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European solidarity in the green transition: Evidence from a conjoint experiment

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European solidarity in the green transition: Evidence from a conjoint experiment¹

Abstract

To fight climate change, the European Union has developed a new growth strategy to transform Europe into the first climate-neutral continent by 2050. However, EU climate change mitigation policies can be designed in different ways and have implications for the nature and intensity of European solidarity. Drawing on data from an original conjoint experiment fielded in Germany (N=5,796), this article investigates how policy design shapes public support for EU climate change mitigation. To this end, the study theoretically and empirically distinguishes four policy dimensions in public support: sectoral scope, social spending, financing structure and allocation principle. The results show that policy packages that target the renewable energy sector, include social investment policies, are financed by increasing taxes on the rich and allocate resources between EU member states based on population size are most supported. These findings shed light on the political viability of alternative EU climate change mitigation policy packages.

Keywords: climate change, public opinion, European Union, European solidarity

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Introduction

The European Union (EU) has emerged as a global leader in the fight against climate change, signing the 2015 Paris Agreement to keep global warming well below 2 degrees Celsius above pre-industrial levels and pursuing efforts to limit it to 1.5 degrees Celsius. Following this commitment, the EU has set an ambitious target of achieving climate neutrality by 2050, as outlined in the European Green Deal, which serves as the EU's new growth strategy (European Commission, 2019). As an intermediate target, the EU aims to reduce greenhouse gas emissions by at least 55% below their 1990 levels by 2030. Moreover, the European Climate Law enacted both the 2030 and 2050 EU climate goals in legislation. Such a significant reduction in emissions will require major shifts in the structure of the European economy. Therefore, the European Green Deal consists of a comprehensive policy package supporting EU member states in their green transition. For example, the Just Transition Mechanism provides targeted support in the most affected regions to alleviate the socio-economic impact of the transition (European Commission, 2022). However, EU-level climate-mitigation policies can be designed in various ways, and gaining citizens' support is crucial for the political viability of the European green transition.

Against this background, the current article expands our understanding of public support for European solidarity in the green transition. More specifically, it investigates public preferences for alternative EU climate change mitigation (ECCM) packages. While previous research has extensively examined Europeans' support for climate-mitigation policies at the national (Fairbrother et al., 2019; Hagen et al., 2016; Jagers et al., 2019; Maestre-Andrés et al., 2021; Savin et al., 2020; Wicki et al., 2019) and global levels (Bayer & Genovese, 2023; Bechtel et al., 2019, 2022; Bechtel & Scheve, 2013; Beiser-McGrath & Bernauer, 2019; Gampfer et al., 2014), surprisingly little attention has been paid to support for EU-level climate-mitigation policy (Janik et al., 2021; Panarello & Gatto, 2023). To address this research gap, this study theoretically and empirically differentiates four key dimensions of public support that speak to distinct debates about policies aimed at supporting EU countries' transition to climate-neutral economies: sectoral scope, social spending, financing structure and allocation principle. Distinguishing these four concrete policy dimensions enables to scrutinise public preferences towards diverse manifestations of European solidarity in the green transition.

I. Policy design: Sectoral scope, social spending, financing and allocation

There are many ways in which EU climate change mitigation policies can vary, but not all those are discussed on the EU agenda. Furthermore, citizens are not equally sensitive to all policy issues. Therefore, I focus on four key policy dimensions that are highly relevant to political support for EU climate change mitigation policy, based on research of public opinion towards climate mitigation and European solidarity (Baute & de Ruijter, 2021; Bechtel et al., 2014; Beiser-mcgrath & Bernauer, 2021; Bergquist et al., 2020; Brannlund & Persson, 2012; Gerhards et al., 2019; Heermann et al., 2022; Tatham & Peters, 2022) and on EU climate policymaking debates (European Commission, 2022; European Parliament, 2020; Kyriazi &

Miró, 2022). These four dimensions outlined below speak to distinct and important debates about policies aimed at supporting European countries in their transition to low-carbon societies.

A first question concerns which economic sectors should receive financial support (Hainsch et al., 2022). The renewable energy sector plays a key role in the transition towards greener economies as it directly affects the supply of green energy (Milek et al., 2022). Support for the development of the renewable energy sector can include subsidies for research and development of green technologies as well as support for companies that produce and distribute renewable energy sources, such as solar and wind energy. However, a much broader approach would consist of supporting all economic sectors to reduce the emission of greenhouse gases (Wolf et al., 2021). For example, emissions can be curbed by supporting the transition of the car industry to electric mobility. Likewise, investing in construction and renovation, ensuring that new buildings are energy efficient and retrofitting old buildings can substantially reduce emissions from residential heating.

