

Fukushima 2011 vs. Chernobyl 1986: Meltdown and (Placebo) Policy Effects

	Very Concerned About the Environment				
	Fukushima OLS 2009-2012	**Fukushima FE 2009-2012**		**Chernobyl OLS 1984-1989**	**Chernobyl FE 1984-1989**
	(1)	**(2)**		**(3)**	**(4)**
$PostMarch11_{i,2011}$*2011 *("After Meltdown")*	0.0712***	0.0797***	$PostApril26_{i,1986}$*1986 *("After Meltdown")*	0.1025***	0.1213***
	(0.0116)	*(0.0104)*		*(0.0175)*	*(0.0151)*
$PostMay30_{i,2011}$ *2011 *("After Permanent Shutdown")*	-0.0871***	-0.1078***	$PostJuly15_{i,1986}$*1986 ("Placebo Policy")	-0.0183	-0.0247
	(0.0191)	*(0.0156)*		*(0.1686)*	*(0.0251)*
2010	0.0338***	0.0348***	1985	-0.0291***	-0.3000***
	(0.0054)	*(0.0042)*		*(0.0100)*	*(0.0088)*
2011	0.0003	0.0092	1986	-0.0869***	-0.1034***
	(0.0082)	*(0.0068)*		*(0.0116)*	*(0.0102)*
2012	0.0003	-0.0002	1987	0.0671***	0.0580***
	(0.0002)	*(0.0001)*		*(0.0108)*	*(0.0097)*
			1988	0.0494***	0.0375***
				(0.0106)	*(0.0092)*
			1989	0.1068***	0.0984***
Controls				*(0.0113)*	*(0.0093)*
Demographic, Educational, and Labor Characteristics	Yes	Yes		Yes	Yes
Year and Month Fixed Effects	Yes	Yes		Yes	Yes
Linear Time Trend	Yes	Yes		Yes	Yes
R^2	*0.0121*	*0.0087*		*0.0655*	*0.0281*
N	**57,492**	**57,492**		***62,540***	***62,540***

Note: * p<0.1, ** p<0.05, *** p<0.01; standard errors are in parentheses and clustered at the interview date level. The treatment statuses are defined by $PostMarch11_{i,2011}$ and $PostMay30_{i,2011}$ and $PostApril26_{i,1986}$ for Chernobyl. To save space, they are not displayed. While April 26, 1986 was the date of the disaster, the actual treatment status for Chernobyl is defined by interviews after April 28, 1986 since the meltdown only became public two days later. The dependent variable is a dummy variable which equals one if the individual is very concerned about the environment. Columns (1) and (3) estimate unbalanced OLS regression models, whereas columns (2) and (4) estimate FE regression models. $PostJuly15_{i,1986}$ is the placebo policy reform date for Chernobyl, 81 days after the disaster.

Source: SOEP v29, 1984-1989 +2009-2012; unbalanced panel, own calculations.

Table 5: **Concerns by Distance to Nuclear Plants (see Fig. 2) and Change in Risk Aversion: Operating Channels**

	Very Concerned About the Environment			**Very Risk Averse**
	Within 50km to Nuclear Plant	**Within 50-80km to Nuclear Plant**	**Next Plant Among 8 Oldest**	
$PostMarch11_{i,2011}$*2011 *("After Meltdown")*	0.0739***	0.0618***	0.0689***	0.0163***
	(0.0097)	*(0.0098)*	*(0.0112)*	*(0.0060)*
$PostMay30_{i,2011}$ *2011 *("After Permanent Shutdown")*	-0.0920***	-0.0858***	-0.0584***	0.0021
	(0.0185)	*(0.0169)*	*(0.0225)*	*(0.0104)*
$PostMarch11_{i,2011}$*2011*Within50kmRadius	-0.0117			
	(0.0177)			
$PostMay30_{i,2011}$ *2011*Within50kmRadius	-0.0078			
	(0.0282)			
$PostMarch11_{i,2011}$*2011*Within50-80km		0.0482**		
		(0.0188)		
$PostMay30_{i,2011}$ *2011 *Within50-80km		-0.0725***		
		(0.0294)		
$PostMarch11_{i,2011}$*2011*Atommoratorium			0.0023	
			(0.0143)	
$PostMay30_{i,2011}$ *2011*Atommoratorium			-0.0676**	
			(0.0282)	
Within50kmRadius	0.0144			
	(0.0561)			
Within50-80km		-0.0688		
		(0.0575)		
Atommoratorium			0.2836***	
			(0.0731)	
Controls				
Socio-Demographics	Yes	Yes	Yes	Yes
Year and Month Fixed Effects	Yes	Yes	Yes	Yes
Linear Time Trend	Yes	Yes	Yes	Yes
R^2	*0.0079*	*0.0084*	*0.0081*	*0.0085*
N	***26,369***	***26,369***	***25,766***	***26,294***

