# Cross-cutting vulnerabilities and preference updating on climate mitigation*

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**Abstract**

Underlying many political tensions amid climate mitigation is distributive conflict, with "losers" including not only workers at risk to decarbonization but also the underprivileged who pay relatively more on the consumer end. With climate change unfolding rapidly, more and more economically vulnerable individuals are at the same time vulnerable to climate hazards. Do people update their policy preferences on climate mitigation when they are cross-pressured by these cross-cutting vulnerabilities? I answer this question empirically using data from the European Social Survey together with find-grained indicators on regional susceptibility to various climate disasters. I find that economic vulnerability, proxied by income insecurity, becomes irrelevant to public opposition to carbon taxes when climate vulnerability is high. But such "cross-pressuring" effect seems nonexistent among direct "losers" in decarbonization. Given the distributional effects of climate hazards, this paper extends the scope of distributive conflict in climate change politics and also sheds new light on the environmental justice literature. Other contributions are also discussed.

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## Introduction

A 1-in-1,000-year flood hit eastern Kentucky in July 2022, killing dozens and displacing thousands more. Unfortunately, Appalachia's susceptibility to similar disasters is only growing due to the warming atmosphere and mountainous terrain. Yet this was not the first time climate change affected this region, nor the last. With generations of poverty and dependency on the fossil fuel industries, many Appalachians are vulnerable to decarbonization economically and therefore strongly opposed to climate action that puts their livelihoods at stake. Such opposition is well-studied (Bechtel, Genovese, and Scheve 2019; Gard-Murray 2019; Gazmararian 2022; Mildenberger 2020; Tvinnereim and Ivarsflaten 2016), but would it become less intense when people are cross-pressured by vulnerability to climate hazards at the same time?

This research question applies beyond carbon-dependent communities like those in Appalachia as the aforementioned cross-cutting vulnerabilities, i.e., economic vulnerability to climate mitigation as well as physical vulnerability to climate hazards,[1] is concurrent society-wide (Gaikwad, Genovese, and Tingley 2022). On one hand, decarbonization is distributive not only between relevant industries but also at the consumer end. Such mitigation policies as carbon taxes are not equally affordable to all, meaning that the underprivileged pay more in relative terms. With pocketbook concerns, economic vulnerability is inversely related to support for costly mitigation policies (Arndt, Halikiopoulou, and Vrakopoulos 2022; Beiser-McGrath and Bernauer 2022; Umit and Schaffer 2020), while my investigation aims at revealing one of the missing scope conditions here.

On the other hand, varieties of abnormal climate events are becoming the new normal globally, many of which, paradoxically, affect economically vulnerable individuals disproportionately since they have less access to resilience and adaptation measures (e.g., US EPA 2021). A growing body of research finds that experiencing own vulnerability to climate hazards promotes people's awareness of climate change or even pro-climate voting (Baccini and Leemann 2021; Bergquist and Warshaw 2019; Egan and Mullin 2012; Hoffmann et al. 2022; Konisky, Hughes, and Kaylor 2016). Yet the unknown is how, if at all, cross-pressured individuals would update their preferences on costly mitigation policies.

I answer my research question empirically with data from the European Social Survey 8. I

1. I hereafter usually use "economic vulnerability" for the former while "climate vulnerability" for the latter.

operationalize individual economic vulnerability to climate mitigation by self-reported income insecurity with fine-grained sectoral fixed effects. The latter allows a fair comparison between individuals facing identical industry-level structural risk to decarbonization. With geo-location information of the respondents, meanwhile, I measure individual vulnerability to climate hazards with detailed, regional-level susceptibility indicators. With regression involving a multiplicative interaction term of the cross-cutting vulnerabilities, I find that climate vulnerability undermines, and even nullifies, the effect of economic vulnerability on public opposition to carbon taxes — the most cost-explicit and politically charged mitigation policy. Nevertheless, such preference updating under cross-pressure seems nonexistent among direct "losers" in decarbonization.

Public opinion is essential to pushing effective political solutions to environmental problems (Anderson, Böhmelt, and Ward 2017; Schaffer, Oehl, and Bernauer 2022) while it has long been argued, and corroborated in part, that pocketbook concerns matter to public support for environmental action (for overviews, see Bernauer 2013; Fairbrother 2022; for positive findings, see Böhmelt and Zhang 2023; Elliott, Seldon, and Regens 1997; Gelissen 2007; for mixed findings, see Douenne and Fabre 2020; Fairbrother 2013; Goldberg et al. 2021; Mildenberger and Leiserowitz 2017). But it is only recently that scholars have started to pay attention to specific environmental policies — in particular, how the policy's cost and distributional effects affect people's policy preferences (Arndt, Halikiopoulou, and Vrakopoulos 2022; Bayer and Genovese 2020; Bechtel, Genovese, and Scheve 2019; Gard-Murray 2019; González-Rostani, Beiser-McGrath, and Aklin 2023; Kachi, Bernauer, and Gampfer 2015; Tvinnereim and Ivarsflaten 2016). Joining this vein of research, my contribution lies in examining one of the possibly missing scope conditions here among some others such as populism (Lockwood 2018), political trust (Fairbrother 2019; Fairbrother, Johansson Sevä, and Kulin 2019; Umit and Schaffer 2020), and policy design (Beiser-McGrath, Bernauer, and Prakash 2022; Huber, Wicki, and Bernauer 2020).

With focusing on cross-cutting vulnerabilities, i.e., economic vulnerability and climate vulnerability at the same time, this paper bridges two notable yet previously disconnected strands of literature together while also adding new to the latter. It has been more than a decade since political scientists started to examine whether personal experience about climatic events increases public awareness of the problem (Egan and Mullin 2012). Noticing a huge gap between awareness and willingness to act when it comes to climate change, later scholars have started to pay more attention to how exposure to climate hazards may actually elicit behavioral change in voting or preference updating in terms of specific policies (e.g., Baccini and Leemann 2021; Gazmararian and Milner 2022; Hoffmann et al. 2022; Reny, Reeves, and Christenson 2022). Building the present paper upon their findings while subscribing to their contributions, I notice that these studies are either context-specific (i.e., single-country case study) or exclusively about a single climate hazard. Given multifaceted climate hazards being rapidly unfolding worldwide, my paper narrows said gaps by using cross-national survey data with comprehensive susceptibility indicators on climate hazards together. The effect heterogeneity between different climate hazards further warrants my contribution.

