Long-Run Trends in Partisan Polarization of Climate Policy-Relevant Attitudes Across Countries

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We summarize long-run trends in partisan polarization of voters' climate policy-relevant attitudes across thirty-six countries and multiple decades (1993-2020). We find substantial growth in partisan polarization of these attitudes in the US, other Anglophone countries and much of Western Europe, but not elsewhere. Comparing Western European to Anglophone countries, partisan polarization is more prominent on different climate policy-relevant attitudes, and primarily involves supporters of different party types. Observed partisan polarization patterns are not well explained by changes in either linkage to economic ideology or levels of general societal disagreement on climate policy-relevant questions. Growing partisan polarization does not generally reflect all partisan groups becoming more accepting of climate reform yet diverging because of differing rates of change. Instead, what disagreements there are on these matters have become increasingly tied to party support. Our findings highlight the increasing difficulty of achieving sustained political consensus for effective climate reform across many countries.

Keywords: polarization, climate attitudes, public opinion, ISSP

Introduction

Scientists agree that human activity is causing climate change and that limiting global temperature rises requires rapid and major transformations to economy and society across many countries (IPPC, 2022). Transformations on this scale depend upon far-reaching policy reforms (Kuramochi et al., 2018; Jordan et al., 2022) which are only likely

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to be implemented—and, crucially, to *endure*—in the presence of broad social and political support (e.g., Clayton, Pidgeon and Whitby, 2006; Bechtel and Scheve, 2013; Poortinga et al., 2018). From this perspective, increasing partisan polarization of public attitudes relevant to climate policy—which occurs when such attitudes become more strongly associated with support for different political parties—has the potential to inhibit climate reforms. The more different political parties rely on support from groups of voters who differ systematically on questions relevant to climate policy, the more difficult it becomes to build stable consensus for effective climate reforms among policymakers representing these different sets of voters (McCright and Dunlap, 2011; Pidgeon, 2012). Furthermore, when voters' disagreements on climate policy-relevant issues become aligned with broader political divides, this can lead to resistance to new information and entrenchment of climate-related disagreements (Hoffman, 2015).

Motivated by these concerns, this paper provides a new summary assessment of the extent to which public attitudes relevant to climate policy have become polarized along partisan lines in different countries. Our analysis builds on a growing number of cross-national studies of the political polarization of climate attitudes, and has several features which yield new insights concerning patterns of such polarization over time and across countries.

First, while existing studies tend to compare levels of political polarization across countries at a particular time, this paper draws on International Social Survey Programme (ISSP) data to chart long-run *trends* in partisan polarization of climate policy-relevant attitudes across 36 countries from 1993 to 2020.[1] This matters because political polarization is often seen as a longitudinal process where political divides become more

[1] Birch (2020) models determinants of ideological polarization of environmental attitudes over time and across countries, but does not explicitly study polarization levels or trends.

substantial over time (DiMaggio, Evans and Bryson, 1996; McCright et al., 2016). Indeed, there tends to be more agreement about whether a political system is polariz*ing* as opposed to what constitutes high or low levels of polarization (Fiorina and Abrams, 2008). Our analysis shows in which countries political divisions relevant to climate policy have grown, by how much, and to what levels. Furthermore, whereas most existing comparative studies provide evidence on climate polarization in the early or mid 2010s, our analysis of comparative data up to 2020 allows us to document how polarization has changed in the years following the 2015 Paris Agreement, which have also witnessed continued growth of many right populist parties (Norris and Inglehart, 2019; Zulianello and Larsen, 2021).

Second, our analysis examines partisan polarization not just of climate concern, the focus of most existing cross-national polarization studies, but also support for costly environmental protection measures, which we believe is the best available proxy in long-term cross-national surveys for peoples' willingness to support costly policies to reduce *climate change*. We argue that polarization of this latter type of attitude is important because popular acceptance of potentially costly and disruptive climate reform depends not only on levels of climate concern. In some countries, climate discourse has increasingly focused not just upon the threat of climate change *per se*, but also upon the policies implemented to achieve climate targets (Coan et al., 2021). For example, in September 2023 the British government delayed the implementation of climate measures, stressing that whilst they believed in and remained committed to combating climate change, the measures would entail unacceptable costs (Prime Minister's Office, 2023). We therefore analyse polarization of both climate concern and support for costly environmental protection—which we refer to collectively as *climate policy-relevant attitudes*.

Third, our analysis uses a new flexible measurement strategy to better study partisan polarization across countries with varying party systems. As explained below, we provide

a simple summary measure of partisan polarization on a given climate policy-relevant attitude in a given country and year: the adjusted R^2 that results when we subset the survey data to that country-year and regress responses to the attitude question on indicators for party support. Whereas existing cross-national studies tend to capture partisan polarization of climate attitudes only to the extent that it operates along left-right ideological lines, our approach captures the overall strength of association between party support and climate policy-relevant attitude while making minimal assumptions about *how* attitudes differ across supporters of different party types. It also allows us to benchmark partisan polarization on climate policy-relevant attitudes against polarization on economic attitudes that are traditionally thought to structure political competition.

Our analysis shows that there has been a substantial growth in partisan polarization of climate policy-relevant attitudes—both over time and relative to partisan polarization of economic attitudes—in the US, in other Anglophone countries and also in many Western European countries, but not elsewhere. Among those countries where partisan polarization of climate policy-relevant attitudes has grown, we find important differences in terms of dynamics. In the US and other Anglophone countries, voters' levels of climate concern have polarized substantially along party lines, and this tends to involve polarization among supporters of mainstream political parties. In Western European democracies, voters' willingness to support costly environmental protection has polarized more substantially along party lines, and this seems to be driven primarily by niche (green and right populist) party supporters.

Our analysis also contributes several findings which illuminate the implications of observed climate polarization dynamics. First, while countries experiencing partisan polarization of climate policy-relevant attitudes have also tended to experience *ideological* polarization of such attitudes along economic lines, this ideological polarization is in most cases less pronounced than partisan polarization. This suggests that parti-

san polarization of climate policy-relevant attitudes has often emerged through mechanisms other than the linkage of free market ideology with aversion to state-led climate reforms. Second, variation in partisan polarization of climate policy-relevant attitudes is not well explained either by variation in how dispersed such attitudes are in a society, nor by variation in average levels of such attitudes in a society. This suggests that partisan polarization of climate policy-relevant attitudes does not reflect increases in basic disagreement on climate issues in a society, nor voters in a country becoming progressively more or less receptive to climate action on average. Rather, partisan polarization of climate policy-relevant attitudes seems to reflect an increasing politicization of existing disagreements on climate policy-relevant questions. Together, our findings point toward the increasing difficulty of creating a broad-based, sustainable political consensus for effective climate reforms in many advanced economies.

Literature Review

We consider partisan polarization of climate policy-relevant attitudes as occurring to the extent that attitudes on climate policy-relevant questions become more strongly associated with support for different political parties. In terms of the foundational four-dimensional conceptualization of polarization set out by DiMaggio, Evans and Bryson (1996), partisan polarization is an example of 'consolidation', which occurs when attitudes on a topic become more strongly associated with membership of salient social groups, either because average attitudes of each group move apart, because attitudes within each group become more homogeneous, or both (DiMaggio, Evans and Bryson, 1996, 698). In the case of partisan polarization, attitudes on a topic become 'consolidated' according to party support, an explicitly political grouping. As such, partisan polarization is one type of *political* polarization, alongside *ideological polarization*, which occurs when people's attitudes on a topic become more strongly associated with their

more general political ideology, and therefore with other attitudes. Ideological polarization corresponds to the dimension of polarization which DiMaggio, Evans and Bryson (1996) label 'constraint'.[2]

Much existing research on the political polarization of mass climate attitudes focuses on the US (McCright et al., 2016), where there is rich longitudinal evidence of increased polarization. Starting in the 1990s, Americans' climate attitudes have become more strongly associated with their partisanship and ideology, due to Republican supporters and conservatives becoming progressively more skeptical about climate change and action (McCright and Dunlap, 2011; Dunlap, McCright and Yarosh, 2016), and latterly also to Democrats and liberals becoming more climate-concerned (Smith and Hempel, 2022). This increasing polarization has been attributed to the influence of elites' climate denial campaigns upon Republican supporters (Tesler, 2018; McCright and Dunlap, 2011) as well as to the "free market" ideology common among conservatives and Republicans (McCright and Dunlap, 2011; McCright, 2011). There is also evidence that partisan polarization on climate issues has increasingly led to polarization of Americans' general environmental attitudes, as people come to think of environmental issues primarily in terms of climate change (Egan, Konisky and Mullin, 2022).