Note: * p<0.1, ** p<0.05, *** p<0.01; standard errors are in parentheses and clustered at the interview date level. The treatment statuses are defined by $PostMarch11_{i,2011}$ and $PostMay30_{i,2011}$. To save space, they are not displayed. *Within50kmRadius*, *Within50km-80km*, *Atommoratorium* ("*next plant among 8 oldest, shut down on March 14*") are lagged by one time period to have the pre-treatment values (see Descriptive Statistic in the Appendix). The dependent variable is a dummy variable which equals one if the individual is very concerned about the environment. Each column stands for one FE model as in equation (1). Note that in the FE models the interaction term $PostMarch11_{i,2011}$* *2011* represent effectively a simple main effect, because $PostMarch11_{i,2011}$ is a time-invariant variable omitted in the regression. Accordingly, all three-way interaction terms should be considered as simple two-way interactions.
Source: SOEP v29, 2010-2011, unbalanced panel, own calculations.

Table 6: Alternative Well-Being Measures

Effects of the Fukushima Meltdown and the Permanent Shutdown of Nuclear Power Plants in Germany

	Life Satisfaction	Happiness	Sadness	Very Concerned About Climate Change
	(1)	**(2)**	**(3)**	**(4)**
$PostMarch11_{i,2011}$*2011 *("After Meltdown")*	0.0344	0.0047	0.0453***	0.0575***
	(0.0318)	*(0.0075)*	*(0.0102)*	*(0.0072)*
$PostMay30_{i,2011}$ *2011 *("After Permanent Shutdown")*	-0.0455	-0.0158	-0.0374	-0.0551***
	(0.0526)	*(0.0188)*	*(0.0264)*	*(0.0141)*
Controls				
Demographic Characteristics	Yes	Yes	Yes	Yes
Educational Characteristics	Yes	Yes	Yes	Yes
Labor Market Characteristics	Yes	Yes	Yes	Yes
Year Fixed Effects	Yes	Yes	Yes	Yes
Month Fixed Effects	Yes	Yes	Yes	Yes
Linear Time Trend	Yes	Yes	Yes	Yes
R^2	*0.0198*	*0.0089*	*0.0065*	*0.0058*
N	***26,369***	***26,369***	***26,369***	***26,321***

Note: * p<0.1, ** p<0.05, *** p<0.01; standard errors are in parentheses and clustered at the interview date level. The treatment statuses are defined by $PostMarch11_{i,2011}$ and $PostMay30_{i,2011}$. To save space, they are not displayed. Columns (1) to (4) use alternative well-being measures as dependent variables, which are life satisfaction, happiness, sadness, and a dummy variable that equals one if the individual is very concerned about climate change. Sadness and happiness refer to the last 4 weeks prior to the interview (see Section 4.2). Consequently, we use April 11, 2011 and June 30, 2011 as cut-off dates for these regressions. Each column stands for one FE regression model, except for the first, which is an ordered probit model.

Source: SOEP v29, 2010-2011, unbalanced panel, own calculations.