Underlying political tensions amid climate mitigation is a distributive conflict between "winners" and "losers" (Aklin and Mildenberger 2020). Among the latter are not only carbon-intensive workers and local stakeholders but also anyone who bears more of the costs, in relative terms, on the consumer end. Yet paradoxically, climate change itself is distributive too, with the underprivileged suffering disproportionately more from climate hazards. When facing these two conflicting distributional effects, how would cross-pressured individuals update their climate policy preferences? This question is significant as, on one hand, many mitigation policies are still giving way to short-term economic considerations while, on the other hand, increasingly frequent climate hazards are putting more and more people in vulnerable positions. By answering this question, my paper contributes to the climate politics research in two interrelated ways. First, it broadens the conceptual scope of distributive conflict — one of the theoretical pillars in the recent literature. Second, it extends the analytical scope as well by moving the lens from distributive conflict between countries and industries onto that dealt by individuals themselves.

## Theory

### Economic vulnerability and climate policy preferences

Underlying decarbonization distributive conflict, so pocketbook concerns shape climate policy preferences (Aklin and Mildenberger 2020; Bernauer 2013). Having career prospects at stake, workers in carbon-intensive industries are understandably opposed to costly emissions-reduction measures collectively, be they direct regulations, carbon taxation, or international cooperation

(Bechtel, Genovese, and Scheve 2019; Gard-Murray 2019; Tvinnereim and Ivarsflaten 2016; see also Mildenberger 2020). Yet at the same time, cost-ambiguous policies like cap-and-trade and green subsidies are faced less backlash (Gard-Murray 2019; Tvinnereim and Ivarsflaten 2016; Stokes 2020). Such preference gradient, which is consistent with the cost ambiguity, underscores that it is very individual pocketbook concerns that unite the sectoral-concentrated opponents of decarbonization.

Due to the spillover impact of industrial decline, meanwhile, community members in where the local economy is dependent on carbon-intensive businesses usually align themselves with at-risk workers (Gaikwad, Genovese, and Tingley 2022; Gazmararian 2022). Such coalition broadens the distributive conflict's scope. That the coal-rich West Virginia acts as a veto player in the US climate legislation exemplifies said alignment between sectoral and local "losers" in decarbonization.

Beyond carbon-dependent sectors and communities, decarbonization is distributive on the consumer end too, with the underprivileged being more vulnerable, i.e., bearing disproportionately more of the costs in relative terms (Arndt, Halikiopoulou, and Vrakopoulos 2022; Jagers and Hammar 2009; Umit and Schaffer 2020). In this regard, Kachi, Bernauer, and Gampfer (2015) found that economically insecure people — who expect a drop in household income in the future — are more averse to climate policies that have cost implications to consumers (see also Böhmelt and Zhang 2022). Beiser-McGrath and Bernauer (2022) showed that individuals lower their support for carbon taxation upon knowing its negative impact on their income but are, in the meantime, more in favor of a carbon tax if it gives rebates to taxpayers (see also Dolšak, Adolph, and Prakash 2020; Huber, Wicki, and Bernauer 2020).

Relevant research in other contexts also lends strong support to the nexus between economic vulnerability and opposition to climate policies. Before decarbonization scholars have already linked individual risks to income or job loss with public support, or lack thereof, for other structurally game-changing policies such as immigration and free trade (Hainmueller and Hiscox 2010; Valentino et al. 2019; Colantone and Stanig 2018; Mansfield and Mutz 2009; Schaffer and Spilker 2019). Advancing the frontier of these studies, González-Rostani, Beiser-McGrath, and Aklin (2023) argued that people at risk of job displacement due to automation are more likely to become opponents of climate policies.

## Cross-cutting vulnerabilities and preference updating

With pocketbook concerns, economically vulnerable people, be they direct "losers" in decarbonization or just the underprivileged for whatever reasons, are on average more opposed to costly mitigation policies. But this relationship is subject to scope conditions, one of which, I contend, is being cross-pressured by vulnerability to climate hazards at the same time.

Finite-pool-of-worry and myopia hinder the public's awareness of — and political willingness to address — climate change. The former suggests that people are cognitively limited to worry about more than one concern at the same time, with an imminent one, e.g., economic insecurity, crowding out a relatively distant one like climatic catastrophe (Beiser-McGrath 2022; Weber 2006). Under the influence of the latter, a typical cognitive fallacy, people knowingly discount the consequence of something temporally distant (Healy and Malhotra 2009; Gailmard and Patty 2019).

Yet with climate change's real consequences materializing worldwide, personally experiencing own vulnerability to climate hazards is becoming one of the most important sources of people's attitudinal or behavioral change with regards to climate change. Egan and Mullin (2012) and Bergquist and Warshaw (2019), just to name a few, showed that exposure to heat waves increases public belief or concern about climate change. While Konisky, Hughes, and Kaylor (2016), for instance, expanded such investigation to other climate change-fueled events such as floods and droughts and concluded the same.

Assuming that people learn in a Bayesian way, these climatic experiential shocks update people's beliefs about climate inaction's material consequences via unmediated and apolitical messages, which are more persuasive (Gazmararian and Milner 2022). Specifically, Gazmararian and Milner found temperature anomalies in areas that are prone to economic damage from climate change increase not only the risk perception and issue salience but also demand for government action. By contrast, Reny, Reeves, and Christenson (2022) focused on more emotional responses, arguing and showing that living in coastal communities intensifies people's anxiety over sea level rise which subsequently leads to higher support for climate mitigation.