To what extent is the US experience of political polarization of climate attitudes generalizable? In favour of generalizability, country-specific studies do document associations between climate attitudes and party support and/or ideology in Australia (Tranter, 2013), Canada (Lachapelle, Borick and Rabe, 2012), Switzerland (Lüth and Schaffer, 2022) and Britain (Kenny, 2022). Meanwhile, analyses of pan-European surveys also document such associations in several Western European countries, although not in Eastern Eu-

[2]The two remaining dimensions of polarization in DiMaggio, Evans and Bryson (1996) ('dispersion' and 'bimodality') do not directly concern connections between political attitudes.

ropean ones (Fisher et al., 2022; McCright, Dunlap and Marquart-Pyatt, 2016). Yet differences in measures and modelling approaches make it difficult to compare the strength of associations found in these studies with those found in studies of the US. Tranter and Booth (2015) overcome some of these difficulties by analysing cross-national surveys which harmonize attitudinal measures across a range of 14 advanced industrialised countries including the US, and show that support for more 'right'-leaning political parties is statistically significantly associated with lower climate concern across many of these countries. Yet they focus less on how the magnitude of this association varies across countries, leaving open the question of whether polarization is less intense outside of the US.

Those cross-national studies which span multiple international regions *and* which more directly compare the magnitude of polarization of climate attitudes across countries tend to conclude that substantial polarization is geographically confined rather than generalizable. First, some argue for *US exceptionalism*, finding that substantial ideological polarization of climate concern (Tesler, 2018) and skepticism (Hornsey, Harris and Fielding, 2018) is unique to the US.[3] Second, others argue for *Anglophone exceptionalism*, finding that ideological and partisan polarization of climate concern is more substantial in a set of Anglophone countries which includes the US alongside Australia, Britain, Canada and New Zealand (Lewis, Palm and Feng, 2019; Smith and Mayer, 2019).

Yet the cross-national analyses underpinning these accounts leave open important questions about the nature and extent of political polarization of attitudes relevant for climate policy across different countries. First, because these studies are cross-sectional, they leave open the question of how political polarization has changed over time. Second, because they focus on data from the mid-2010s at the latest, the studies

[3]McCright et al. (2016, p.182) draw similar conclusions in their systematic literature review.

also leave open the question of how political polarization has evolved in recent years, as more ambitious international climate agreements have enhanced the salience of climate policy debates (Raiser et al., 2020), and as right populist political actors (Norris and Inglehart, 2019; Zulianello and Larsen, 2021), who tend to oppose ambitious climate reforms (Lockwood and Lockwood, 2022) and green parties (Hoffmann et al., 2022), who tend to advocate for ambitious reforms, have both become increasingly electorally successful. Third, because these cross-national studies focus on political polarization of climate concern, they leave open the question of whether countries have experienced political polarization of other attitudes plausibly relevant for receptiveness to ambitious climate reforms. Finally, because these studies operationalize partisan polarization as the degree to which climate concern is associated with left-right party positions, they do not tell us whether countries have experienced partisan polarization of climate-related attitudes beyond that which operates via left-right party positioning. Our analysis contributes by addressing these open questions.

Methods and Data

Data

We use data from all four ISSP Environment Modules to date (ISSP Research Group, 2022).[4] The ISSP collects high quality social survey data using comparable methods across countries. Fielded in 1993, 2000, 2010 and 2020, the ISSP Environment modules measure respondents' climate policy-relevant attitudes as well as the political parties they support. Our analysis focuses on the 36 countries which feature in at least two ISSP Environment Modules. We incorporate survey weights into our analysis where available.

[4]Ethical approval for our secondary analysis from Durham University reference: SGIA-2024-0301-293.

Table 1: Climate policy-relevant attitude items in the ISSP data

Variable	Item wording	Item type
grhseff2	In general, do you think that a rise in the world's temperature caused by the 'greenhouse effect'/climate change is extremely dangerous for the environment, very dangerous, somewhat dangerous, not very dangerous, or not dangerous at all for the environment?	Climate Concern
prenvir	How willing would you be to pay much higher prices in order to protect the environment? Five response categories from very willing to very unwilling.	Support for costly environmental protection
taxenvir	And how willing would you be to pay much higher taxes in order to protect the environment? Five response categories from very willing to very unwilling.	Support for costly environmental protection
cutenvir	And how willing would you be to accept cuts in your standard of living in order to protect the environment? Five response categories from very willing to very unwilling.	Support for costly environmental protection

Note:
The wording in grhseff2 changes from 'greenhouse effect' in 1993 and 2000 to 'climate change' in 2010 and 2020.

Supplementary material SM1 provides further details on the data.

Individual-Level Measures of Climate Policy-Relevant Attitudes

We focus on four ISSP survey items which we argue are particularly relevant for respondents' likely dispositions towards ambitious climate policy. The first is the 'climate danger' item studied in previous cross-national analysis of the 2010 ISSP Environment Module (Smith and Mayer, 2019). This measures how dangerous a respondent perceives climate change to be, and thus reflects climate concern. The three remaining items are all included in every round and ask how willing respondents would be to bear different types of costs—in terms of higher prices, higher taxes, and lower standard of living,

respectively—to protect the environment. Table 1 presents full wording of these questions.[5] Although phrased in terms of "the environment" rather than "climate change" specifically, respondents' answers to these items are plausibly relevant to their stance on climate policies in a context of growing debates about the costs of climate policies alongside debates about the threat of climate change *per se* (Coan et al., 2021), and given experimental research showing that public support for costly sustainability policies is similar whether framed in terms of climate benefits or other environmental benefits (Fesenfeld et al., 2021).

Individual-level Measures of Party Support

We use the 'party affiliation' variable from the ISSP data to measure respondent party support.[6] All parties with less than 1% support in a weighted country-year sample are grouped into an 'other' category.[7] A separate 'non-partisan' category captures responses like 'refused' and 'don't know'. There is some variation in the types of survey question used to measure party support in different ISSP countries and waves. Controlling for this does not appreciably change our main findings.

Country-Level Measures of Partisan Polarization of Climate Policy-Relevant Attitudes

We measure partisan polarization using a regression R^2 approach. Specifically, the partisan polarization score for a given climate policy-relevant attitude in a given country-year is the adjusted R^2 (hereafter $\bar{R}^2$) obtained when we subset the ISSP data to that

[5]Responses are (re)scaled so that higher values indicate more concern or support for costly environmental protection. 'Don't know' responses are dropped.

[6]We recode the ordinal American party identification scale to make it more comparable with other countries.

[7]We exclude Russia in 1993 which has only one observed party support category.

country-year and use OLS to regress respondents' answers to the attitude item on a series of dummy variables measuring which party respondents support. We focus on adjusted $\bar{R}^2$ to account for the fact that increasing the number of political parties in a system increases the number of indicators in the regression model and therefore mechanically increases the R^2. Overall, we observe 400 partisan polarization scores on climate policy-relevant items, each the $\bar{R}^2$ from a unique item-country-year regression.