Table 7: Fukushima Effects in Switzerland and the UK

Effects of the Fukushima Meltdown in Switzerland (Swiss Household Panel) and the UK (Understanding Society)

	Waves 11-14		***Waves 11 vs. 13***		***Waves 1-3***	
	2009-2013		**2009-2012**		**2009-2013**	
	Switzerland				**United Kingdom**	
	Life Satisfaction		**Importance of environmental protection vs. GDP**		**Life Satisfac-tion**	**Happiness**
	(1)	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**
$PostMarch11_{i,2011}$*2011 *("After Meltdown")*	-0.197	-0.228	0.018***	0.001	0.020	-0.005
	(0.179)	*(0.183)*	*(0.005)*	*(0.025)*	*(0.020)*	*(0.007)*
$PostMarch11_{i,2011}$*0-25 km radius to nearest NPP*2011		0.078*		0.017		
		(0.046)		*(0.019)*		
$PostMarch11_{i,2011}$*25-50 km radius to nearest NPP*2011		0.027		0.014		
		(0.041)		*(0.019)*		
$PostMarch11_{i,2011}$*50-100 km radius to nearest NPP*2011		0.001		0.029		
		(0.044)		*(0.021)*		
Controls						
Demographic, Educational, and Labor Characteristics	Yes	Yes	Yes	Yes	Yes	Yes
Year Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Month Fixed Effects	No	No	No	No	Yes	Yes
Linear Time Trend	Yes	Yes	No	No	Yes	Yes
R^2	*0.018*	*0.018*	*0.010*	*0.011*	*0.008*	*0.006*
N	***27,069***	***27,069***	***12,656***	***12,656***	***122,287***	***123,502***

Note: * p<0.1, ** p<0.05, *** p<0.01; standard errors are in parentheses and clustered at the interview date level. The dependent variable is defined as follows: Model (1) and (2) use life satisfaction on a scale from 0-10; Model (3) and (4) use a dummy variable which equals one if the individual prefers protection of the environment over economic growth. The indicator is 1 for all respondents who value environmental protection more than economic growth and "0" for all respondents who (a) value economic growth more than environmental protection or who (b) are indifferent. Model (5) uses life satisfaction on a scale from 1-7 scale and Model (6) happiness measured on a scale from 1-4. Each column stands for one FE model as in equation (1). For models (3) and (4), the triple interactions $PostMarch11_{i,2011}$*radius to nearest NPP*2011 represent effectively simple interaction terms since we basically compare 2009 to 2011 with few observations in 2010 and 2012 of waves 11 and 13 of the SHP. Since the SHP solely conducts interviews from Sep to Feb in a given wave, we cannot employ month fixed effects along with $PostMarch11_{i,2011}$ and $PostMarch11_{i,2011}$*2011.

Source: SHP w11-14, Understanding Society wave 1-3, unbalanced panel, own calculations.

