Understanding Macro Developments in Environmental Public Opinion

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Declaration

I declare that this thesis is entirely my own work and describes my own research.

Abstract

This thesis examines macro developments in environmental public opinion to not only discern the patterns and driving factors of these changes, but to also investigate the potential consequences of such. Given the lack of climate opinion data, it first examines existing temporal measures of cross-national climate concern, and how well these align across survey organisations. As the attention given to the environment by the public has fluctuated over time, a British-focused investigation then examines how monthly changes in public salience between 2006-2019 may be linked to agenda-setting forces including media coverage, parliamentary debate, environmental protest, as well as other exogenous factors. Considering the surge in green party support in the 2021 German elections, this theoretical approach is then extended to examine changing green support in Germany between 1994-2019.

Findings show that cross-national metrics of climate opinion do not always align, highlighting issues with relying on a single survey to establish cross-national differences. They also indicate that the global public have become more climate conscious, that is they increasingly recognise the seriousness of climate change as a problem, with this now at its highest ever level. Both British and German analyses find that protest activity is important in understanding environmental public opinion dynamics; protest can be predicted by public attention levels, but in turn, is successful in increasing broader environmental salience. The British analysis additionally suggests media coverage moves in response to public attention rather than the reciprocal, and that public attention may drop following heightened political attention. Relatedly, in Germany media is also not predictive of green support. Levels of public attention to the environment were previously predictive of changes in party support, however, this is no longer the case. Instead, monthly changes in the perceived importance of the environment to the public are occurring after changes in green support. These findings provide important insight into shifting opinion on a global phenomenon with geopolitical significance.

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Outline of Thesis

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Chapter 1
Introduction

In October 2022 political leaders from around the world met for the 27th Conference of the Parties to the United Nations Framework Convention on Climate Change (COP27). Global policymakers have come together at such events annually since 1995 to discuss cross-national commitments to climate change mitigation and, with the outcome of COP27 including a decision to aid more vulnerable countries, this emphasises the extent to which climate change is a substantive geopolitical issue. Yet, with the most recent Intergovernmental Panel on Climate Change (IPCC) report stating 'the available evidence suggests that current adaptation efforts may be insufficient to help ensure sustainable development' (2022: 178), many have argued that insufficient progress has been made by politicians (Politico 2022; Townend 2022).

Climate change is inherently a sociological phenomenon due to it being both caused by, and of consequence to, societies across the globe (cf. Wiertz and de Graaf 2022). Central to political sociology, as the fundamental basis of political representation and democracy, most scholars agree that public opinion influences policymaking at least to some extent (cf. Erikson et al. 2002; Burstein 2003). Changes in public opinion therefore have the potential to either motivate or deter politicians' implementation of climate mitigation and adaptation policies and, given that societal changes are necessary for any such solutions, understanding aggregate changes in public opinion is thus crucially important (Dryzek et al. 2012). This forms the central research question for this thesis: how has public opinion on climate change moved over time, and what are the causes and consequences of this? While primarily interested in climate opinion, some of the Chapters examine environmental opinion more broadly due to a lack of available data.

Indeed, many countries have seen a surge in environmentalism in recent years, with climate concern among the public at an all-time high (Pew 2019). Yet, this surge in public concern is a

relatively recent phenomenon. Despite the rising threat of climate change, the perceived importance of the environment to the public has fluctuated dramatically over time, having previously already peaked in the decade prior (Kenny 2021). So, how can we understand the mediating factors of these aggregate changes in opinion?

As a physical phenomenon, a dominant theory of environmental opinion is the "objective problems" explanation, which emphasises that concern increases with environmental degradation (Inglehart 1995; Echavarren 2017). However, while global CO2 emissions (a leading cause of climate change) have increased steadily in recent decades, as have global temperatures (a leading metric of climate change), as already established, concern has not accordingly increased in a linear fashion. At the more short-run level, scholars have tested the impact of other environmental indicators such as extreme weather events and natural disasters (Zaval et al. 2014; Capstick et al. 2015), though the evidence for this has been mixed, with others finding no effects on public opinion (Running 2012; Brulle et al. 2012).

Post-materialist theory tells us as countries get richer, we should expect to see trends towards increased environmentalism in line with cohort replacement as existential security leads people to prioritise "quality of life" values (Inglehart 1971; Inglehart 2008). Yet, as previously noted, this is not the case, with public opinion having fluctuated over time in a non-linear manner. Inglehart's (2008) theory also tells us that this may be due to "period effects", whereby short-term conditions such as economic downturn may lead all cohorts to prioritise economic values over environmentalism. This is evidenced by environmental concern having fallen in response to the 2008 recession (Brulle et al. 2012; Scruggs and Benegal 2012; Kenny 2019). This is linked to the "finite pool of worry" hypothesis (Weber 2006; Capstick et al. 2015), which says that as other problems emerge, concern about climate change will fall because individuals have finite emotional resources.