Our regression $\bar{R}^2$ approach for measuring partisan polarization has several advantages over other measures of polarization which focus only on between-group attitudinal differences.[8] Crucially, the $\bar{R}^2$ statistic from a regression of attitude on party support indicators captures both key conceptual features of group-based opinion polarization ('consolidation') as defined by DiMaggio, Evans and Bryson (1996): it will increase not just as *between*-party attitudinal differences *increase*, but also as *within*-party attitudinal disagreement *decreases*. The statistic is also sensitive to the relative size of party support groups.[9] At the same time, the regression $\bar{R}^2$ approach handles varying numbers of political parties across countries while making minimal assumptions about which party supporters have higher or lower levels of climate attitude: the use of party support dummy variables means that these differences are estimated separately for each party in each country based on the data. This contrasts with approaches used in ex-

[8] Most existing comparative analyses focus only on between-group differences because they measure partisan polarization with party support coefficients from regression models of climate attitudes.

[9] Kevins and Soroka (2017) use R^2 to study multiparty partisan polarization on non-climate attitudes. Our approach is similar to other recent methods for capturing within- and between-group aspects of partisan polarization (Traber, Stoetzer and Burri, 2022; Mehlhaff, 2023). On our data, $\bar{R}^2$ and the Cluster-Polarization Coefficient from Mehlhaff (2023) are practically identical ($r > .99$).

isting cross-national studies of partisan polarization of climate attitudes (Lewis, Palm and Feng, 2019; Smith and Mayer, 2019), which handle varying numbers of political parties across countries by examining the association between the left-right position of the party a respondent supports and the respondents' climate attitude. Those approaches only capture partisan polarization to the extent that it operates along similar left-right party ideological lines across countries.

Country-Level Measures of Partisan Polarization on Economic Attitudes

Because economic disagreements have traditionally played an important role in structuring electoral politics in many democracies (Lipset and Rokkan, 1967; Hellwig, 2014), we later benchmark partisan polarization on climate policy-relevant attitudes against partisan polarization on economic attitudes. We again use the regression $\bar{R}^2$ approach to measure partisan polarization on economic attitudes. The only change is that the dependent variable in each item-country-year-specific regression is respondent attitude as measured by one of two economic items. These two items elicit respondents' level of agreement that 'Private enterprise is the best way to solve [Country's] economic problems' and 'It is the responsibility of the government to reduce the differences in income between people with high incomes and those with low incomes'. We code 'Don't know' responses as missing. This results in 200 partisan polarization scores.

Country-Level Measures of Ideological Polarization of Climate Policy-Relevant Attitudes

We later analyse *ideological polarization* of climate policy-relevant attitudes along economic lines. For each climate policy-relevant item and each country-year, we generate two *economic ideological polarization* scores, one for each economic item described above. The economic ideological polarization score is the $\bar{R}^2$ obtained from subsetting to observations to a given country-year and regressing responses to a climate policy-

relevant item on responses to an economic item. Overall, we observe 800 ideological polarization scores measured in this way.

Results

Partisan Polarization of Climate Concern

We begin by analyzing country-level trends in partisan polarization of climate concern. The dots in Figure 1 show the observed partisan polarization scores for the climate danger item in each observed country-year.[10] Although there may be some evidence of nonlinearity in polarization trends in some countries, a linear summary seems a reasonable approximation, particularly given that we observe scores at most four times for any particular country.

For each country, we summarize the linear trend in partisan polarization via the black lines in Figure 1. These country-level trend lines are estimated using a multilevel regression which models partisan polarization scores as a linear function of time with random intercepts and slopes by country. This multilevel modelling approach offers a principled way to estimate country-specific trends given the limited number of partisan polarization scores observed per country, since it partially pools this country-specific information with a 'global' trend across all countries. We can also readily extend the approach—and will do so below—to model average trends in polarization scores across multiple attitude items and to incorporate additional predictors of polarization. Our cross-national approach to modelling trends in partisan polarization extends a multilevel modelling framework that is well established for analyzing single-country trends in political polarization (e.g., Baldassarri and Gelman, 2008; Cohen and Cohen, 2021).

Focusing on summary country-level trends, there is considerable variation in these

[10] Regression tables for all models can be found in Supplementary Material SI5.

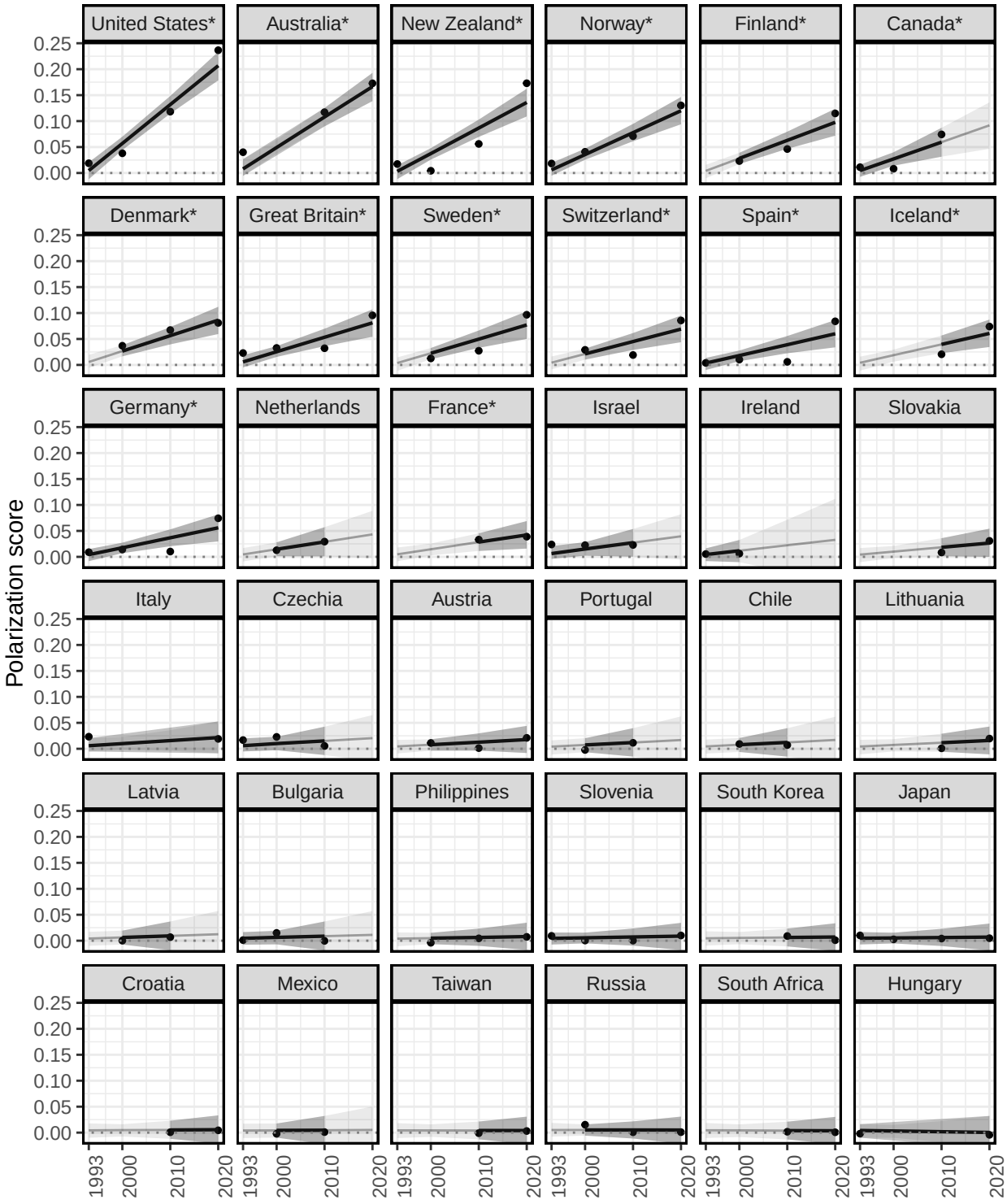

Figure 1: Trends in multiparty polarization on climate concern. Black lines indicate summary country-specific trends in partisan polarization estimated from multilevel model. Points display raw partisan polarization scores for individual country-years. Countries are ordered by summary trend slope. * indicates the 95% credible interval for trend slope is entirely positive. Shaded areas display 95% credible interval for summary trend (higher transparency for time-periods outside the observed data).

across countries in Figure 1. In 22 of the 36 countries, there is persistently low partisan polarization of climate concern, with trend lines that start low and remain relatively flat. These countries tend to be Central and Eastern European (Lativia, Lithuania, Hungary, Bulgaria, Russia, Slovenia, Czechia, Croatia) or non-Anglophone and non-European (Chile, Japan, Israel, Mexico, Philippines and Taiwan).