Appendix: Descriptive Statistics

	Mean	*Std. Dev.*	*Min.*	*Max.*	*Obs.*
Dependent Variables					
Very Concerned About the Environment	0.3019	0.4591	0	1	26,369
Very Concerned About Climate Change	0.2941	0.4556	0	1	26,321
Very Concerned About Job Security	0.1074	0.3096	0	1	14,871
Very Concerned About Health	0.2055	0.4041	0	1	26,324
Very Concerned About the Economy	0.2819	0.4499	0	1	26,336
Very Concerned About Crime	0.3428	0.4747	0	1	26,312
Life Satisfaction	6.9961	1.7318	0	10	26,369
Happiness	0.1352	0.3420	0	1	26,369
Sadness	0.5428	0.4982	0	1	26,369
Demographic Characteristics					
Age	51.2484	17.4013	18	101	26,369
Age Squared	2,929	1,810	324	10,201	26,369
Female	0.5243	0.4994	0	1	26,369
Married	0.6285	0.4832	0	1	26,369
Single	0.2224	0.4159	0	1	26,369
Disabled	0.1396	0.3465	0	1	26,369
No German Nationality	0.0463	0.2101	0	1	26,369
Number of Children in Household	0.8180	1.1956	0	12	26,369
Educational Characteristics					
In School	0.0150	0.1216	0	1	26,369
Lower Than Secondary Degree	0.1366	0.3435	0	1	26,369
Secondary Degree	0.5354	0.4988	0	1	26,369
Tertiary Degree	0.3130	0.4637	0	1	26,369
Labor Market Characteristics					
Full-Time Employed	0.3905	0.4879	0	1	26,369
Part-Time Employed	0.1165	0.3208	0	1	26,369
Out of the Labor Force	0.4236	0.4941	0	1	26,369
On Maternity Leave	0.0180	0.1329	0	1	26,369
Unemployed	0.0508	0.2196	0	1	26,369
Heterogeneity *(for Heterogeneity Tests, Tab A4-A6)*					
Within 50km Radius of Nuclear Plant (Lagged)	0.2225	0.4159	0	1	26,369
Within 50-80km of Nuclear Plant (Lagged)	0.1594	0.3660	0	1	26,369
Atommoratorium (*next Nuclear Plant Among Oldest 8, shut down on March 14*)(Lagged)	0.4594	0.4984	0	1	25,766
Supports SPD (Lagged)	0.3004	0.4584	0	1	9,981
Supports Greens (Lagged)	0.1242	0.3299	0	1	9,981
Supports Opposition (Lagged)	0.4246	0.4943	0	1	9,981
Supports Government (Lagged)	0.4648	0.49882	0	1	9,981
Risk Averse [0-4 on scale to 10] (Lagged)	0.5459	0.4979	0	1	20,918

Source: SOEP v29, 2010-2011, own calculations.

Online Appendix

Figure A1: Share of SOEP Respondents Who Are Very Concerned About Environmental Protection

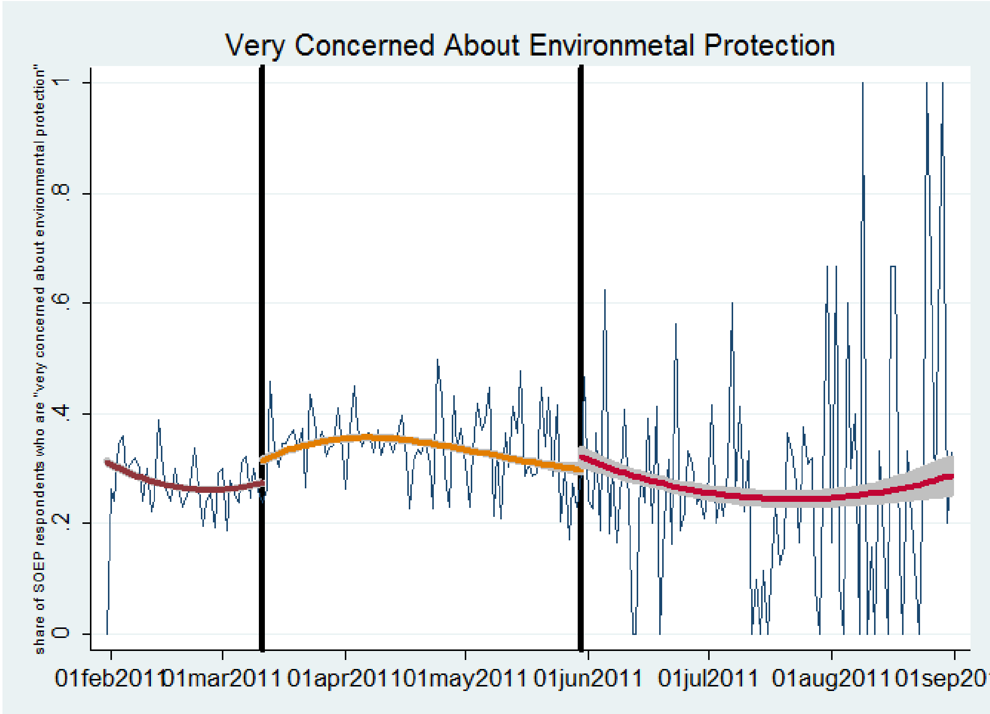
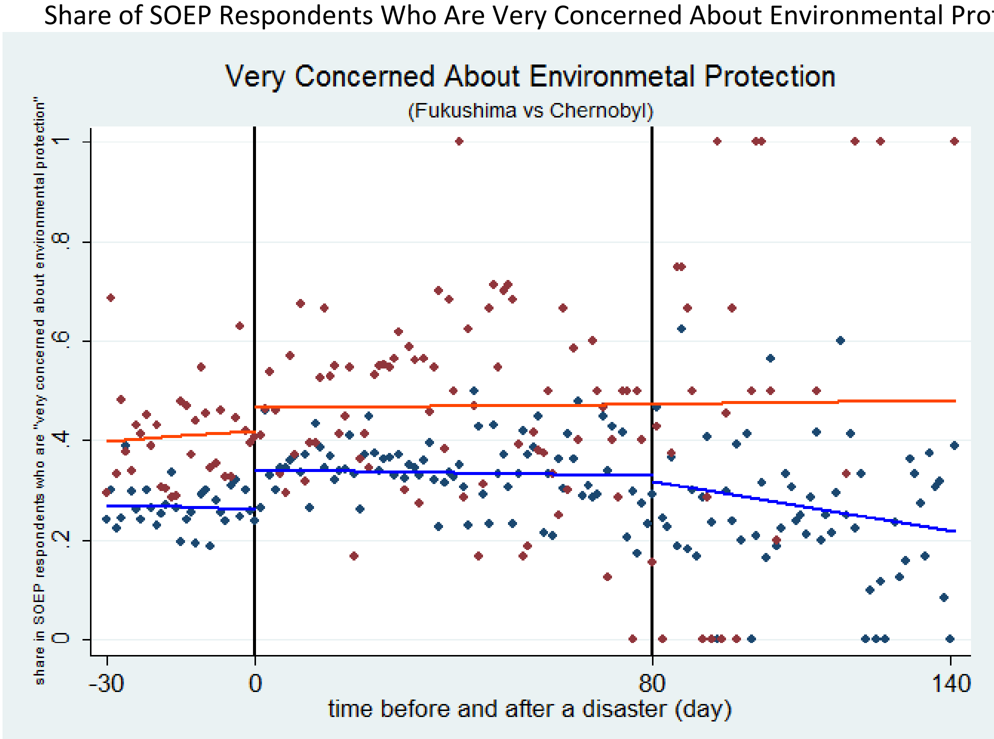