When considering changing public opinion, another key sociological theory is agenda-setting. This tells us that public salience, which is defined as the attention given to an issue by the

public relative to other political issues, is impacted by the extent to which it is covered by the media, or the extent to which politicians give it consideration (Dearing and Rogers 1996). For example, if politicians talk about an issue more or the media publish a greater number of articles on it this can cause the public to believe it is of greater importance. As the amount of attention given to the environment by the media and politicians has also shown dramatic change over time, these patterns might explain why public attention to the issue has likewise varied so much. But equally, there is also the potential that the media and political actors may be moving in response to changes in public opinion. There is not a huge amount of research in this area regarding environmental opinion, and most has been conducted at the annual-level, which prevents a more detailed understanding of short-run fluctuations. Moreover, much of the existing literature has been conducted in the United States and/or in previous decades and, given the structure of climate change discourse and influence is found to differ greatly between countries (Schäfer, Ivanova and Schmidt 2014), it therefore does not necessarily reflect the dynamics of recent shifts in attention. Because of this, the extent to which the media and politicians are impacting public opinion is unclear.

A key feature of the recent surge in environmentalism is that it coincided with protest movements including Extinction Rebellion and Greta Thunberg's School Strikes for Climate, which occurred across multiple countries. These protests may have partially been propelled by the wave of public attention, however, they may also have succeeded in directing public attention to the issue. Previous literature on the power of environmental protest has been sparse and there is not much understanding as to how public opinion and protest are related, so a major contribution of this thesis is in determining what difference these recent movements may have made.

Even if the public become increasingly concerned about the environment, for this to have meaningful impact it needs to be translated into political action through legislative change. From the public's perspective, they can either achieve this by influencing incumbent politicians, or at election periods by voting in candidates with a stronger ecological commitment, such as those

from green parties. In line with rising climate concern, many countries have seen an increase in green voting in recent years, and one case where the latter has successfully been achieved is in Germany. In the 2021 federal elections, the German greens (Bündnis 90/Die Grünen) saw the greatest upwards vote swing of any party (+5.9%) and now form part of the coalition government, having come in third overall with a 14.8% vote share.

Understanding green voting is important as it has the potential to impact both national and intergovernmental institutions, as well as shape the policy offerings of mainstream parties. Yet, this surge in green voting was largely unanticipated given traditional explanations for green support emphasise that economic and environmental conditions motivate voters' desire for pro-environmental policies (Grant and Tilley 2019), and that the response of other mainstream parties may also shape niche party success (Meguid 2005; van Spanje and de Graaf 2018). However, in recent years economic conditions have not changed much (at least not positively in a way that would foster green support), the scientific evidence for climate has also not changed markedly, and mainstream parties have been mostly pro-environmental, playing into an accommodative strategy in Meguid's (2005) terms. This discord raises questions about how we understand rises and falls in green voting behaviour more generally.

Dennison (2019) highlights that while public salience is usually considered an important mediating factor in voting studies, it has not been sufficiently examined as a causal, or outcome, variable. Dennison and Kriesi's (2022) study is the only to have empirically considered how changes in the perceived importance of the environment to the public may impact green success at elections, finding that green voting increases as environmental salience does and decreases as the salience of unemployment increases. This thesis builds upon this seminal work by extending the period of study, conducting analysis at the monthly level (thus allowing a more detailed understanding of short-run fluctuations), and considering how media coverage of the issue and occurrence of environmental protest may also feed into this.

As outlined, there are various classic sociological debates around what motivates concern about climate change, however, to test these theories, and/or to simply compare differences in countries over time requires opinion polls on climate change across different countries and periods. Much of our understanding regarding the patterns of environmental opinion, and the determinants of such, are based upon research which has focused on a Eurocentric subset of countries which is perhaps largely due to there being a scarcity of repeated opinion poll data. Because of this, Chapter Two asks: what cross-national data *is* available, and how and why has cross-national climate opinion moved over time?

To address this question Chapter Two first compiles and examines all existing cross-national climate polls that have been fielded in multiple years. A dynamic Bayesian model is then used to produce latent country-year estimates of climate consciousness. The findings of such highlight significant differences in the results of different climate polls, both within and between countries. This suggests there are issues both in telling the story of within-country trends, and in using any one survey to talk about cross-national differences. Despite this, at the global level there has been increasing recognition of climate change as a problem in recent years, with this now at its highest ever level.