Personal experience of being vulnerable to climate hazards leads to behavioral change too. According to Baccini and Leemann (2021), pro-climate votes in Swiss referenda could increase by as many as 20% among recently flooded villages. Meanwhile, Hoffmann et al. (2022) and Garside and Zhai (2022) found that heats, droughts, and floods all persuade European voters to cast ballots for Green parties. Yet the unknown is how, if at all, vulnerability to climate hazards would cross-pressure economically vulnerable individuals to have less intense opposition to costly mitigation policies.

There is a renaissance of research on cross-pressure in the political behavior literature, in which one of the strands is studying preference updating when political predisposition such as identity, ideology, or partisanship conflicts with economic interest. Benedictis-Kessner and Hankinson (2019), for example, revealed that low-income Republicans sometimes cross the partisan line to support redistributive social policies. Similarly, Marble and Nall (2021) found that liberal homeowners are almost in line with those conservative when it comes to affordable housing in their own backyards (see also Stokes 2016). In comparison with these studies, the cross-pressure in this paper involves no political predisposition and is instead all about material self-interest itself. Specifically, individuals are cross-pressured by the costs of climate mitigation and that of climate change itself simultaneously.

Paradoxical to opponents of mitigation policies under self-regarding economic considerations is climate hazards, should they happen, are usually way more unaffordable. Heat waves and air pollution, which is made worse by climate change, increase health risks and ultimately lead to not only medical bills but also decreased earnings due to less fitness-to-work. Some more severe disasters such as floods and wildfires could seriously disrupt education and labor force participation, both of which are deterministic to lifelong income. Such extreme climatic events also destroy houses which are often the most valued asset of an ordinary family.

To make things worse, climate hazards are regressively distributive too. With spatial injustice of public services and infrastructures, the underprivileged are more likely to have less access to climate resilience and adaptation measures (see, for example US EPA 2021; Teodoro, Zuhlke, and Switzer 2022). Neither do they afford to relocate to elsewhere with less susceptibility to climate hazards. Put it differently: while well off people can freely choose between mitigation and adaptation to avoid economic losses from climate change, those economically vulnerable can only go for supporting the former, hoping to reverse the course of climate change. In some sense, the underprivileged perceives climate mitigation as a publicly financed insurance that guards themselves from potential climatic-economic disasters in the future. Therefore, economically vulnerable people may tend to become more willing to pay for costly mitigation policies if they are cross-pressured by vulnerability to climate hazards. With that, my testable hypothesis is: *the positive effect of economic vulnerability on opposition to costly climate mitigation policies attenuates with growing vulnerability to climate hazards*.

## Data

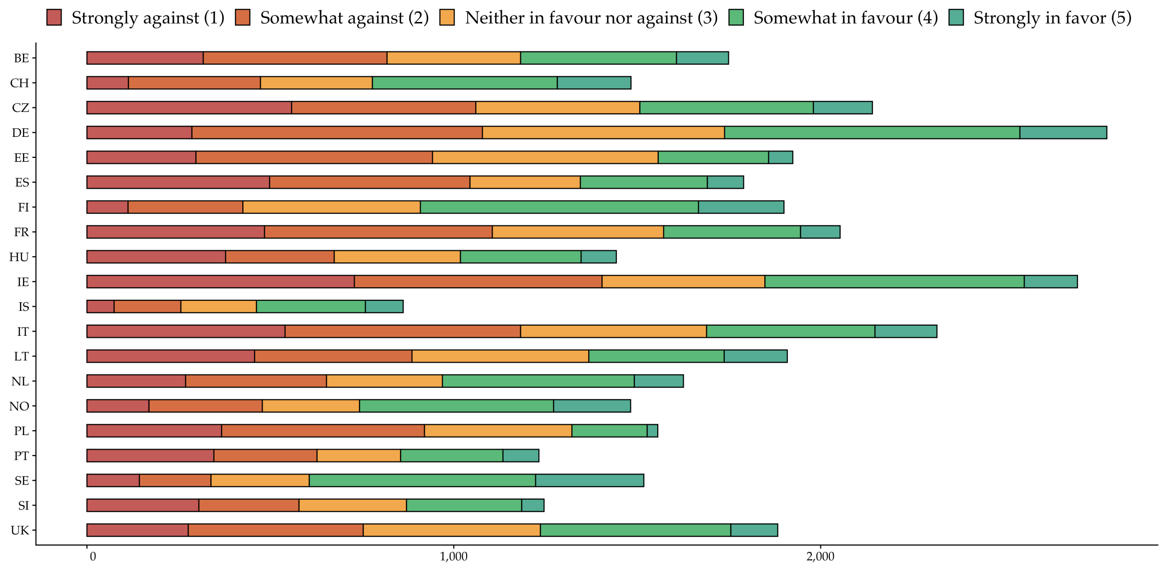
### Outcome variable

I use the European Social Survey (ESS), round 8 (2016), to test my hypothesis. With probability sampling and face-to-face interviews, the ESS 8 collected data from more than 44,000 respondents in 23 European countries. Though relevant information essential to my analyses in incomplete in 3 countries (Austria, Israel, and Russia), all of which are therefore not in my sample. Acknowledging the limited geographic scope here, my decision about the data source is made to ensure, firstly, that there exists a question about individual preferences on a specific, costly mitigation policy and, secondly, that respondents are geo-located such that measuring individual vulnerability to climate hazards is possible. Given its economic development and established social welfare system (i.e., less economic vulnerability for an average person), as well as better climate adaptation (i.e., less exposure to climate hazards for an average person), Europe is a hard case to test my hypothesis. I therefore expect the findings to follow to generalize.

I operationalize my dependent variable by the extent to which a person is "in favor or against increasing taxes on fossil fuels in [country] to reduce climate change" on a 5-point Likert scale in ascending order of opposition.[2] By mentioning climate change explicitly in the wording, a survey item like that enables even the least politically informed respondents to know the broader policy context in question and discourages some sceptical interviewees from misunderstanding carbon taxes as narrow as a revenue-raising measure. My dependent variable shows diverse attitudes towards carbon taxation among European people: upon dropping less than 2,000 "don't know" or missing cases from the sample (around 4.5%), 8% of the respondents were "strongly in favor" (1), with the number for the following three categories being 25%, 23%, and 26%, respectively,

2. This question was erroneously excluded from the Austrian questionnaire, so that all Austrian respondents are excluded from my sample.