Yet Figure 1 also provides strong evidence of an increase in partisan polarization of climate concern since the 1990s in a large number of countries. 14 of the 36 countries analyzed have summary trend lines which slope upwards with greater than 95% probability (i.e., the 95% credible interval for the slope is entirely positive). Consistent with past research emphasizing political polarization of climate attitudes in the US (McCright et al., 2016) and other Anglophone democracies including Australia, Britain, Canada, and New Zealand (Lewis, Palm and Feng, 2019; Smith and Mayer, 2019), all of these countries have clearly positive trend lines, and the United States, Australia and New Zealand have the steepest polarization trends and reach the highest levels of partisan polarization. There are also several non-Anglophone, Western European democracies which exhibit substantial polarization trends in Figure 1. Of the 14 countries with clearly positive trend lines in our study, 9 are non-Anglophone Western European (Switzerland, Germany, Denmark, Spain, Finland, France, Iceland, Norway, Sweden). Of these, three (Denmark, Finland, Norway) have posterior mean slopes which are steeper than that of at least one Anglophone country (Britain).

Many of the countries have summary climate concern polarization trends which reach substantively important levels, not just in cross-national comparison, but also compared to polarization on other politically important issues within those same countries. We illustrate this by benchmarking partisan polarization on climate policy-relevant attitudes against partisan polarization on economic attitudes, which have traditionally structured electoral politics in many countries. We estimate country-level trends in partisan po-

larization on economic attitudes using the approach outlined above, except the polarization scores measure partisan polarization on the two economic items. We model country-level polarization trends averaging across the economic items, including varying intercepts and slopes by attitude item. This controls for potentially differential polarization trends across items.

Figure 2 plots summary country-level trends in partisan polarization on climate concern alongside trends in partisan polarization on economic attitudes. It shows that there are several Anglophone *and* Western European democracies where partisan divisions on climate policy-relevant issues have become pronounced even compared to traditional partisan divisions relating to economic intervention. By the time they are last observed in the data, partisan polarization on climate concern is estimated to be greater than partisan polarization of economic attitudes in three Anglophone countries (United States, Australia and New Zealand), and more than 75% of it in Great Britain and Canada. Additionally, partisan polarization on climate concern polarization is more than 75% of partisan polarization on economic attitudes in four non-Anglophone Western European democracies (Norway, Finland, Switzerland, Germany), and more that 40% of it in a further three (Iceland, Denmark, Spain) of the Western European democracies which experienced significant increases in climate polarization.

Partisan Polarization on Costly Environmental Protection

We now turn to the partisan polarization of more general environmental attitudes which are plausibly relevant proxies for peoples' disposition towards ambitious climate policy. Specifically, we study three items which ask whether respondents would be willing to bear different types of costs—higher prices, higher taxes, lower standard of living—to protect the environment. Figure 3 plots the summary country partisan polarization trends averaging across these items, based on multilevel models which again include

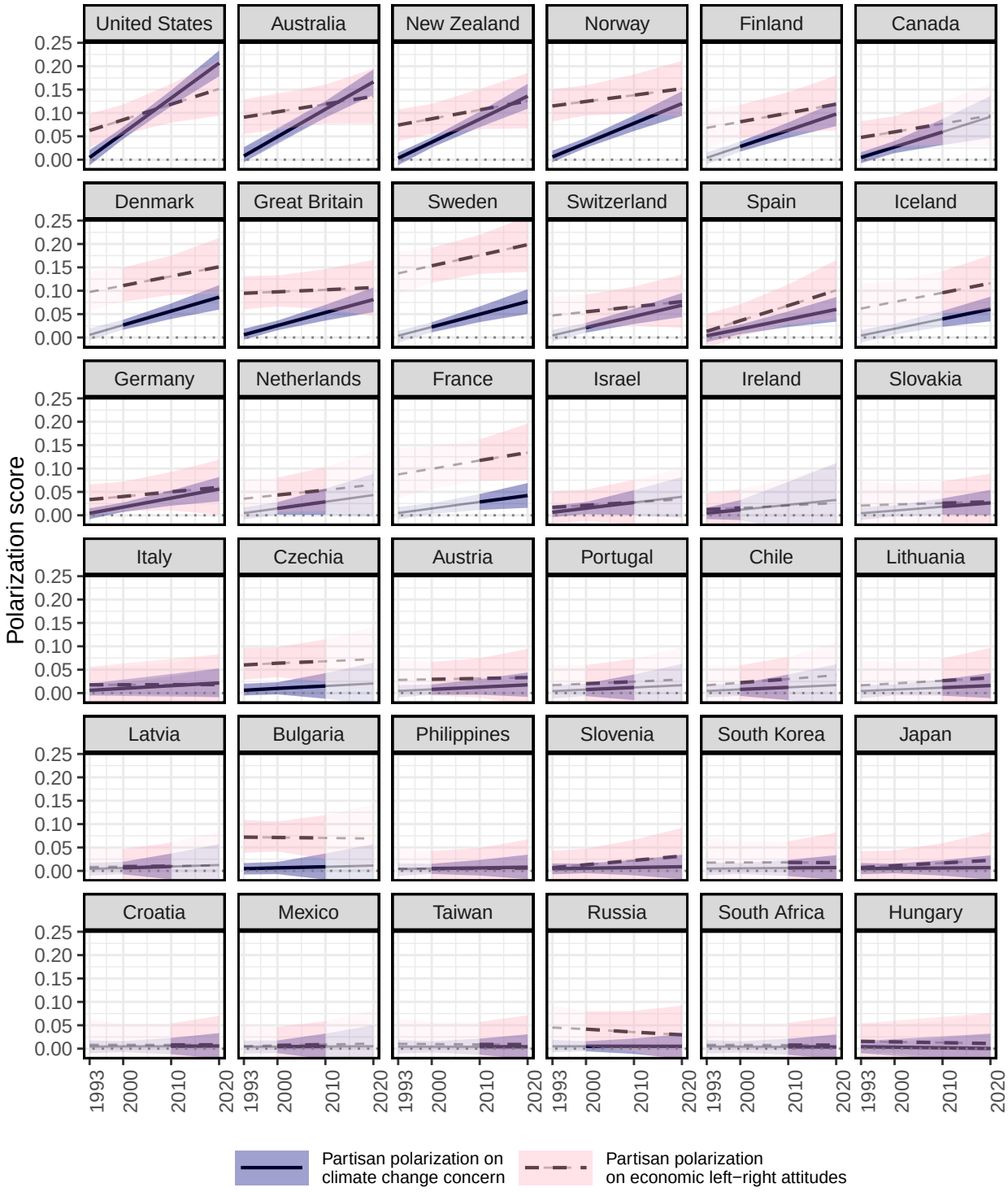

Figure 2: Climate concern polarization benchmarked against economic polarization. Lines indicate summary country-specific trends in partisan polarization estimated from multilevel model. * indicates an entirely positive 95% credible interval for trend slope. Shaded areas display 95% credible interval for summary trend (higher transparency for time-periods outside the range of observed data).