Given the puzzle surrounding the driving forces of public opinion, as well as the scarcity of temporal data on climate change opinion (particularly at the sub-annual level) that is highlighted in Chapter Two, the following Chapter looks at Britain as a case study, asking the question: how can we explain variation in public opinion on the environment in Britain over time? To do so it looks at monthly changes between 2006-2019, using climate change as a highly salient issue, and in doing so, builds a case for co-dependence of environmental salience between the public, media, politicians and protest occurrence. Monthly changes in the perceived importance of the environment to the public – measured as the proportion reporting the environment as a "most important problem" – are analysed against the extent the issue is referenced in parliamentary debate, levels of newspaper coverage and occurrence of environmental protest, while also

controlling for a range of economic and environmental indicators as well as political events. This is done using Zellner-Aitken Seemingly Unrelated Regression (SUR) estimations, with relationships established through Granger-causality, whereby a variable can be said to Granger-cause another if its values in preceding months are useful in predicting the value of the secondary variable for any given month, while also controlling for the latter variable's prior values. One of the main findings of Chapter Three is that environmental protest can be directly linked to changing public opinion; public attention to the environment in Britain simultaneously influences and is influenced by protest activity. The findings also indicate that media coverage is more likely to respond to changes in public attention than the other way around, and that public attention to environmental issues may decline after a period of increased political activity on the issue.

This approach is then extended to examine monthly changes in public opinion and green party support in Germany between 1994-2019 in Chapter Four. In doing so, protest is similarly found to both predict, and be predicted by, levels of green support as well as public salience. The analysis also finds that prior to 2018, changing party support could be predicted by levels of public attention to the environment, but in recent years this is not predictive and changes in the perceived importance of the environment to the public are instead occurring after changes in green support. Media is not predictive of party support for any time period, rather, there is evidence to suggest that media coverage follows changes in green voting. Moreover, while media is not predictive of public opinion when looking at the period as a whole, it is predictive (there is bidirectionality) when looking at earlier time periods. This suggests that media coverage does not explain the recent surge in public attention to the issue, nor voting intentions, indicating a potential weakening of media effects. Overall, exogenous factors such as economic and environmental conditions are not very useful in being able to consistently predict changes in public opinion, though media is found to be responsive to such and the occurrence of natural disasters is associated with changes in both green support and public opinion. Green support in Germany is also found to have fallen during the previous coalition period.

The contributions of this thesis are in identifying and presenting striking global patterns in environmental opinion across a broad set of polling organisations and countries and, in turn, in empirically examining what may have caused it, providing novel insight into public opinion dynamics in Britain and voting behaviour in Germany. From a theoretical perspective, by applying agenda-setting theory this thesis identifies how mechanisms of influence - which are often studied separately - may interact when modelled together. While it is commonly discussed that protest could be important for shaping public opinion on environmental issues (e.g., through mobilising citizens), with environmental protest it is hard if not impossible to point to other studies confirming this finding, rather than relying on anecdotal evidence or perceptions alone. The findings of Chapter Three and Four both systematically demonstrate significant links between environmental protest and increased salience among the public overall. Chapter Four also shows it is important in understanding green voting. Considering such findings, protest necessitates inclusion within models attempting to understand environmental opinion and voting intentions. These findings have important implications for our understanding of public opinion on a major geopolitical policy issue.

This thesis proceeds as follows: Chapter Two examines the available cross-national data on climate opinion, and gauges to what extent this can be used to accurately measure aggregate opinion across time and space. The following Chapter looks at the dynamics of public opinion in Britain, examining what has driven changes in the perceived importance of the environment over time. Chapter Four then builds upon the findings of such, namely the dynamics of agenda-setting and the impact of protest, to better understand the success of the green party in Germany and their fluctuating support over the past three decades. Finally, Chapter Five concludes by summarising the main findings of each component study, considering the implications of such as well as the scope for future research.

Chapter 2
Trends in cross-national climate opinion: how do measures compare within and between polling organisations?

There are many theories on what drives concern about climate change, and whether policymakers respond to changes in public demand. Yet, if we want to compare countries, and to test the efficacy of these theories at the international level, we need a comparable time-series measure of public opinion. The difficulty is, with so few repeated opinion polls on climate change, particularly ones that are cross-national, our understanding is restricted to a small coverage of countries and/or time periods. This chapter compiles existing repeated cross-national polls on climate concern and uses a dynamic Bayesian model to product latent metrics of climate consciousness. In doing so, it examines systematic differences between 81 countries and trends in climate consciousness between 1998-2022. Findings show variance across organisations and measures, both within and between countries. This suggests there are issues both in telling the story of within-country trends, and in using any one survey to talk about cross-national differences. Despite this, at the global level there has been increasing recognition of climate change as a problem, with this now at its highest ever level. This has important implications for our understanding of aggregate climate opinion.