A second issue at stake is what role social policies should play in the transition towards climate-neutral economies and the mitigation of its social consequences (Kyriazi & Miró, 2022; Laurent, 2020; Sabato & Fronteddu, 2020; Schoyen & Hvinden, 2017). Adequate social benefits can cushion the impact of job losses through their compensatory effect given that numerous jobs in the fossil fuel industry, for instance, are threatened by the green transition. Hence, the EU programme could support national governments with their expenses for *unemployment benefits*. An alternative approach consists of social investment policies, supporting *training programmes* for new jobs that have been or are likely to be created and providing up- and re-skilling programmes for workers who become unemployed. Such programmes reduce the skill gap between the jobs created and those abandoned as a result of the green transition. While unemployment benefits and (re)training programmes focus both on the labour market, inequality in the wider population can be addressed through *subsidies to low-income people*. Such redistributive policies enable a more inclusive green transition by taking into account the fact that low-income groups spend higher shares of their income on energy consumption (Carley & Konisky, 2020) and have fewer resources to improve housing energy efficiency.

A related but distinct issue in the policy debate concerns how the green transition should be financed. *Cutting expenditures* in other areas of the public budget would release resources without raising taxes. In the context of an EU fund, this implies that existing money from the EU budget is being redirected towards the green transition rather than collecting fresh money. A second financing option consists of *increasing taxes on fossil fuels*, such as oil, coal and gas. This option adheres to the ‘polluter-pays principle’, which asserts that those responsible for greenhouse gas emissions should shoulder the costs associated with policies aimed at preventing potential harm resulting from the effects of climate change. Third, resources could be generated by *increasing taxes on the rich*. The rich have a higher ability to pay for better public goods, and a growing body of empirical research shows that higher-income groups emit more greenhouse gases than the poor (Barros & Wilk, 2021; Büchs & Schnepf, 2013; Chancel, 2022; Papathanasopoulou & Jackson, 2009; Weber & Matthews, 2008). Hence, a wealth tax combines economic (‘ability-to-pay’) and environmental (‘polluter-pays’) rationales. Yet

another financing option consists of *increasing public debt*, putting a higher burden on future generations as the money spent on climate change mitigation policy will have to be paid back later on.

Finally, EU climate-mitigation policies can vary in how they distribute financial resources across EU member states (Colli, 2020; Kyriazi & Miró, 2022). If all EU member states are allocated an *equal amount per inhabitant*, the population size of countries is accounted for. By contrast, allocation on the basis of economic development takes into account the spending capacities of each state installing redistribution *from richer to poorer* EU member states. Alternatively, countries' carbon intensity, either regarding emissions or employment, can serve as an allocation principle. *Emission-based allocation* provides more generous support to countries with higher emissions of greenhouse gases to facilitate the transformation of their energy landscape and enable them to abandon fossil fuels faster. To mitigate the consequences of the green transition on labour markets in particular, *employment-based allocation* could provide more generous support to countries with higher shares of employment in high-emission industries.

II. Research design

II.1. Data

To examine how policy design shapes public preferences for ECCM, an original conjoint experiment was designed and preregistered at the AEA RCT Registry under #AEARCTR-0010463. The conjoint survey experiment was fielded between 11 January and 30 January 2023 in Germany. Data collection was conducted by the survey company IPSOS based on their online access panel. Quotas for age, gender, education and regional distribution were applied (with cross-quotas between age and gender) to ensure that the sample was representative of the demography of the general population aged 18–75 years. Informed consent was obtained from all participants. Respondents who did not pass the IPSOS quality checks were excluded from the sample. This includes respondents who completed the survey three times faster than the median click speed (based on the number of responses per minute, $N = 82$) and respondents who are identified as straight liners (giving identical responses on all items of at least one grid while completing the survey two times faster than the median click speed, $N = 212$). I additionally excluded respondents with item nonresponse on at least 30% of the questionnaire ($N = 5$) and those who participated in the pre-test ($N = 200$). This resulted in a total sample of 5,796 respondents. Germany is a particularly interesting and relevant case for this study since it is the largest economy and emitter of greenhouse gases in the EU (European Environment Agency, 2023) while having strong capacities to act as a donor country for European solidarity.