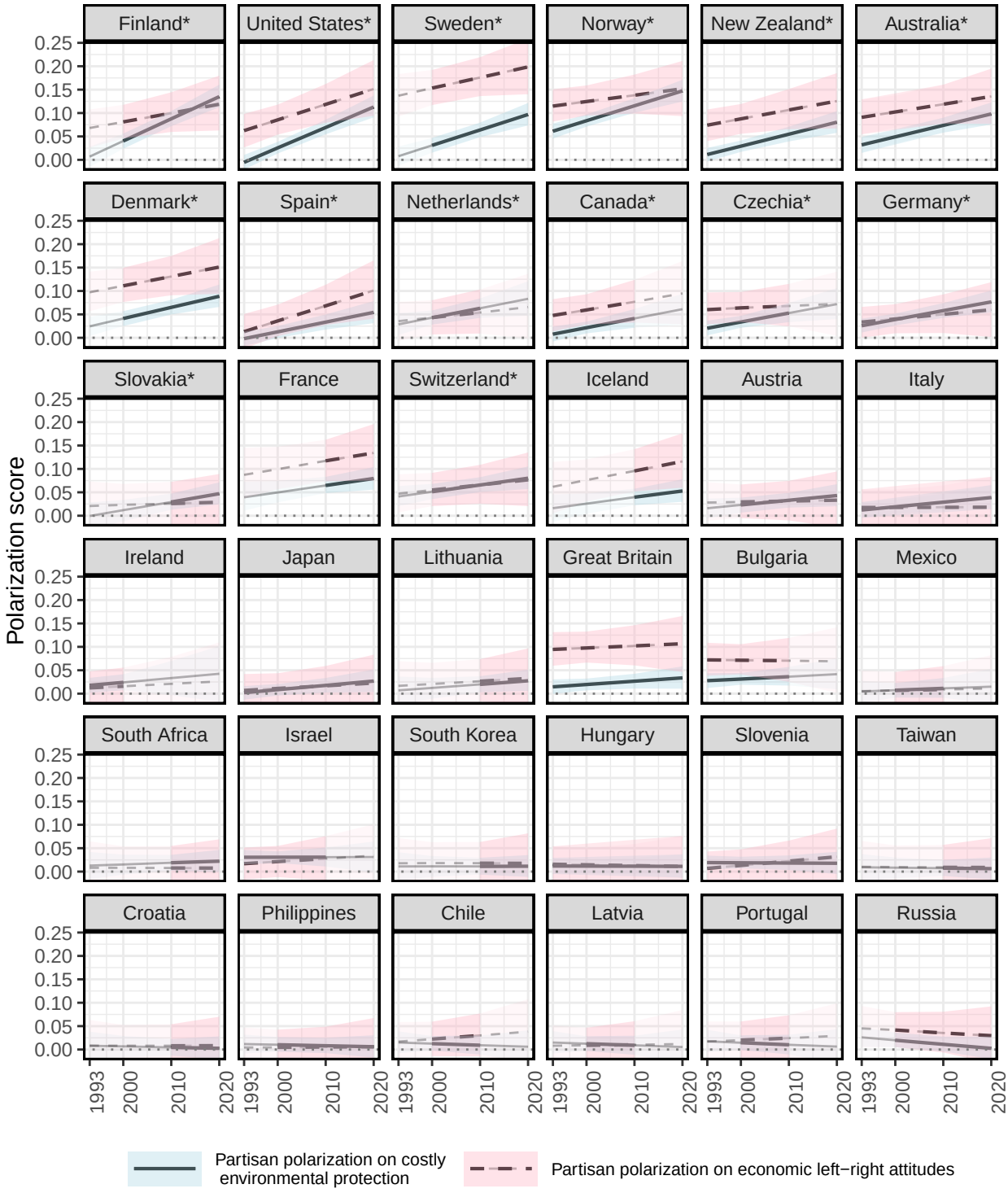

Figure 3: Trends in polarization on costly environmental protection benchmarked against economic polarization. Lines indicate summary country-specific trends in partisan polarization averaging over items. Shaded areas display 95% credible interval for summary trend. Summary trend lines and credible intervals have higher transparency for time-periods outside the range of observed data for a country.

varying intercepts and slopes by country and by item. The figure once more includes trends in partisan polarization of economic attitudes, as a benchmark.

Figure 3 shows an increase in partisan polarization of support for costly environmental protection in a substantial number of countries. Fourteen of the 36 countries analyzed have summary trend lines which slope upwards with greater than 95% probability. These tend to be Anglophone (Australia, Canada, New Zealand, and United States) and Western European (Switzerland, Germany, Denmark, Spain, Finland, Netherlands, Norway, and Sweden) countries, although we find significant polarization also in Czechia and Slovakia. This partisan polarization is substantial when benchmarked against partisan polarization of economic attitudes. Considering countries which have clearly polarized along partisan lines on support for costly environmental protection, by the time they are last observed in the data, this polarization is estimated to be greater than partisan polarization on economic attitudes in five countries (Switzerland, Finland, Netherlands, Germany, and Slovakia), to be more than 75% of partisan polarization on economic attitudes in two (Czechia and Norway) and more that 40% of it in a further seven countries (Sweden, Canada, Spain, Denmark, New Zealand, Australia, and United States). We find little evidence of polarization of support for costly environmental protection in 22 of 36 countries in our study. These countries tend to be Central or Eastern European former communist countries and non-Anglophone and non-European countries.

The rates and levels of polarization are quite similar in the Anglophone and Western European democracies which exhibit substantial polarization trends in Figure 3. Finland has a posterior mean slope which is greater than that of the United States. A further two Western European democracies have posterior slopes greater than New Zealand (Norway and Sweden) and the other five (Switzerland, Germany, Denmark, Spain, and Netherlands) have posterior mean slopes which are steeper than that of Britain.

How do patterns of partisan polarization of support for costly environmental protec-

tion compare to those patterns of partisan polarization of climate concern? There are some clear similarities, particularly because polarization on both measures has been occurring in a similar set of countries, primarily in Anglophone and Western European democracies.

However, there are also differences in geographic patterns of partisan polarization across these two types of attitude. In the US and all the other Anglophone countries, climate concern has polarized along partisan lines more quickly, and to higher levels than support for costly environmental protection. However, in all the Western European countries in our analysis the opposite pattern is observed: partisan polarization on support for costly environmental protection tends to reach higher levels than partisan polarization on climate concern.

Ideological Polarization of Climate Policy-Relevant Attitudes

Does partisan polarization of climate policy-relevant attitudes stem from the more general economic ideological faultlines that organize electoral competition between political parties in many countries? Some argue that right-leaning parties attract the support of voters with more free market economic beliefs, and those economic beliefs make those voters particularly averse to the large-scale state interventions often associated with climate change mitigation (McCright and Dunlap, 2011; McCright, 2011; McCright, Dunlap and Marquart-Pyatt, 2016). If this explanation is correct we should observe that, where climate policy-relevant attitudes become more polarized along party lines, they also become more polarized along the lines of general economic ideological disagreements in society.