Figure 1: Mass preferences on "increasing taxes on fossil fuels to reduce climate change" in European countries




and as many as 19% of the respondents were "strongly against" (5). These divergent preferences on carbon taxes were present everywhere including such climate action leaders as Germany and the United Kingdom, and carbon taxation's strongest opponents outnumbered the strongest advocates in almost all countries (Figure 1).

## Economic vulnerability

Testing my hypothesis entails a careful measurement of economic vulnerability, which "is theorized to affect social and political attitudes only to the extent that individuals feel anxious or worried about their economic security" (Melcher 2021, p. 7). In other words, cognitive perception about income or economic risk does not necessarily translate into affective economic insecurity (Anderson and Pontusson 2007). Individuals who know themselves being at risk of job displacement, for instance, may nonetheless not care about unemployment that much if alternative income sources, such as a generous welfare state or a comfortable family, are readily available to them (Abou-Chadi and Kurer 2021; Mau, Mewes, and Schöneck 2012). I therefore use the self-assessed likelihood of not having "enough money for household necessities [over the] next 12 months," i.e., *Income insecurity*, to measure individual economic vulnerability to costly mitigation policies.

Unlike in many other surveys, this survey item here is only about the personal but not national economy, meaning that it does not involve sociotropic economic concern. On a 4-point scale, the possible substantive answers to it are in ascending order of likelihood, and missing values are dropped from the sample (less than 4%). The majority in my sample is more or less vulnerable economically. Only 35% of the respondents thought the descried hardship is "not at all likely" (1) to happen to them in the future while more people (40%) were less certain about their economic futures by merely choosing "not very likely" (2). Further, it was "likely" (3) for 18% of the respondents to struggle to make ends meet over the coming months, not to mention there were 7% feeling that is "very likely" (4) to happen.

Direct "losers" in decarbonization such as carbon-dependent workers and local stakeholders are structurally more vulnerable to costly climate mitigation policies. To incorporate this equally important source of variation into account, I add fine-grained sectoral fixed effects throughout my regression analyses. With that, I only compare individuals with identical industry-level vulnerability against each other. I extract relevant information from the self-reported industry of employment which is categorized by "NACE Rev. 2," the second version of the "statistical classification of economic activities in the European Community," with the following adjustments. First, I merge some categories in accordance with the categorization seen in the European Commission's air emissions accounts for greenhouse gases. For example, "manufacture of food products," "manufacture of beverages," and "manufacture of tobacco products" are three different industries as defined in "NACE Rev. 2," but the European Commission treats them as a whole in its sectoral-level emissions statistics because of their homogeneous carbon intensities: accordingly, I assume individuals employed in these three industries facing the same sectoral-level economic vulnerability to decarbonization. Second, I extend this categorization to individuals not in the labor force such as students, retirees, and the job less. In total, individual respondents belong to 43 different sectors in my sample.

### Climate vulnerability

The ESS respondents were geo-located to by NUTS (nomenclature of territorial units for statistics), making measuring individual vulnerability to climate hazards (with a proxy) possible. The vulnerability data in this part maps regional susceptibility — specifically, at-risk area in percentage — to certain climate hazards at the NUTS 3 (the most detailed) level (Carter et al. 2018). Among others, I consider 4 climate hazards, namely coastal storm surges and sea level rise, wildfires, floods, and landslides for subsequent measurement. It is important to note that central to preference updating is the *perceived* climate vulnerability, while vulnerability to all these 4 hazards is easily noticeable by either heuristics from the surrounding environment (for example, low-laying coasts priming people about vulnerability to sea level rise) or past events.