Figure A2: Chernobyl (red) vs. Fukushima (blue) on a Normalized Scale:
Share of SOEP Respondents Who Are Very Concerned About Environmental Protection



Note: Day "0" denotes the day of the disaster; day "80" is equivalent to 30 May, 2011, when the policy measures were announced by the German government.

Table A1: **Determinants of Environmental Concerns**

	OLS	**FE**
Age	0.0079***	
	(0.0012)	
Age Squared/100	-0.0076***	
	(0.0012)	
Female	0.0681***	
	(0.0075)	
Married	-0.0152	-0.0185
	(0.0098)	*(0.0350)*
Single	0.0030	-0.0062
	(0.0133)	*(0.0496)*
Disabled	0.0455***	0.0343*
	(0.0091)	*(0.0198)*
No German Nationality	-0.0080	-0.0563
	(0.0152)	*(0.1649)*
Number of Children in Household	-0.0096***	-0.0047*
	(0.0036)	*(0.0025)*
In School	0.0616**	-0.0157
	(0.0293)	*(0.0508)*
Lower Than Secondary Degree	-0.0071	-0.2148***
	(0.0107)	*(0.0620)*
Secondary Degree	-0.0064	-0.0324
	(0.0071)	*(0.0378)*
Full-Time Employed	-0.0461***	-0.0576***
	(0.0125)	*(0.0202)*
Part-Time Employed	-0.0108	-0.0101
	(0.0144)	*(0.0190)*
Out of the Labor Force	-0.0022	-0.0241
	(0.0129)	*(0.0166)*
On Maternity Leave	0.0113	0.0014
	(0.0228)	*(0.0268)*
Unemployed	-0.0095	-0.0270
	(0.0150)	*(0.0196)*
Distance to the Next Nuclear Power	-0.0011**	-0.0007
	(0.0004)	*(0.0045)*
Month Fixed Effects and Linear Time Trend	Yes	Yes
R^2	*0.0126*	*0.0075*
N	***26,369***	***26,369***

Note: * p<0.1, ** p<0.05, *** p<0.01; standard errors are in parentheses and clustered at the individual level. The dependent variable is a dummy variable which equals one if the individual is very concerned about the environment.
Source: SOEP v29, 2010-2011, unbalanced panel, own calculations.