We assess the potential explanation using Figure 4. It again plots summary country trends in partisan polarization of climate concern, this time alongside summary country trends in economic ideological polarization of climate concern. The latter are estimated

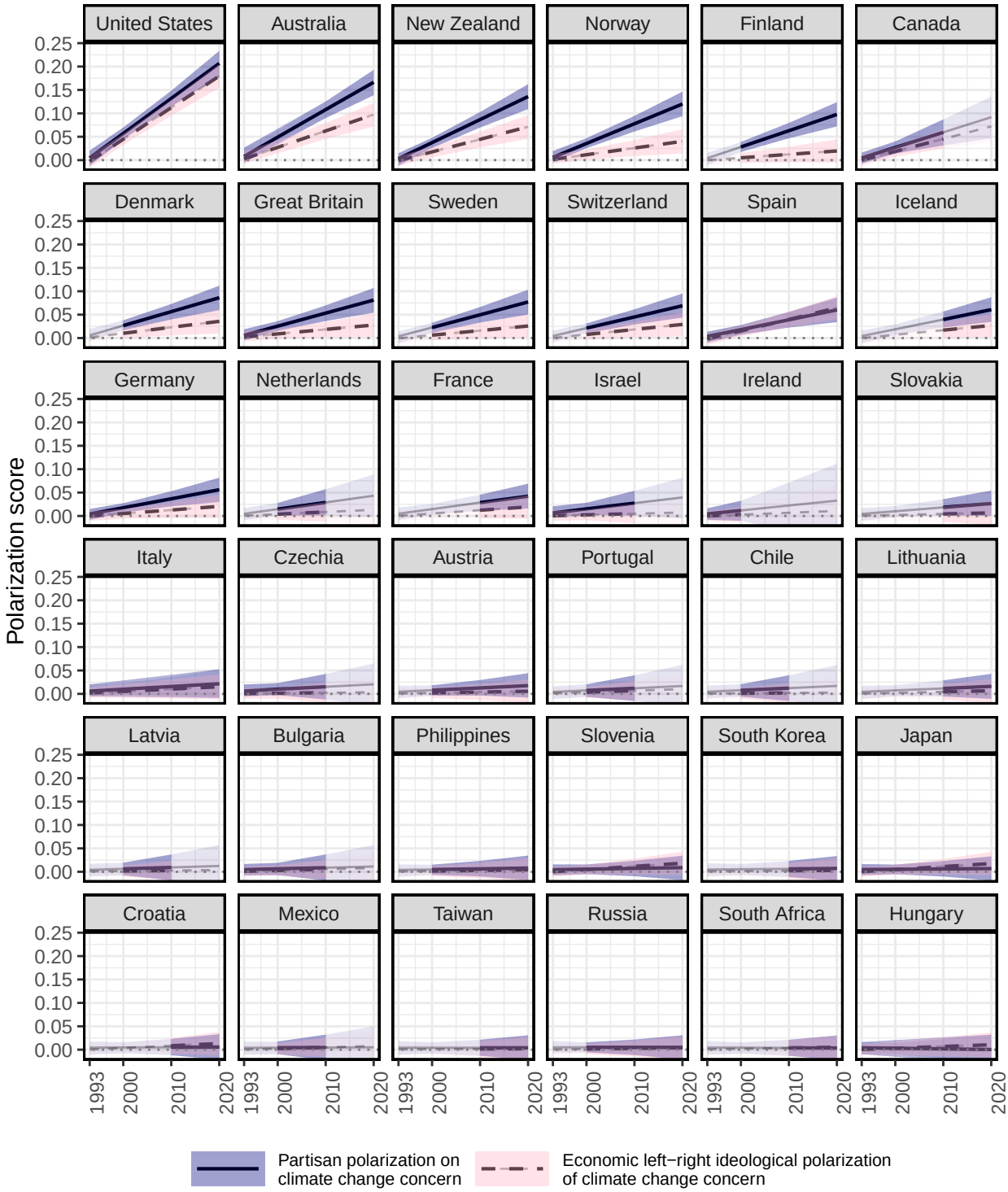

Figure 4: Country-specific trends in partisan polarization and economic ideological polarization of climate concern. Lines are fitted country-specific trends based on multilevel models of country-year partisan polarization scores, with country-specific random intercepts and random coefficients on time. Shaded areas represent the 95% credible interval for these trends. Line segments and credible intervals have higher transparency for time-periods outside the range of observed data for a country.

using the same method as for the partisan polarization trends, except that: the underlying raw polarization scores measure strength of association between climate concern and one of the two economic items (rather than between climate concern and party support), and the multilevel model includes varying intercepts and slopes by country and item pair.

Figure 4 shows that, in many of the countries which have experienced partisan polarization of climate concern, climate concern has also become more polarized along economic ideological lines (the slopes of both trendlines are positive with greater than 95% probability in 10 countries). Comparing the summary trend lines within each country, we see that there are a small number of countries where the trends are rather similar (particularly the US, but also Canada and Spain). However, for most countries, trends in economic ideological polarization of climate concern tend to be notably shallower than trends in partisan polarization of climate concern. In the Supplementary Material we show very similar patterns comparing partisan and ideological polarization of support for costly environmental protection.

These results indicate that only in a small number of countries—such as the US—can ideological polarization of climate policy-relevant attitudes along economic lines account for a substantial part of the increase in partisan polarization of such attitudes. Across many other countries it cannot.

Partisan Polarization and Secular Trends in Climate Policy-Relevant Attitudes

Are increases in partisan polarization on climate policy-relevant questions associated with changes in citizens' average response to such questions? To see why this may be important, consider a scenario where partisan polarization on climate concern arises because everyone responds to increased evidence of anthropogenic climate change by increasing their climate concern, but the most initially climate concerned partisan groups

are most responsive. This would be like the patterns found in the polarization of moral issues in the US (Baldassarri and Park, 2020). Contrast this with a scenario where partisan polarization arises because the climate concern of different partisan groups moves in different directions against a static level of average society-wide climate concern. Both scenarios exhibit partisan polarization, but in the first this emerges from a process which is more promising for the prospects of public acceptance of ambitious climate reforms than in the second.

To examine which, if any, of the above scenarios tends to pertain, we re-estimate our summary country-level trends in partisan polarization of climate policy-relevant attitudes, this time controlling for the mean response on the relevant attitude in each country-year (see SI 3). When we do so, estimated country-level trends in partisan polarization remain substantively unchanged relative to our main results, and there is little evidence that increasing partisan polarization of climate policy-relevant attitudes is positively (or negatively) related to trends in society-wide average attitudes. This suggests that the partisan polarization we document reflects a process where the climate policy-relevant attitudes of different partisan groups are moving in different directions, rather than moving in a positive direction at different rates. We provide further evidence of this process in SI4.

Partisan Polarization and Dispersion of Climate Policy-Relevant Attitudes

Is the increase in partisan polarization of mass opinion on climate policy-relevant attitudes driven by increasing societal disagreement on such issues? To examine this possibility, in SI 3 we re-estimate our summary country-level trends in partisan polarization of climate policy-relevant attitudes, this time controlling for the dispersion (standard deviation) of opinion on each attitude in each country-year. We find that our country-level trends in partisan polarization remain substantively unchanged. This suggests that

increasing partisan polarization of climate-policy related attitudes is not driven by increasing societal disagreement on these issues.

Which Parties Drive Partisan Polarization?

Partisan polarization of climate policy-relevant attitudes may reflect different party political dynamics which have varying implications for effective and durable climate reforms. For example, partisan polarization might be driven primarily by different mainstream parties increasingly drawing support from groups of voters with divergent climate policy-relevant attitudes. On the other hand, it might be driven mainly by niche party dynamics: in particular, by green parties—who tend to advocate for ambitious climate reforms—and right populist parties—who tend to be more inimical toward such reforms (Lockwood and Lockwood, 2022)—mobilising increasing support among distinct groups of voters with divergent climate policy-relevant attitudes.