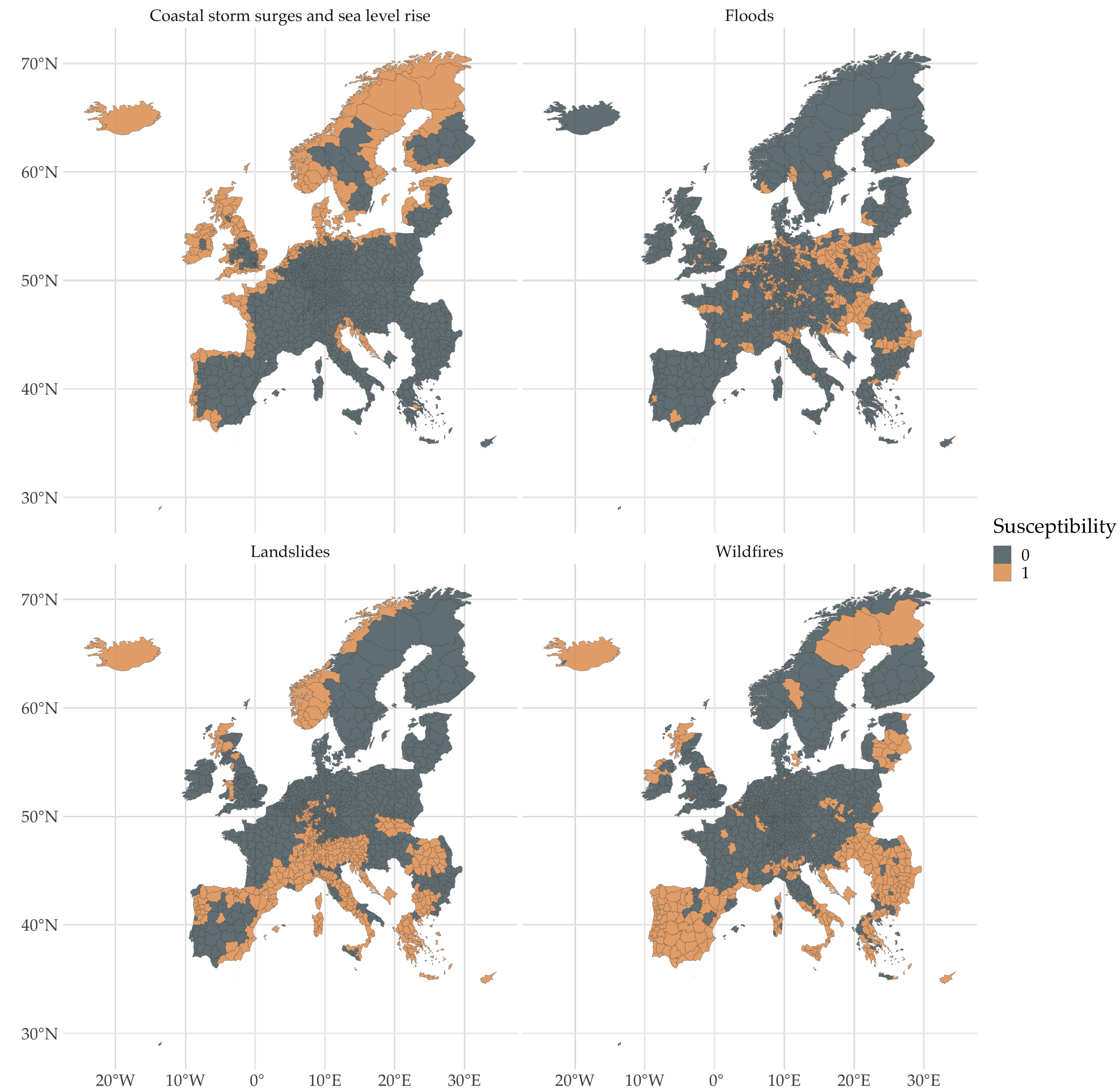
For the main analysis I create a composite indicator. I first recode the continuous susceptibility indices for the 4 chosen climate hazards in a binary way such that a NUTS 3 region's susceptibility to a given climate hazard is coded 1 if it is greater than the European average. Next, I add up these recoded indices. Since no region is simultaneously vulnerable to said 4 climate hazards, the resulting indicator ranges from 0 to 3 in ascending order of climate vulnerability. Its modal value is 1: about 51% of the respondents were living with the threat of a single climate hazard. In the meantime the raw indices are also used separately in one of the robustness checks. My hypothesis is about a conditional, or moderating, effect, which I test with a multiplicative interaction term between economic vulnerability and climate vulnerability — the moderator (Brambor, Clark, and Golder 2006).

### Control variables

Though I measure economic vulnerability with *Income insecurity*, omitting *Current income* would bias the entire estimation, given the latter being inversely related to both the perceived and actual risk of an income decline in the future. In the ESS 8 *Current income* refers to household net income and is self-assessed by respondents based on deciles (1–10), with 1 indicating the lowest 10% income group and so forth. What follows is the 7-point, Europe-wide harmonized *Education* level, with 1 standing for "less than lower secondary" while 7 denoting postgraduate. People's educational background, on one hand, is inversely related to their socioeconomic vulnerabilities in general and, on the other hand, could influence their willingness to pay carbon taxes through various mechanisms (Aklin and Ding 2021; Angrist et al. 2023).

Next, I include *Age*, which not only is an important risk factor for individual economic vulnerability (Rueda and Stegmueller 2019) but also affects people's environmental (Liere and Dunlap

Figure 2: Vulnerability to climate hazards by NUTS 3 regions



1980) and distributional (Busemeyer, Goerres, and Weschle 2009) concern. The universe of the ESS 8 was anyone older than 14, but I restrict my analysis to those aged between 18, when people become — legally speaking — independent economically, and 90, which is greater than the 99 percentile value in my sample. Given the well-documented gender differences in both economic vulnerability (through gender pay gap, glass ceiling, gendered unemployment risk, and so on) and environmental attitudes (Dietz, Kalof, and Stern 2002; Stern, Dietz, and Kalof 1993), I also add *Female* as a control variable which equals 1 if yes.

After that is a binary indicator of *Rural residency* which equals 1 if respondents lived in a "country village" or a "farm or home in countryside" other than "a big city," "suburbs or outskirts of big city," or a "town or small city." Behind this control variable is the core-periphery cleavage in economic geography, meaning that rural residents are on average subject to more economic vulnerability than do their urban counterparts, as well as the widely-perceived "rural bias" of some environmental levies, especially fuel taxes (Arndt, Halikiopoulou, and Vrakopoulos 2022; Broz and Maliniak 2010). Last, I include *Living with child*, which is dichotomous and equals 1 if yes. It arguably could push parents to become more willing to pay carbon taxes now for a stable climate for their kid(s) in the future. In the meantime, parents of minor children are more likely to become economically vulnerable than others due to more essential expenses and less geographic mobility (Abou-Chadi and Kurer 2021; Flaherty 2022).

The confounders listed in this subsection are not exhaustive as I intentionally refrain from adding posttreatment variables to my main regression model, with the "treatment" here being increased economic vulnerability. Controlling posttreatment variables would in many cases introduce more bias to regression against the intention of attenuating confounding effects (Dworschak 2023; Montgomery, Nyhan, and Torres 2018), but I do it anyway as a part of the robustness checks. Finally, I also include country fixed effects that hold cross-national heterogeneities such as tax regime, electoral dynamics, and many more unobservables constant.

# Empirical analyses

## Main results

I estimate my main regression model as if the outcome variable was continuous for the ease of interpretation, though the ordered logit model produces similar results. The first column in Table 1 shows the estimates derived from the benchmark specification, in which the multiplicative interaction term and the moderator's constituent term are not yet included, to serve as a baseline for what follows. The baseline results corroborate previous studies. Economic vulnerability and higher income correlate with less opposition to carbon taxes, so does more schooling. Age works in the opposite direction, though whether it is a life-cycle or cohort effect remains unclear due to my data's cross-sectional nature. In the meantime, females on average are moderately more in favor of carbon taxes then males while rural residents and parents of minor children are more likely to become an opponent.