II.2. Measurements

Conjoint experiments have become widely used to study public preferences on policy designs (Burgoon et al., 2022; Gallego & Marx, 2017; Hahm et al., 2020; Hainmueller et al., 2014; Häusermann et al., 2019; Knotz et al., 2021; Leeper et al., 2020; Vanhuyse et al., 2021). In this conjoint experiment, respondents first received general information on the aim of EU-level policies for climate change mitigation (see Supplementary Table 1) and evaluated three pairs of multi-dimensional packages. Each package comprised the four policy dimensions outlined above (see Table 1) with varying, randomised levels. The dependent variable, support for EU climate change mitigation policy, is measured by two variables. First, after being presented a side-by-side pairing of policy packages, respondents were asked which package they preferred. Supplementary Figure 1 shows an example of the conjoint experiment. This yields a binary variable Choice ECCM for package choice. Second, respondents were asked to rate each of the presented packages on a five-point scale ranging from ‘strongly against’ to ‘strongly in favour’. This question was asked for each of the packages, irrespective of the response to the preceding binary-choice question, in which respondents had to identify the package they favoured most. For the models reported in this article, this rating variable was recoded into binary variables: Support ECCM, where 1 equals somewhat or strongly favouring a package and 0 equals somewhat or strongly opposing or being neutral towards a package, and Support versus Oppose ECCM, where 1 equals somewhat or strongly favouring a package, 0 equals somewhat or strongly opposing it, and neutrals are censored out. I excluded respondents who gave more than one inconsistent response in their package rating and choice of package (e.g. choosing package 1 over package 2 in a pairing while rating package 2 higher than package 1) and who failed an attention check. This removed 14.20% of the respondents and resulted in a final sample size of 4,973 respondents that is analysed in this study.

The conjoint experiment includes four varying policy dimensions, summarised in Table 1. The first dimension concerns the sectoral scope of the programme, featuring two possibilities, namely, financial support for the renewable energy sector only versus a wider scope providing support to all sectors where emissions can be reduced. The second dimension concerns the social spending side of the programme. Packages that do not include additional support for social programmes are contrasted with those that support either unemployment benefits, training and retraining of workers or subsidies to low-income households. The third dimension defines the financing structure of the programme. Here, I distinguish between spending cuts in other areas of the public budget, increasing taxes and fossil fuels such as oil, gas and coal, raising taxes on the rich and increasing public debt to be paid back in the future. The final dimension concerns how resources should be distributed across EU member states and differentiates four allocation principles. The programme could either provide an equal amount of funding per inhabitant, provide more generous support to poorer countries, to countries with higher emissions or to countries with a higher share of the labour force working in high-emission industries.

Table 1: Conjoint matrix of policy packages

Policy dimension	Attribute description	Policy features
Sectoral scope	Which sectors can receive financial support?	<ul style="list-style-type: none"> - Support for the development of the renewable energy sector - Support for all sectors to reduce emissions
Social spending	Which social programmes can receive additional financial support?	<ul style="list-style-type: none"> - No additional social programmes - Support for unemployment benefits - Support for training and retraining of workers - Subsidies for low-income households
Financing	How is the programme funded by EU countries?	<ul style="list-style-type: none"> - By cutting expenditures in other areas of the public budget - By increasing taxes on fossil fuels such as oil, gas and coal - By increasing taxes on the rich - By increasing public debt that will have to be paid back in the future
Allocation	How is financial support distributed between EU countries?	<ul style="list-style-type: none"> - Each country receives the same amount per inhabitant - Poorer countries receive more - Countries with higher emissions receive more - Countries with more employees in high-emission industries receive more

II.3. Statistical modelling

Following the standard approach of conjoint-experimental analysis (Hainmueller et al., 2014), the baseline models are ordinary least squares (OLS) regression estimations with standard errors clustered by respondent to correct for the possibility of non-independence of outcomes from the same respondent. I control for a package's pairing order, which is the round (first, second or third) in which the policy package is shown to the respondent. In addition, all models control for basic demographics, including age, gender, education (distinguishing lower secondary or less, upper-secondary and post-secondary non-tertiary, and tertiary education) and net household income. The OLS regression estimates are summarised in Supplementary Table 2. Figure 1 displays the resulting AMCEs for both the choice (Choice ECCM) and binary rating (Support ECCM) variables, which can be interpreted as the average difference in the probability of a package being chosen or supported when comparing two different attribute values – for example, a package with support for unemployment benefits versus a package with no social programmes – where the average is computed based on all