Table A2: **Effects of the Fukushima Meltdown and the Permanent Shutdown: Robustness Checks with Survey Modes**

	Very Concerned About the Environment			
	Only Pre-Scheduled Interviews	**Excludes CAPI Interviews**	**Excludes Postal + CAPI Interviews**	**Includes Only CAPI Interviews**
	(1)	**(2)**	**(3)**	**(4)**
$PostMarch11_{i,2011}$*2011 *("After Meltdown")*	0.0793***	0.0597***	0.0464**	0.0985***
	(0.0150)	*(0.0091)*	*(0.0232)*	*(0.0201)*
$PostMay30_{i,2011}$ *2011 *("After Permanent Shutdown")*	-0.1248***	-0.1070***	-0.1776***	-0.1053***
	(0.0248)	*(0.0168)*	*(0.0340)*	*(0.0344)*
Controls				
Demographic Characteristics	Yes	Yes	Yes	Yes
Educational Characteristics	Yes	Yes	Yes	Yes
Labor Market Characteristics	Yes	Yes	Yes	Yes
Year Fixed Effects	Yes	Yes	Yes	Yes
Month Fixed Effects	Yes	Yes	Yes	Yes
Linear Time Trend	Yes	Yes	Yes	Yes
R^2	*0.0153*	*0.0076*	*0.0271*	*0.0199*
N	***13,235***	***19,548***	***6,601***	***6,634***

Note: * p<0.1, ** p<0.05, *** p<0.01; standard errors are in parentheses and clustered at the interview date level. The treatment statuses are defined by $PostMarch11_{i,2011}$ and Post-$May30_{i,2011}$. To save space, they are not displayed. The dependent variable is a dummy variable which equals one if the individual is very concerned about the environment. Overall there are ten different categories of interviews but only four are of quantitative relevance. *(a)* Oral interviews, pre-scheduled and carried out by a professional interviewer at the respondent's home (19%), *(b)* self-administered interviews filled out by the respondent without the help of the interviewer (29%), *(c)* written interviews sent in by mail (20%), and *(d)* CAPI interviews which are also pre-scheduled and carried out by a professional interviewer at the respondent's home at a computer (25%). Column (1) excludes categories (b) and (c). Column (2) excludes CAPI interviews , category (d); column 3 excludes categories (c) and (d) and column (4) excludes all columns but (d).
Source: SOEP v29, 2010-2011, unbalanced panel, own calculations.

Table A3: **Placebo Effects of the Nuclear Phase-Out on Environmental Concerns 2011**

	Very Concerned About the Environment					
	Real Policy Dates		**Placebo Policy Dates**			
	(1)	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**
$PostMarch11_{i,2011}$*2011	0.0713***	0.0610***	0.0724***	0.0728***	0.0728***	0.0726***
("After Meltdown")	*(0.0088)*	*(0.0086)*	*(0.0147)*	*(0.0147)*	*(0.0147)*	*(0.0147)*
$PostMay30_{i,2011}$*2011	-0.0994***					
("After Permanent Shutdown")	*(0.0159)*					
$PostJune30_{i,2011}$*2011		-0.0959***				
("After Permanent Shutdown")		*(0.0213)*				
$PostMay15_{i,2011}$*2011			-0.0158			
			(0.0246)			
$PostMay17_{i,2011}$*2011				-0.0010		
				(0.0238)		
$PostJune15_{i,2011}$*2011					-0.0089	
					(0.0298)	
$PostJuly15_{i,2011}$*2011						0.0443
						(0.0380)
Controls						
Demographic Characteristics	Yes	Yes	Yes	Yes	Yes	Yes
Educational Characteristics	Yes	Yes	Yes	Yes	Yes	Yes
Labor Market Characteristics	Yes	Yes	Yes	Yes	Yes	Yes
Year Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Month Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Linear Time Trend	Yes	Yes	Yes	Yes	Yes	Yes
R^2	*0.0075*	*0.0061*	*0.0083*	*0.0083*	*0.0083*	*0.0083*
N	***26,369***	***26,369***	***26,369***	***26,369***	***26,369***	***26,369***