2.1 Introduction

As a global phenomenon, addressing the climate crisis requires international collaboration and substantive political change. With policymakers, at least to some extent, driven by the demands of their public (Erikson et al. 2002), cross-national surveys provide important insight into how public support for mitigation measures varies across countries and thus, willingness for action. Studies have highlighted the recent surge in climate concern that has occurred across Western countries such as Britain, Germany, and the US (Pew 2019; Kirby 2022). However, with so few repeated cross-national surveys on climate change and, with public opinion in some countries often changing substantially (*ibid.*), measures at one given point in time are not necessarily indicative of country-level differences in attitudes towards climate change. This Chapter considers the extent to which measures of climate concern are aligned, both within and between polling organisations. In doing so, it also examines cross-national patterns and trends, assessing whether levels of climate concern that have been established in the West also extend to developing and middle-income countries.

Not only does a lack of time-series measures make it difficult to compare levels of concern across countries, but also to conduct macro-level analysis of the determinants of change. Previous debates about changing public opinion on climate change have highlighted the impact of things such as increasing scientific consensus (e.g. van der Linden et al. 2015), increasing visibility of the problem (e.g. Zaval et al. 2014), greater media coverage (e.g. McCombs 2004) and economic conditions (e.g. Kenny 2019). However, these effects might be true for some countries, but not all. This paper addresses previous debates as, considering all these theories it is important to know what the patterns are over time and between countries in order to explain such.

Of course, there do exist some repeated cross-national surveys, but the issue is these tend to have smaller geographical coverage, restricting analysis to a smaller, typically Eurocentric, subset of countries. In addition to this, you are then reliant on a single survey item/measure to gauge public opinion. If the results of a cross-national survey are taken at a static point in time, countries will be stratified by climate concern, with some countries presenting as more in favour of green policies. However, these cross-national differentials may in fact be due to the contextual impact of specific questions. For example, asking someone whether climate change is a threat to their country is not the same as asking them if it is a serious global problem. This makes it hard to objectively compare countries and public support for mitigation measures. Studies have found varying response to different measures of climate opinion due to question wording (Kyselá et al. 2019; Motta et al. 2019; Chen et al. 2021). However, there is little understanding of how these differences may cumulate at the aggregate-level, and how they may impact cross-national longitudinal measures.

In the absence of systematic surveys, how can we delineate change in public opinion over time? If we start from the position that climate change is a real problem, a key question regarding people's willingness to address the issue is whether the public recognise the issue as a problem. If the public recognise climate change as a serious problem, then by extension they are also likely to be concerned about it. Thus, this can be conceptualised as "climate consciousness" – understood

as the extent of problem perception and acceptance of the issue. Stimson (1999) tells us that as public attitudes on particular issues have a tendency to move together over time, this means that there are underlying factors or dimensions, defined as the "policy mood", which explain common trends in general support for government action. This theory has typically been applied to model change in individual countries. However, in line with this, though they may be conducted over different periods and using different methods, the results of cross-national climate polls might be taken as reflecting some form of latent attitudinal measure. Thus, while climate surveys are sparse and can produce very different outcomes depending on question wording, they still represent some underlying measure of climate consciousness.

To better understand how climate consciousness has changed over time and across countries, this study compiles all repeated cross-national polls which ask about climate concern, producing a dataset which covers 81 countries (equivalent to 83% of the global population) between 1998-2022. In doing so, it assesses their comparability to determine whether aggregation is appropriate, and whether they can be used to establish a wider set of cross-national trends. A dynamic Bayesian latent variable model (Claassen 2019) is then used to generate comparable annual metrics of climate consciousness for 2007-2021. The main contributions are in bringing together what existing cross-national data there is on climate concern, highlighting the trends in such over time (particularly for countries which are not often included in cross-national analyses), and in identifying there is a problem regarding different indicators not telling the same story about patterns of within- and between-country change.

Analyses find that while measures of climate concern align in some countries (particularly countries such as the US, Germany and the UK), in many others this is not the case. Variance across polling organisations and survey items, both within and between countries, suggests that it is problematic to rely on a single metric when discussing cross-national differences as these vary depending on the survey. By generating metrics of climate consciousness, this confirms that many countries witnessed a fall in recognition of climate change following the 2008 crisis, that the recent

wave of environmentalism has been accompanied by rising consciousness for many countries, but equally that other nations have seen falling consciousness during the same period. Nonetheless, while most of the world's population skews less climate conscious on average, at the global level there have been significant increases in the last decade in the extent to which the public recognise climate change as a problem, with climate consciousness now at its highest ever level. This contributes to our understanding of public opinion on a global issue and informs future substantive research on climate opinion.