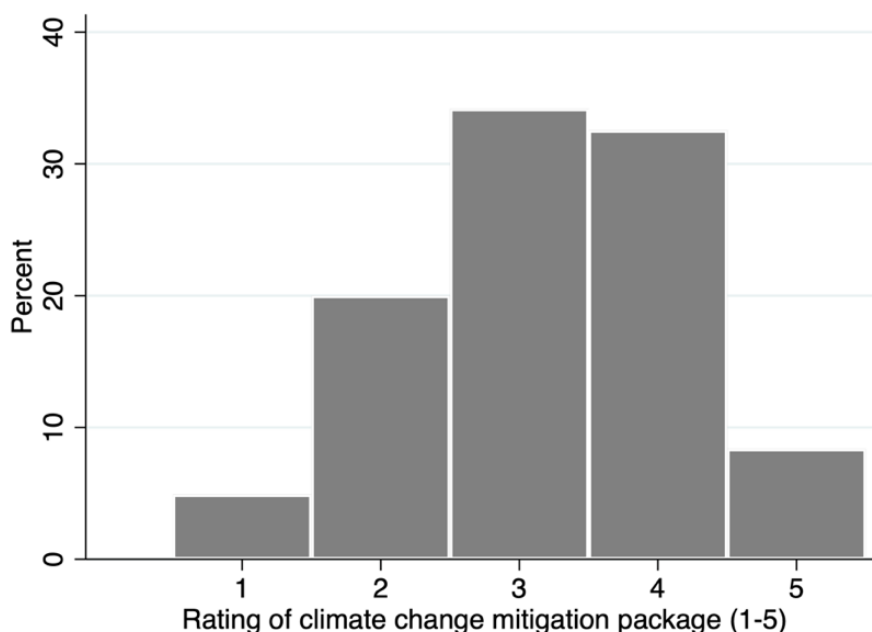
possible combinations of the other attributes in the conjoint experiment. I discuss the AMCEs of the choice variable in the article since it forces respondents to think more carefully about trade-offs. However, the models yield similar results using the binary rating variable, providing evidence for the robustness of the findings.

III. Results

III.1. Overall support for EU climate change mitigation

Since respondents rated each climate change mitigation policy on a 5-point Likert scale, the data contains information about the average level of support across policy proposals. Figure 1 displays overall support for ECCM policy across respondents and packages. About 41 percent of the packages is somewhat (33%) or strongly (8%) supported, while 25 percent of the packages is somewhat (20%) or strongly (5%) opposed. About 34 percent of the packages received neutral responses. These figures indicate moderate baseline support for ECCM policy. While Figure 1 shows the overall distribution of ratings across all respondents and the total set of 128 policy packages, Supplementary Figure 2 displays the distribution plots of the ratings by sectoral scope, social spending, financing and allocation.

Figure 1. Distribution of ratings across all conjoint packages (ranging from 1 = strongly against to 5 = strongly in favour).



III.2. Effects of policy features

What policy features do citizens prefer when it comes to EU climate change mitigation policy? Figure 2 plots the average marginal component effects (AMCEs), which gauge the causal effect of a given attribute value on the probability that a package is chosen or supported relative to the baseline attribute value. The figure shows that the sectoral scope of policy packages matters for public support. Packages that provide financial support for all sectors to

reduce greenhouse gas emissions are, *ceteris paribus*, 4 percentage points less likely to be chosen than packages that target support to the renewable energy sector exclusively. Different rationales may lie behind this observation. Citizens may, for example, prioritise the development of the renewable energy sector because they consider it an essential driver of the green transition, perceive it as beneficial to job creation or want to speed up the transition to renewables to become independent of (Russian) fossil fuels since domestic energy security has become intensely debated in the context of rising energy prices following Russia's invasion of Ukraine.