Note: * p<0.1, ** p<0.05, *** p<0.01; standard errors are in parentheses and clustered at the interview date level. The treatment statuses are defined by $PostMarch11_{i,2011}$, $PostMay15_{i,2011}$, $PostMay17_{i,2011}$, $PostMay30_{i,2011}$, $PostJune15_{i,2011}$, $PostJune30_{i,2011}$, and $PostJuly15_{i,2011}$. To save space, they are not displayed. Columns (1) and (2) make use of the real policy dates, May 30 and June 30, 2011. Columns (3), (4), and (5) make use of the placebo policy dates May 15, May 17, June 15, and July 15, 2011. The dependent variable is a dummy variable which equals one if the individual is very concerned about the environment. Each column stands for one regression model as in equation (1).
Source: SOEP v29, 2010-2011, unbalanced panel, own calculations.

Table A4: **Effect Heterogeneity of Fukushima and the Phase-Out by Socio-Demographics**

	Very Concerned About the Environment			
	Risk Averse	**Female**	**Above 40**	**Supports Greens**
	(1)	**(2)**	**(3)**	**(4)**
$PostMarch11_{i,2011}$*2011*RiskAverse	-0.0156			
	(0.0193)			
$PostMay30_{i,2011}$ *2011*RiskAverse	0.0479			
	(0.0303)			
$PostMarch11_{i,2011}$*2011*Female		0.0246*		
		(0.0140)		
$PostMay30_{i,2011}$ *2011 *Female		-0.0616***		
		(0.0225)		
$PostMarch11_{i,2011}$*2011*Above40			0.0127	
			(0.0169)	
$PostMay30_{i,2011}$ *2011*Above40			-0.0184	
			(0.0256)	
$PostMarch11_{i,2011}$*2011*SupportsGreens				-0.0726*
				(0.0430)
$PostMay30_{i,2011}$ *2011*SupportsGreens				-0.0832*
				(0.0469)
RiskAverse	0.0233**			
	(0.0110)			
Female				
Above40			-0.0194	
			(0.0242)	
SupportsGreens				-0.0167
				(0.0537)
$PostMarch11_{i,2011}$*2011 *("After Meltdown")*	0.0802***	0.0585***	0.0611***	0.0669***
	(0.0137)	*(0.0115)*	*(0.0144)*	*(0.0142)*
$PostMay30_{i,2011}$ *2011 *("After Permanent Shutdown")*	-0.1274***	-0.0672***	-0.0842***	-0.0357
	(0.0231)	*(0.0196)*	*(0.0245)*	*(0.0266)*
Controls				
Socio-demographic Characteristics	Yes	Yes	Yes	Yes
Year and Month Fixed Effects	Yes	Yes	Yes	Yes
Linear Time Trend	Yes	Yes	Yes	Yes
R^2	*0.0092*	*0.0085*	*0.0077*	*0.0106*
N	***20,918***	***26,369***	***26,346***	***9,981***

Note: * p<0.1, ** p<0.05, *** p<0.01; standard errors are in parentheses and clustered at the interview date level. The treatment statuses are defined by $PostMarch11_{i,2011}$ and $PostMay30_{i,2011}$. To save space, they are not displayed. *RiskAverse*, *Female*, *Above40*, and *SupportsGreens* are lagged by one time period to have the pre-treatment values (see Descriptive Statistic in the Appendix). The dependent variable is a dummy variable which equals one if the individual is very concerned about the environment. Each column stands for one FE model as in equation (1). Note that in the FE models the interaction term *$PostMarch11_{i,2011}$* 2011* represent effectively a simple main effect, because *$PostMarch11_{i,2011}$* is a time-invariant variable omitted in the regression. Accordingly, all three-way interaction terms should be considered as simple two-way interactions. **Source:** SOEP v29, 2010-2011, unbalanced panel, own calculations.