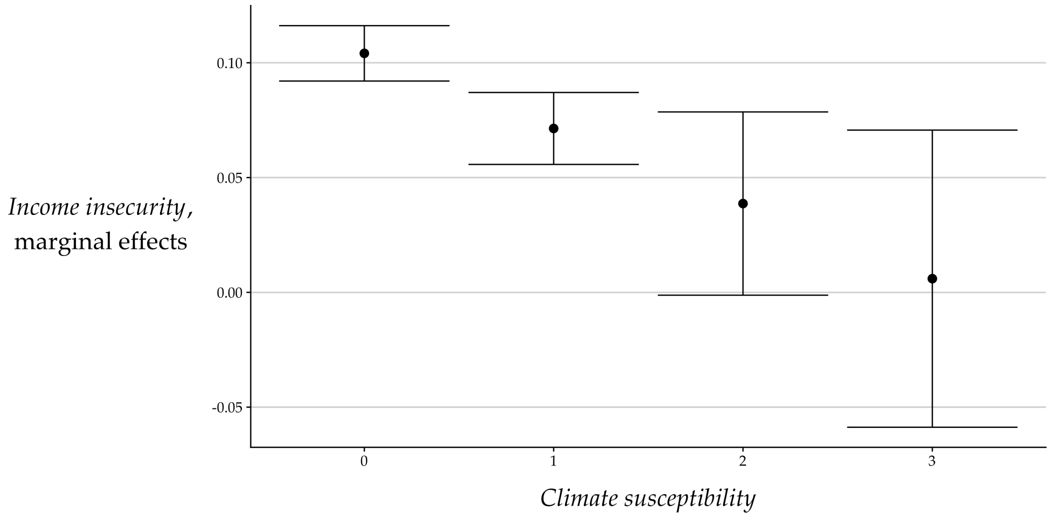
Table 1: Cross-cutting vulnerabilities and public opposition to carbon taxes

| | Full sample | | Decarbonization "losers" |
|---|---|---|---|
| | Baseline | Multiplicative | Multiplicative |
| Income insecurity | $0.064^{***}$ | $0.104^{***}$ | $0.209^{**}$ |
| | (0.011) | (0.006) | (0.082) |
| Climate susceptibility | | 0.045 | 0.046 |
| | | (0.032) | (0.067) |
| Income insecurity $\times$ Climate susceptibility | | $-0.033^{**}$ | $-0.065$ |
| | | (0.013) | (0.045) |
| Current income | $-0.024^{***}$ | $-0.024^{***}$ | $-0.015$ |
| | (0.005) | (0.005) | (0.019) |
| Education | $-0.086^{***}$ | $-0.086^{***}$ | $-0.093^{***}$ |
| | (0.009) | (0.009) | (0.030) |
| Age | $0.004^{***}$ | $0.004^{***}$ | $-0.000$ |
| | (0.001) | (0.001) | (0.003) |
| Female | $-0.051^{**}$ | $-0.049^{**}$ | $-0.128$ |
| | (0.024) | (0.024) | (0.091) |
| Rural residency | $0.144^{***}$ | $0.142^{***}$ | $0.148^{**}$ |
| | (0.021) | (0.021) | (0.066) |
| Living with kid(s) | $0.078^{***}$ | $0.082^{***}$ | $-0.045$ |
| | (0.017) | (0.015) | (0.045) |
| Obs | 28,611 | 28,150 | 1467 |
| Country FEs | 20 | 20 | 20 |
| Sectoral FEs | 43 | 43 | 12 |
| Log likelihood | $-45,302.688$ | $-44,560.361$ | $-2320.199$ |

Twoway-clustered SEs in parentheses; $^{***}p < 0.01$; $^{**}p < 0.05$; $^{*}p < 0.1$.

Then the second column shows regression results based on the hypothesized specification.

Figure 3: Climate vulnerability attenuating the effect of economic vulnerability on public opposition to carbon taxes (95% CIs shown)




The negatively estimated sign and statistical significance of the multiplicative interaction term substantiate my argument about how cross-cutting vulnerabilities cross-pressure individuals to update their preferences on climate mitigation: economically vulnerable individuals become less opposed to carbon taxes when facing vulnerability to climate hazards at the same time than would otherwise be the case.

Substantively, though, interpreting the interaction term itself without involving a constituent term is hardly meaningful. Thus, I plot the marginal effects of *Income insecurity* on opposition to carbon taxes against every value that *Climate susceptibility* could possibly takes in Figure 3. When *Climate susceptibility* = 0, the effect of *Income insecurity* is even higher than it is in the baseline specification. That is to say, the bias from ignoring cross-cutting vulnerabilities is bidirectional. When *Climate susceptibility* = 1, *Income insecurity*'s effect attenuates by about 30%. It is important to note, nevertheless, that pocketbook concerns still matter to pubic opposition to carbon taxes in this case, though to a lesser extent.

The dynamic changes categorically when *Climate susceptibility* = 2 or 3. With the lower bounds of confidence intervals crossing 0, the marginal effects of *Income insecurity* are no more statistically distinguishable from null. In substantive terms, it means that when individuals are overwhelmed by multifaceted vulnerability to more than one climate hazard, pocketbook concerns become irrelevant to their preferences on costly mitigation policies.

Structural risk to economic disruptions (e.g., decarbonization in this paper) accounts significant variation in individual economic vulnerability. Though that is held constant by sectoral fixed effects technically, a substantively meaningful question worth asking is whether the found preference updating under cross-cutting vulnerabilities applies to direct "losers" in decarbonization. Here I define "losers" as individuals currently employed in extractive, heavy manufacturing, utilities, or transportation sectors, many of which are notorious for their high emissions and resistance to change. When restricting my sample only to these decarbonization "losers," as shown by the third column in Table 1, the interaction term of interest is no more significant statistically. This null result implies that when individual economic vulnerability coincides with sectoral precarity amid decarbonization, pocketbook concerns still govern people's policy preferences on climate mitigation unconditionally.