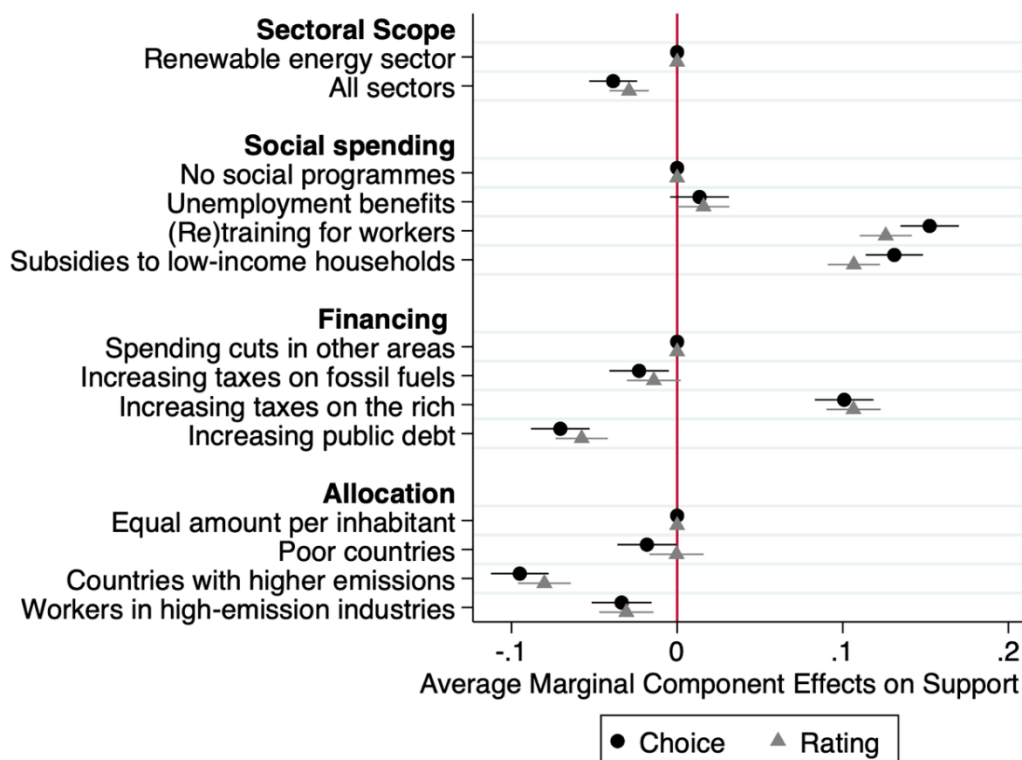
The effect of social programmes varies depending on the type of social spending. Social investment policies that provide support for (re)training of workers are the most favoured; this feature increases the likelihood that a package is chosen by 15.23 percentage points. The appeal of compensatory policies, meanwhile, depends on the target group. Supporting unemployment benefits as a form of compensatory policy has no effect on package selection, whereas providing subsidies to low-income households increases the likelihood that a package is chosen by 13.11 percentage points. These results suggest that low-income individuals are perceived as more deserving of support than the unemployed.

Furthermore, citizens' support is conditional on how the EU programme is financed. Here, all coefficients must be interpreted relative to the baseline of cutting public spending in other areas. While packages that increase taxes on fossil fuels are somewhat less popular, those that impose higher taxes on the rich are 10.09 percentage points more likely to be chosen. Thus, the effect of tax hikes depends on the tax structure. Interestingly, respondents prefer intersectoral transfers (i.e. cutting public expenditure on other programmes) to intertemporal ones (i.e. increasing public debt, which would have to be repaid in the future). The latter option reduces the likelihood that a package is chosen by 7.1 percentage points. This finding may signal a persistent aversion among citizens to EU governments incurring public debt following the Eurozone crisis, which illustrated the negative consequences of accumulating sovereign debt.

Finally, citizens are sensitive to the allocation principle for distributing resources across EU member states. Effects are compared to programmes allocating an equal amount per inhabitant. The likelihood of choosing a policy package drops by 9.5 percentage points if the package provides more resources to countries with higher levels of emissions and by 3.4 percentage points if it provides more generous support to countries with larger shares of their workforce active in high-emission industries. This points to a challenge for the EU. While cutting greenhouse gas emissions is at the core of the European Green Deal, targeting EU funds at the most polluting member states is by far the least-supported policy choice. This suggests that German citizens may fear that carbon-based allocation will give rise to moral hazard, a situation in which countries do not suffer from their (in)actions. In such case, respondents assume that receiving countries lack the incentive to reduce their emissions because they are financially supported by the EU programme for their carbon intensity. Interestingly, redistribution towards poorer member states is relatively more accepted than redistribution towards higher-emission countries, which provides new insights into which deservingness rationales shape European solidarity. This matters because allocation based on

emissions results in a different ranking order of EU member states than allocation based on economic wealth.

Figure 2. Average marginal component effects (AMCEs) of policy attribution based on Support package (Binary) and Choice package (Binary).