Table A5: **Effects of Fukushima and the Phase-Out on Political Party Support**

	Political Attitudes			
	Supports SPD	**Supports Greens**	**Supports Opposition**	**Supports Government**
	(1)	**(2)**	**(3)**	**(4)**
$PostMarch11_{i,2011}$*2011 *("After Meltdown")*	-0.0102*	0.0174***	0.0072	-0.0006
	(0.0057)	*(0.0054)*	*(0.0057)*	*(0.0044)*
$PostMay30_{i,2011}$ *2011 *("After Permanent Shutdown")*	-0.0204*	-0.0055	-0.0259**	0.0170**
	(0.0115)	*(0.0110)*	*(0.0119)*	*(0.0084)*
2011	0.0000	0.0006**	0.0006*	-0.0006**
	(0.0003)	*(0.0003)*	*(0.0003)*	*(0.0003)*
Controls				
Demographic Characteristics	No	Yes	No	Yes
Educational Characteristics	No	Yes	No	Yes
Labor Market Characteristics	No	Yes	No	Yes
Year Fixed Effects	Yes	Yes	Yes	Yes
Month Fixed Effects	Yes	Yes	Yes	Yes
Linear Time Trend	Yes	Yes	Yes	Yes
R^2	*0.0079*	*0.0186*	*0.0090*	*0.0061*
N	***12,556***	***12,556***	***12,556***	***12,556***

Note: * p<0.1, ** p<0.05, *** p<0.01; standard errors are in parentheses and clustered at the interview date level. The treatment statuses are defined by $PostMarch11_{i,2011}$ and $PostMay30_{i,2011}$. To save space, they are not displayed. The dependent variable is a dummy variable which equals one if the individual is supportive of the respective party or coalition. *Opposition* includes the SPD, the Greens, and the Left. *Government* includes CDU/CSU and FDP (see Descriptive Statistic in the Appendix). Each column stands for one regression model as in equation (1).
Source: SOEP v29, 2010-2011, unbalanced panel, own calculations.

Table A6: **Effects of Fukushima and the Nuclear Phase-Out: Robustness Check with an RD Design for 2011**

	Very Concerned About the Environment			
	OLS	**OLS**	**OLS**	**OLS**
	(1)	**(2)**	**(3)**	**(4)**
$PostMarch11_{i,2011}$ *("After Meltdown")*	0.0660***			
	(0.0099)			
$PostMay30_{i,2011}$ *("After Permanent Shutdown")*		-0.0494**		
		(0.0209)		
$PostJune30_{i,2011}$ *("Alternative Policy Date")*			-0.0552**	
			(0.0265)	
$PostJuly30_{i,2011}$ *("Placebo Policy Date")*				0.0018
				(0.0418)
Controls				
Demographic Characteristics	Yes	Yes	Yes	Yes
Educational Characteristics	Yes	Yes	Yes	Yes
Labor Market Characteristics	Yes	Yes	Yes	Yes
R^2	*0.0164*	*0.0195*	*0.0186*	*0.0223*
N	***11,881***	***3,503***	***1,989***	***1,035***

Note: * p<0.1, ** p<0.05, *** p<0.01; standard errors are in parentheses and clustered at the interview date level. The treatment statuses are defined by $PostMarch11_{i,2011}$, $PostMay30_{i,2011}$, $PostJune30_{i,2011}$, and $PostJuly30_{i,2011}$. The dependent variable is a dummy variable which equals one if the individual is very concerned about the environment. Each column stands for one local linear regression model around the respective cut-off date, plus minus 45 days, i.e., the identification of the effects is based on a Regression Discontinuity (RD) design.
Source: SOEP v29, 2011, own calculations.

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