## Robustness checks

As previously mentioned, the control variables in my main regression model are not exhaustive since I exclude some posttreatment confounders on purpose. It is well-established that ideology, for instance, matters to individual support for climate policies (e.g., Böhmelt and Zhang 2023), yet *Income insecurity* (the "treatment") is likely to push a person to the left. A similar example is the worry about climate change. In the abstract, these variables are supposed to control the non-random "assignment" of personal economy but are nonetheless influenced by personal economy itself to some degree. Table A1 in Appendix shows regression results when the aforementioned posttreatment controls are included anyway: neither statistical inference nor substantive conclusion made previously changes.

Then, Table A2 uses single, continuous *Climate susceptibility* indices separately. The results show that vulnerability to any single climate hazard, but coastal storm surges and sea level rise, can cross-pressure economically vulnerable individuals to update their preferences to carbon taxes upwards. Next, Table A3 shows qualitatively the same regression results from the ordered logit model that fully respect the ordinal nature of my dependent variable. Last, Figure A1 in Appendix visualizes the point estimates of *Income insecurity* $\times$ *Climate susceptibility* derived from the leave-one-out estimation, which omits an entire country's or sector's respondents each time iteratively.

That all of the reestimated coefficients are below 0 indicates that my empirical findings are not driven by any peculiar industry or country.

## Concluding remarks

Increasingly frequent climate hazards are putting more and more people in vulnerable positions worldwide, with economically vulnerable people being disproportionately affected. These cross-cutting vulnerabilities, nevertheless, received little attention from political scientists until recently (Gaikwad, Genovese, and Tingley 2022), let alone how this intersectionality may change mass preferences on mitigation policies. My papers joins some recent quantitative works on environmental justice in pollution (see, for example Currie, Voorheis, and Walker 2023; Teodoro, Zuhlke, and Switzer 2022), but it expands the issue being considered to climate change and is also beyond a single-country analysis.

The economic vulnerability part in my paper echoes that a successful energy transition hings on just solutions for those most socioeconomically vulnerable — not only in the carbon-dependent workforce and the affected local communities (Gaikwad, Genovese, and Tingley 2022; Gazmararian 2022; Snyder 2018), but also on the society-wide consumer end. In the meantime, the climate vulnerability part helps to make the concept of just transition inclusive of just resilience as well (Davoudi 2018). My findings also lend support to climate policy bundling, like the Green New Deal, that encompasses such interlinked socioeconomic issues as job creation and economic equality to expand the pro-climate coalition as widely as possible (Bergquist, Mildenberger, and Stokes 2020).

Finally, it is worth noting that Europe is a hard case to answering my research question, given its high economic development and established social welfare system — which reduces economic vulnerability — as well as its better climate adaptation — which cushions against climate vulnerability. Future research may consider to expand the geographic scope of this paper and, in particular, focus more on developing countries where people are more likely to become cross-pressured by cross-cutting vulnerabilities (Gaikwad, Genovese, and Tingley 2022).

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# Appendix

Table A1: Cross-cutting vulnerabilities and public opposition to carbon taxes, with posttreatment variables added

| | (1) | (2) | (3) |
|---|---|---|---|
| Income insecurity | $0.123^{***}$ | $0.126^{***}$ | $0.142^{***}$ |
| | (0.014) | (0.012) | (0.016) |
| Climate susceptibility | $0.065^{**}$ | 0.047 | $0.067^{**}$ |
| | (0.029) | (0.032) | (0.029) |
| Income insecurity $\times$ Climate susceptibility | $-0.041^{***}$ | $-0.034^{**}$ | $-0.041^{***}$ |
| | (0.013) | (0.014) | (0.014) |
| Current income | $-0.028^{***}$ | $-0.020^{***}$ | $-0.023^{***}$ |
| | (0.005) | (0.005) | (0.004) |
| Education | $-0.080^{***}$ | $-0.075^{***}$ | $-0.070^{***}$ |
| | (0.009) | (0.007) | (0.007) |
| Age | $0.003^{**}$ | $0.003^{***}$ | $0.003^{**}$ |
| | (0.001) | (0.001) | (0.001) |
| Female | $-0.046^{*}$ | $-0.023$ | $-0.021$ |
| | (0.026) | (0.020) | (0.024) |
| Rural residency | $0.124^{***}$ | $0.129^{***}$ | $0.115^{***}$ |
| | (0.021) | (0.020) | (0.020) |
| Living with kid(s) | $0.077^{***}$ | $0.077^{***}$ | $0.074^{***}$ |
| | (0.011) | (0.011) | (0.008) |
| Ideology (left-right) | $0.061^{***}$ | | $0.050^{***}$ |
| | (0.013) | | (0.011) |
| Worried about climate change | | $-0.244^{***}$ | $-0.237^{***}$ |
| | | (0.029) | (0.031) |
| Obs | 24,891 | 27,562 | 24,418 |
| Country FEs | 20 | 20 | 20 |
| Sectoral FEs | 43 | 43 | 43 |
| Log likelihood | $-39,157.996$ | $-43,112.203$ | $-37,981.035$ |

Twoway-clustered SEs in parentheses; $^{***}p < 0.01$; $^{**}p < 0.05$; $^{*}p < 0.1$.

Table A2: Cross-cutting vulnerabilities and public opposition to carbon taxes, with single *Climate vulneralbility* indecies used separately