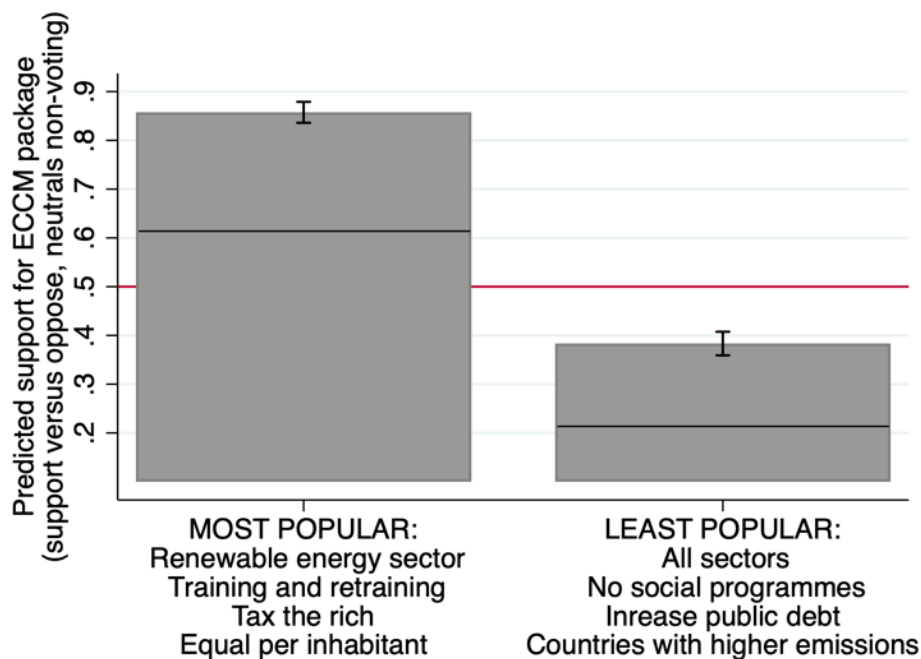
Note: Effects of policy features on the probability of choosing a package (black circles) or supporting a package (grey triangles). Horizontal bars indicate 95% confidence intervals; points without bars denote the reference category for each policy dimension. Estimations based on models in Supplementary Table 2.

III.3. Support for policy packages

While Figure 2 clarifies the effects of policy features on support across the dimensions, policy packages consist of a combination of attributes. Therefore, it is relevant to explore predicted support for policy packages that combine certain policy features concerning the sectoral scope, social spending, financing and allocation. Which policy mixes leverage the most and least support? Figure 3 depicts predicted voter support for the most and least popular policy packages. The grey bars represent the proportion of respondents who somewhat or strongly support climate change mitigation. This share assumes that all neutral answers can be ignored or presumed to not vote or be split evenly between supporters and opponents. It is important to note that these estimates are rough metrics since neutrals may not necessarily stay home on an election day or split evenly between supporters and opponents. To address the possibility that neutrals may alter the picture, the solid horizontal lines on each bar illustrate what the result would be if all neutrals voted against the package. Although this scenario is unlikely, it provides a good low-floor estimate for this purpose. The results can be judged relative to a 50% vote threshold necessary for a majority-rule vote.

The most popular package is supported by 86% of the sample and combines financial support for the renewable energy sector, (re)training of workers, tax increases for the rich and allocation based on the same amount per inhabitant for all EU countries. Even if we assume that all neutrals would vote against the package, it still receives support from 61% of the sample. By contrast, the least-supported package – providing support to all sectors while excluding social programmes, increasing public debt and allocating resources based on emissions – does not have majority support in either the high (38%) or low (21%) estimate predictions. These findings highlight how important policy design is in shaping public opinion on EU-level climate change mitigation.

Figure 3. Predicted vote for most and least popular EU climate change mitigation (ECCM) packages.



Note: Bars show the results of high-estimate support based on Support versus Oppose ECCM (1 = somewhat or strongly in favour of EURS; 0 = somewhat or strongly against; missing = neutral). Horizontal lines show low-estimate support based on Support ECCM (binary) (1 = somewhat or strongly in favour; 0 = neutral or somewhat or strongly against). Estimations based on Models 2–3 in Supplementary Table 2.

Of specific interest are policy designs that are most effective in fighting climate change while minimising political and social conflict (Kallbekken, 2023). Therefore, Figure 4 models a set of packages that are informative of how two identified obstacles to European solidarity in the green transition, namely, concerns about increasing costs and moral hazard, can be overcome.