To explore which party political dynamics underpin partisan polarization of climate policy-relevant attitudes in different countries, we examine partisan polarization when differentiating only green party supporters and right populist party supporters from all other voters. Specifically, we recalculate our partisan polarization score for each attitude item, country and year as the $\bar{R}^2$ obtained in the relevant country-year sample when we regress attitude item responses on a measure of respondent partisanship restricted to three categories: green supporter versus right populist supporter versus all other respondents. We define these scores as zero in cases where the party support recategorization leaves only one partisan group. We label the resulting polarization scores 'restricted party information' scores. In this analysis, the size of party groups is of substantive interest, and this is captured in the $\bar{R}^2$: for example, when the number of green and/or right populist supporters is small in a country-year sample, the proportion of overall variation in climate policy-relevant attitudes explained by green or right pop-

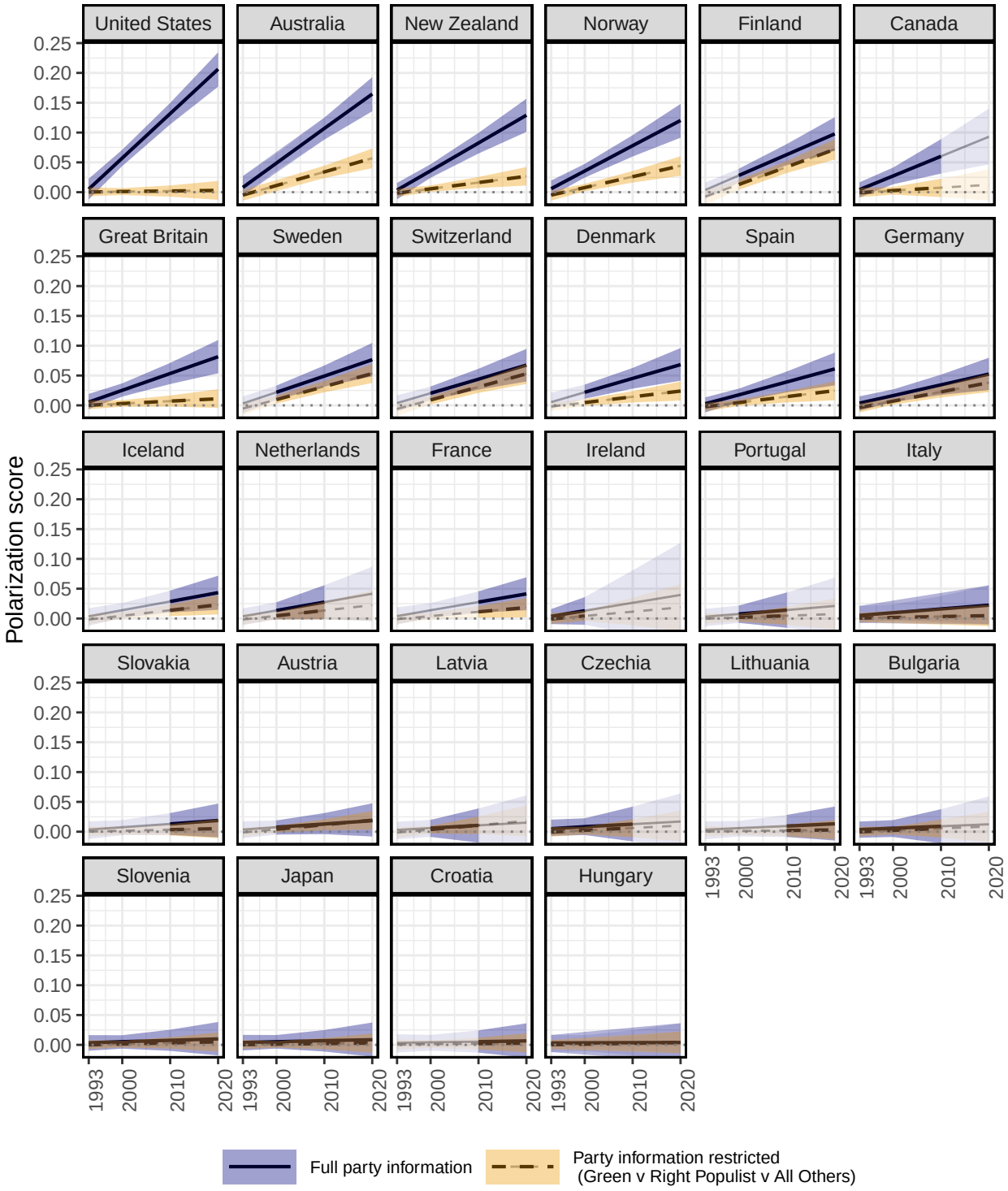

Figure 5: Climate concern polarization when partisan information is restricted to green v right populist v All Others benchmarked against climate concern polarization trends based on full partisan information. Shaded areas display 95% credible intervalfor summary trend (higher transparency for time-periods outside the range of observed data).

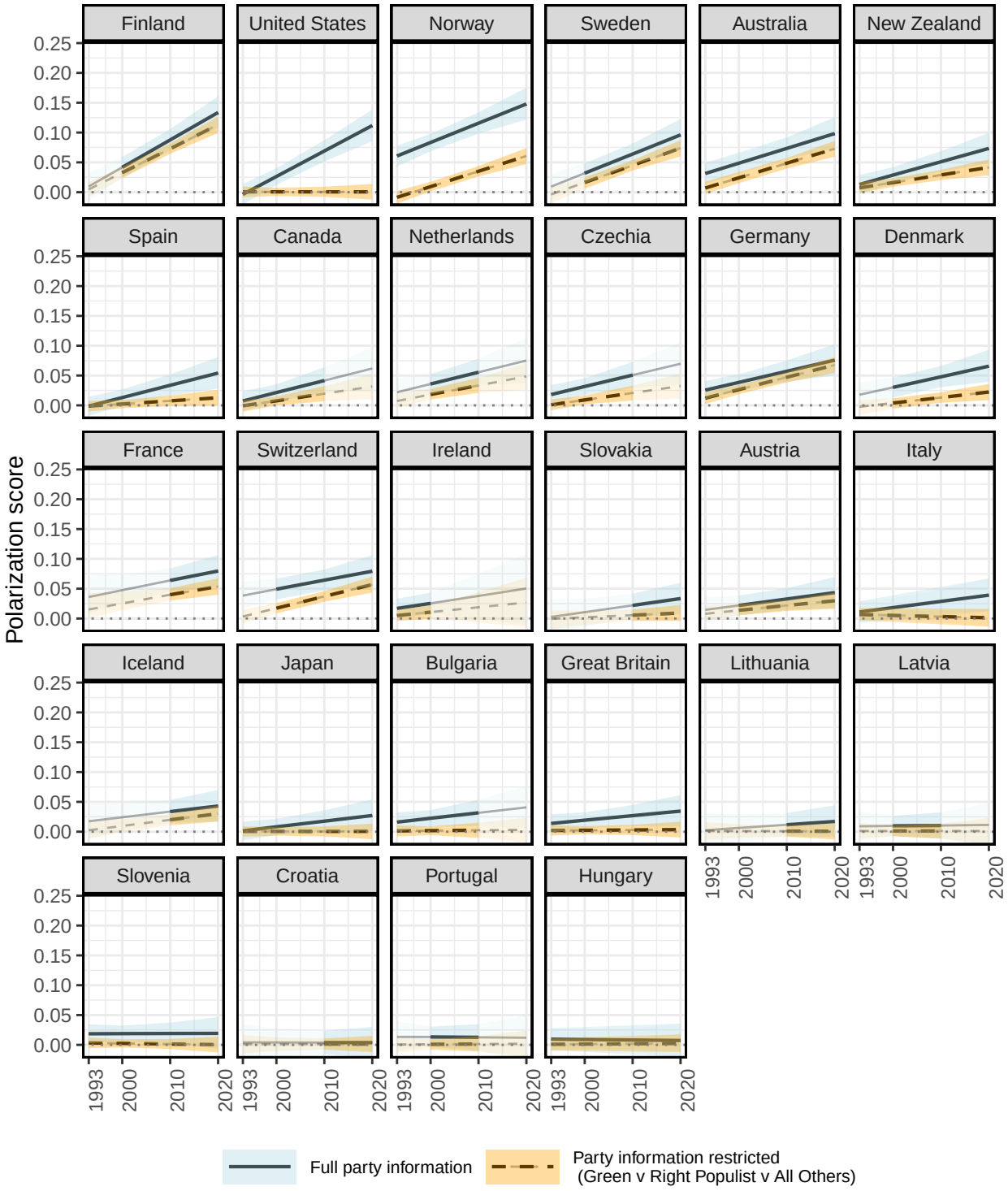

Figure 6: Costly environmental protection polarization when partisan information is restricted to green v right populist v All Others benchmarked against costly environmental protection polarization trends based on full partisan information. Shaded areas display 95% credible intervalfor summary trend (higher transparency for time-periods outside the range of observed data).