| | Coastal | Floods | Landslides | Wildfires |
|---|---|---|---|---|
| Income insecurity | $0.063^{***}$ | $0.078^{***}$ | $0.079^{***}$ | $0.073^{***}$ |
| | (0.014) | (0.008) | (0.012) | (0.009) |
| Climate susceptibility | $-0.006$ | $0.003^{**}$ | $0.004^{**}$ | $0.267^{**}$ |
| | (0.031) | (0.001) | (0.002) | (0.108) |
| Income insecurity × Climate susceptibility | 0.001 | $-0.002^{*}$ | $-0.002^{**}$ | $-0.084^{***}$ |
| | (0.011) | (0.001) | (0.001) | (0.031) |
| Current income | $-0.024^{***}$ | $-0.025^{***}$ | $-0.024^{***}$ | $-0.024^{***}$ |
| | (0.005) | (0.005) | (0.005) | (0.005) |
| Education | $-0.086^{***}$ | $-0.086^{***}$ | $-0.086^{***}$ | $-0.085^{***}$ |
| | (0.009) | (0.009) | (0.009) | (0.009) |
| Age | $0.004^{***}$ | $0.004^{***}$ | $0.004^{***}$ | $0.004^{***}$ |
| | (0.001) | (0.001) | (0.001) | (0.001) |
| Female | $-0.049^{**}$ | $-0.049^{**}$ | $-0.049^{**}$ | $-0.049^{**}$ |
| | (0.024) | (0.024) | (0.024) | (0.024) |
| Rural residency | $0.142^{***}$ | $0.141^{***}$ | $0.142^{***}$ | $0.140^{***}$ |
| | (0.022) | (0.022) | (0.021) | (0.022) |
| Living with kid(s) | $0.082^{***}$ | $0.082^{***}$ | $0.082^{***}$ | $0.082^{***}$ |
| | (0.015) | (0.015) | (0.015) | (0.015) |
| Obs | 28,150 | 28,150 | 28,150 | 28,150 |
| Country FEs | 20 | 20 | 20 | 20 |
| Sectoral FEs | 43 | 43 | 43 | 43 |
| Log likelihood | $-44,566.889$ | $-44,559.504$ | $-44,562.935$ | $-44,561.179$ |

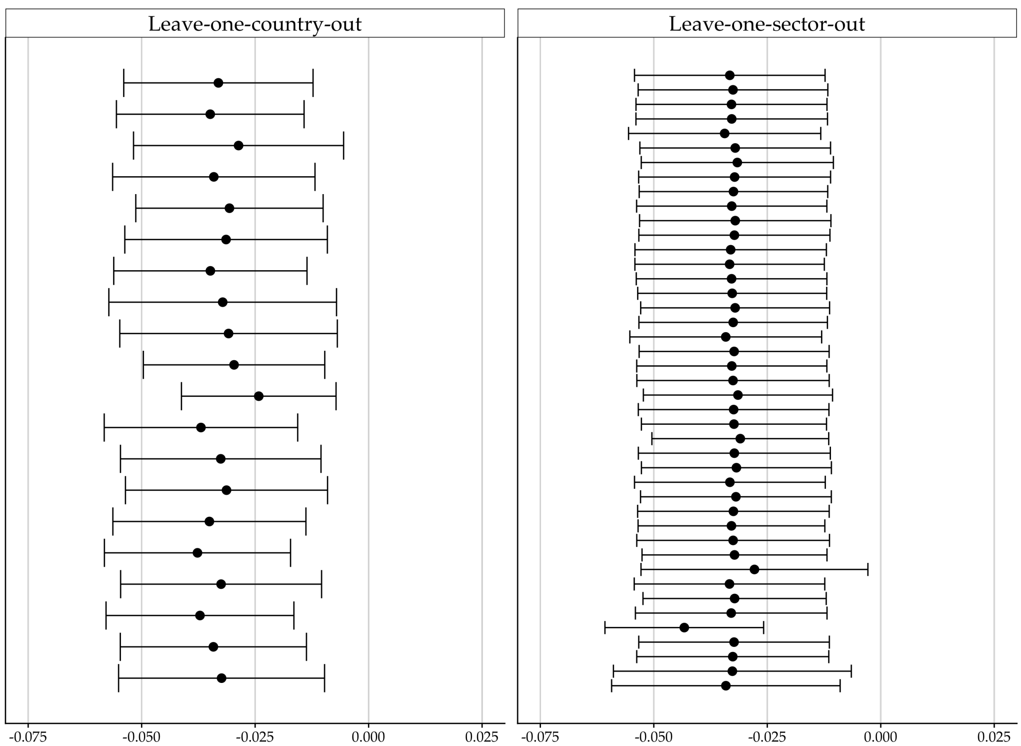
Twoway-clustered SEs in parentheses; $^{***}p < 0.01$; $^{**}p < 0.05$; $^{*}p < 0.1$.

Table A3: Cross-cutting vulnerabilities and public opposition to carbon taxes, estimation by logit model

| | Baseline | Multiplicative |
|---|---|---|
| Income insecurity | $0.104^{***}$ | $0.158^{***}$ |
| | (0.014) | (0.024) |
| Climate susceptibility | | $0.064^{*}$ |
| | | (0.035) |
| Income insecurity × Climate susceptibility | | $-0.046^{***}$ |
| | | (0.016) |
| Current income | $-0.036^{***}$ | $-0.036^{***}$ |
| | (0.005) | (0.005) |
| Education | $-0.132^{***}$ | $-0.132^{***}$ |
| | (0.007) | (0.007) |
| Age | $0.005^{***}$ | $0.005^{***}$ |
| | (0.001) | (0.001) |
| Female | $-0.068^{***}$ | $-0.066^{***}$ |
| | (0.023) | (0.023) |
| Rural residency | $0.214^{***}$ | $0.211^{***}$ |
| | (0.023) | (0.023) |
| Living with kid(s) | $0.112^{***}$ | $0.118^{***}$ |
| | (0.024) | (0.024) |
| Cut point (1\|2) | $-2.937^{***}$ | $-2.836^{***}$ |
| | (0.116) | (0.123) |
| Cut point (2\|3) | $-1.072^{***}$ | $-0.974^{***}$ |
| | (0.114) | (0.122) |
| Cut point (3\|4) | $-0.120$ | $-0.024$ |
| | (0.114) | (0.122) |
| Cut point (4\|5) | $1.211^{***}$ | $1.313^{***}$ |
| | (0.114) | (0.122) |
| Obs | 28,611 | 28,150 |
| Sectoral FEs | 43 | 43 |
| Log likelihood | $-42,728.552$ | $-42,024.177$ |
| Country FEs | 20 | 20 |

SEs in parentheses; $^{***}p < 0.01$; $^{**}p < 0.05$; $^{*}p < 0.1$.

Figure A1: leave-one-out iterative estimation




Point estimates of multiplicative interaction term with 90% CIs