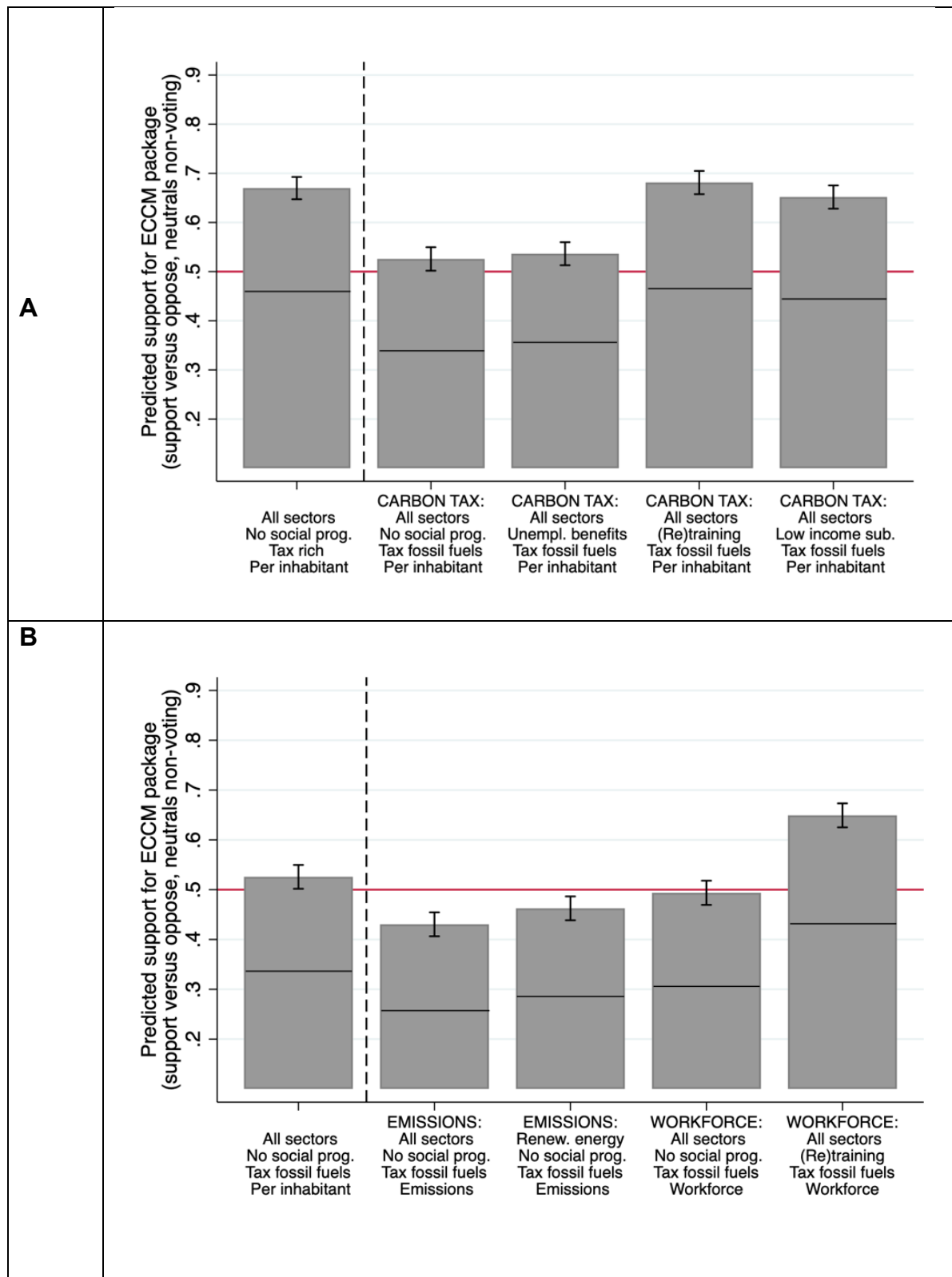
Panel A of Figure 4 explores whether the unpopular tax increase on fossil fuels – creating greater incentives to adjust behaviour – can be compensated by social programmes that support the workers and households that are most adversely affected by the green transition. As a reference, support levels are compared to a package that is financed by a tax hike for the rich without including social programmes. Support decreases from 67% to 53% if the

financing structure changes from a wealth tax to a carbon tax, respectively.² However, when the latter package includes support for social investment policies or income subsidies, support levels recover to 68% and 65%, respectively, which equals the reference package consisting of the popular wealth tax without social programmes. Thus, increasing taxes on fossil fuels is not necessarily the least favourable policy choice. The decisive factor is whether and how this choice is combined with social policies.