ulist support will be small.[11]

Figure 5 compares trends in the partisan polarization of climate concern when using the restricted party information and our main partisan polarization scores (which incorporate 'full information' on party support). To help interpret this figure we first look at the US, where there is a substantial trend when using full information about parties, but where no significant support is recorded in any period for either populist right or green parties. There is a large difference between the 'full information' and the 'restricted party information' polarization trend, so we conclude that a substantial part of overall partisan polarization in the US remains unexplained by niche supporter dynamics.

Across Anglophone countries there is a large difference between the full and restricted party information polarization trends. Thus, a substantial part of the overall trends in partisan polarization of climate concern in these countries is unexplained by green and/or right populist supporter dynamics. Indeed, in some cases (the US and the UK), there is no significant trend on restricted party information polarization, so we can conclude that niche supporter dynamics play no substantial role in explaining partisan polarization of climate concern in these countries during the studied period.

In non-Anglophone Western Europe, the differences between the full and restricted party information polarization trends are generally much smaller. In these countries, therefore, niche supporter dynamics always explain a substantial part of a significant trend in partisan polarization of climate concern. In fact, in many of these countries (e.g. Finland, Sweden, Switzerland and Germany), the overall trend in partisan polarization of climate concern is nearly entirely explained by green and/or right populist supporter dynamics.

Figure 6 provides the same information but this time relating to partisan polarization

[11]We take party labels from the *party family* measure in the Comparative Political Data Set (CPDS, Armingeon, Engler and Leemann, 2022) which covers 28 of the 36 countries.

on support for costly environmental protection. On this, there are more countries where niche supporter dynamics can explain a substantial portion of overall partisan polarization trends. This includes some of the countries with the most pronounced polarization trends (e.g. Finland and Sweden), and is the case for not just several Western European countries but also some Anglophone countries (e.g. Australia and New Zealand).

This evidence suggests that polarization in Western Europe has somewhat different implications for climate policy reform than it does in the US and other Anglophone countries. In non-Anglophone Western European countries, partisan polarization of climate policy-relevant attitudes is more attributable to greens mobilising voters who hold attitudes likely to make them favourable to climate reforms and right populist parties mobilising voters who hold attitudes likely to make them more inimical to such reforms. In contrast, in Anglophone countries, partisan polarization of climate policy-relevant attitudes is less attributable to these sorts of niche party dynamics, and as such appears more attributable to changes in the attitudes of mainstream party supporters. We provide further evidence in support of these conclusions in SI4.

Discussion

We have studied trends in partisan polarization of climate policy-relevant attitudes in 36 countries over the thirty-year period to 2020. We studied two types of climate policy-relevant attitudes: climate concern—the focus of previous studies—and support for costly environmental protection. We show that there has been a substantial growth in the partisan polarization of both climate concern and of support for costly environmental protection across the US and other Anglophone countries. but also in many Western European countries. Polarization of climate policy-relevant attitudes in many of these countries is now substantively large when benchmarked against partisan polarization of economic attitudes. However, we did not find substantial polarization trends in the

Eastern European, Asian, South and Central American or African countries in our study.

We found mixed results on whether the extent of polarization is substantially greater in the US and Anglophone countries than in Western European cases. Consistent with previous research (Lewis, Palm and Feng, 2019; Smith and Mayer, 2019), we showed partisan polarization on climate concern has risen fastest, and reached the highest levels, in the US and other Anglophone countries. However, by 2020 polarization it had reached substantial levels in many Western European democracies. Moreover, on support for costly environmental protection, partisan polarization has risen at similar speeds, and has reached similar levels, across many Anglophone and Western European countries.

We also point to two important differences between Anglophone and Western European countries, which do not reduce simply to the question of whether there is greater partisan polarization in the US and Anglophone countries.

First, the partisan polarization experienced in Western European countries is dissimilar to that in Anglophone countries in that it is not at its most severe when it comes to climate concern. Instead, in Western European countries partisan polarization seems to have emerged as dramatically in relation to questions concerning the types of trade-offs societies face in tackling environmental problems like climate change.

Second, the polarization is underpinned by different party political dynamics. In Western Europe, a large portion of partisan polarization of climate policy-relevant attitudes is explained by changes in the attitudes and/or number of green and right populist party supporters. In the US and other Anglophone democracies, niche supporter dynamics tend to explain a smaller portion of overall partisan polarization, suggesting that it is explained more by changes in the attitudes of mainstream party supporters. To the extent that niche parties have more limited opportunities to participate in government, the patterns of polarization observed in Western Europe might seem less consequential for climate policy. However, both green parties and right populist parties do sometimes en-

ter government coalitions (e.g., green parties in Germany in 1998 and 2021 and Austria in 2019; right populist parties in Finland in 2023) or have otherwise gained policy influence by agreeing to prop up minority governments (e.g., right populist Sweden Democrats in 2022). Further, mainstream parties are often tempted to try to woo green or right populist supporters by shifting closer to them on key issues which differentiate them from other voters (Meguid, 2008). From this perspective, even where partisan polarization of climate policy-relevant attitudes is driven mainly by green and right populist supporter dynamics, it is still likely to be consequential for government policy.

Our findings also have implications for our understanding of two other aspects of the polarization of climate policy-relevant attitudes. First, our evidence is inconsistent with accounts that view climate polarization as driven mainly by an ideological objection toward state intervention on the part of those with more free market ideologies. Second, we argue that the partisan polarization we document is not driven by increasing underlying disagreement on climate policy-relevant questions in societies, and neither is it driven by different partisan groups becoming more climate concerned and more supportive of costly environmental protection but at different rates. Instead, it often seems to be due to partisan groups moving in different directions on these questions, which could be because partisans are changing their climate policy-relevant attitudes in line with co-partisans, or because people are increasingly switching their partisanship based on their climate policy-relevant attitudes (Fiorina and Abrams, 2008; Cohen and Cohen, 2021).

While we think that studying support for costly environmental protection has offered some insights, there are still limitations. Perhaps most importantly, the items we studied are phrased in terms of "the environment" in general rather than "climate change" in particular. While we maintain that such items capture attitudes with clear relevance for a person's stance toward different possible climate policies, it would nevertheless

be desirable for future cross-national survey research to ask a broad range of climate policy-focused questions.

Notwithstanding these limitations, our analysis suggests that substantial partisan polarization of climate policy-relevant attitudes has occurred in a broader range of countries than much existing research based on earlier time periods would suggest. The ultimate implications of such polarization will vary due to the differences in underlying party political dynamics we have highlighted, but also due to other factors such as differences in political institutions across countries. Nevertheless, our results are overall discouraging in terms of the political prospects for climate action: the more countries where disagreements on climate policy-relevant matters become increasingly aligned with party support, the more countries in which it becomes more difficult to build broad-based political support for ambitious climate reforms.

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