Panel B of Figure 4 provides insights into the possibility of overcoming *moral hazard* concerns towards climate laggards by conditioning EU funds on the economic and social spending scope of the programme. It presents support levels for selected packages that redistribute funds to countries with higher carbon intensity, which can be compared to a reference package where each EU member state receives an equal amount per inhabitant. Can sectoral targeting build trust? Even when the spending of the funds is conditioned on the renewable energy sector, programmes redistributing to high-emission countries remain significantly less popular. Although sectoral targeting could help the most polluting countries reduce their emissions, the compensating impact on support is minimal. In addition, Panel B also models packages that redistribute to countries with more people active in high-emission industries. Social investment policies can be particularly effective in achieving the required labour market transformations in these countries. The results show that such a policy mix is well received since (re)training programmes outweigh the negative effect of employment-based allocation on support levels.

² These percentages correspond to the high-estimate predictions, treating neutral responses as missing. If the neutrals vote against the package, the percentages equal 46% and 34%, respectively (see horizontal lines in Figure 4a).

Figure 4. Predicted vote for selected climate change mitigation (ECCM) packages



Note: Bars show results of high-estimate support based on Support versus Oppose ECCM (1 = somewhat or strongly in favour of EURS; 0 = somewhat or strongly against; missing = neutral). Horizontal lines represent low-estimate support based on Support ECCM (binary) (1 = somewhat or strongly in favour; 0 = neutral or somewhat or strongly against). Estimations based on Models 2–3 in Supplementary Table 2.

Discussion

EU leaders aspire to make Europe the first climate neutral continent by 2050. To this end, the European Green Deal consists of a comprehensive policy package supporting EU member states in their shift towards a climate-neutral economic model. However, to date, no scientific knowledge exists on how policy designs shape public support for EU-level climate change mitigation policy. Drawing on data from an original conjoint survey experiment, the current study analysed the causal effects of four key policy dimensions – sectoral scope, social spending, financing and allocation – using a sample of the German population. The key finding is that public support for climate-mitigation policies at the EU level is conditional and relies heavily on policy design. German citizens generally prefer packages that target support at the renewable energy sector, include social investment policies, are financed by increasing taxes on the rich and allocate resources between EU member states based on an equal amount per inhabitant.

The analyses also consider how respondents think about concrete policy packages with features that can address key worries that commonly shape attitudes towards European solidarity, notably increasing costs and moral hazard (Baute et al., 2021; Beetsma et al., 2022; Burgoon et al., 2022; Heermann et al., 2022). Although raising taxes on fossil fuels is generally not favoured, the package modelling analysis demonstrates that its negative effects can be offset by supporting (re)training programmes or subsidies to low-income households. While carbon taxation is considered an effective instrument in the fight against climate change, its political success will thus depend on how this measure is complemented with social programmes that support the most vulnerable members of society. Furthermore, the relatively unpopular carbon-based mode of allocation points towards concerns about polluting member states being rewarded for their inaction on climate change by profiting from EU funding without making efforts to decarbonise. The results suggest that concerns about such moral hazard can be outweighed by concrete labour market policies (i.e. (re)training programmes) that help countries on their path towards a climate-neutral economic model. Although the present study included only a selection of possible strategies that EU policies could adopt to guarantee a return on investment, it highlights the importance of careful policy packaging for constructing public support for EU climate policy. These findings resonate with opinion research on climate policies at the national (Amdur et al., 2014; Bergquist et al., 2020; Wicki et al., 2019) and global levels (Bechtel et al., 2022; Bechtel & Scheve, 2013; Gampfer et al., 2014).

The analysis has certain limitations that warrant highlighting. First, it can be worthwhile to explore in even greater detail the policy mixes considered in this study to reflect the complex policy options of European governments. For instance, the social spending dimension of the conjoint experiment did not include the combination of compensatory and social investment policies. Similarly, further exploration of policy mixes concerning allocation principles is recommended. While allocation based on population size, economic wealth, emissions and workforce were disentangled from one another, combinations of these principles may yield different preference patterns. Second, the political viability of EU climate-mitigation policies depends on whether majority support can be found not only within societies but also across EU member states. A potential European North-South gradient in climate change vulnerability

and varying adaptive capacities may shape public attitudes. Therefore, a major endeavour for future research is to explore cross-national variation in public preferences for EU climate change mitigation policies. Nevertheless, the analysis provides important insights for understanding support for European solidarity in the green transition. By scrutinising the impact of sectoral scope, social spending, financing and allocation principles, the current study illustrates how public support for the green transition is conditional on its institutional design.

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