2.2 Literature

Climate change is a cross-national policy issue, with global impact. Because of this, it is necessary to have a cross-national understanding of how publics around the globe perceive the issue, and how attitudes have changed over time. Cross-national research is therefore vital in this respect, but is nonetheless restricted by a lack of available data. This section considers what data is indeed available, how this has resulted in analysis being restricted to environmentalism more broadly and/or Eurocentric countries, and then considers how we may quantify climate consciousness as a potential solution to such.

2.2.1 Cross-national environmental research

In conducting cross-national analysis of environmental opinion, most research has made use of the following datasets. Some scholars (e.g. Franzen and Meyer 2010; Franzen and Vogl 2013; Nawrotzki and Pampel 2013; Weaver 2016) have used the International Social Survey (ISSP) which covers around 31 countries. The environment module has multiple climate change questions, though these do not directly measure concern about the problem and instead centre around whether a rise in the world's temperature caused by climate change is dangerous for the environment, the causes of climate change, and which environmental problem is the most important (with climate change as an option). The ISSP environment module is only fielded once

every decade and, while dating back to 1993, the latest available version is from 2010 and the latter question regarding its importance is only available for 2010.[1] The World Values Survey (WVS) has asked various questions about environmental protection and involvement in environmental organisations dating back almost annually to 1981, as has the European Values Study (EVS) albeit with less frequency. However, the WVS only included a question about the seriousness of global warming in Wave 5: 2005-2009, which was used by Running (2012) to test the impact of economic and environmental conditions. Kenny (2019) used the economic vs. environmental trade-off measure from Wave 5 and 6 of the WVS to test the impact of economic fallout following the 2008 recession, though this is not a direct measure of climate concern. The European Social Survey (ESS) asked about environmental attitudes in ESS9 (2018) and climate change attitudes in ESS8 (2016).[2] The Eurobarometer has repeatedly asked an item on protecting nature and fighting pollution, although with different question wordings. Bakaki et al. (2019) use this by combining two measures for six countries to analyse the determinants of changing European opinion between 1983-2012, looking at policy, media coverage, economic and environmental conditions. Overall, this review highlights that many large cross-national surveys either have not asked about climate opinion, and/or they have not done so in a repeated way that would highlight trends.

Because of these problems regarding a lack of suitable data, cross-national analyses are therefore limited by numerous issues. Firstly, by the time coverage, as surveys may either have a limited range of temporal coverage, or gaps in coverage at certain time points. The former matters as it restricts our understanding to a smaller time period and, due to the time taken to publish large-scale social surveys and the often fast-changing nature of public opinion, estimates may not be the most up to date. The latter causes problems when analysing data, as many time-series models

[1] Since writing this Chapter the ISSP 2020 "Environment IV" has been partially pre-released. They have now introduced concern-based questions which ask – "*On a scale from 0 to 10, how bad or good do you think the impacts of climate change will be*" for a) the world as a whole and b) the respondent and their family. However, the full data is due to be released in Spring 2023 and, due to not being a repeated measure, this would not be able to be used in this study anyway.

[2] ESS10 (2020) also includes climate change questions which have the same wording to 2016, however, the results are not due to be published until December 2022, which prevented including these two years in analysis.

require data points over an interrupted period. Another issue that arises relates to survey items, as even if a polling organisation fields a survey in every year they may use different question wordings, making it hard to compare the metrics of opinion over time. A further concern is that many surveys only focus on a smaller number of countries and, as Capstick et al. note, 'there exists a substantial bias toward longitudinal studies of public perceptions in developed nations' (2014: 54). Not only does this mean that many countries are excluded from public understanding and decision-making on a global issue that they are affected by, but our theory on the determinants of environmental opinion is based on a specific set of countries and may not be generalisable to other contexts. A substantial amount of research into environmental opinion is US-centric but given the polarised nature of environmental discourse in the US (Dunlap et al. 2016), this does not necessarily apply to other countries.

With this study focusing on climate change as a specific environmental issue, it is crucial to note that most research has focused on environmental opinion more broadly. This is understandable given the sparsity of data on climate change attitudes, but this is significant as the two are not necessarily synonymous. Indeed, there is likely high correlation at the individual-level in terms of being concerned about climate change and other environmental issues more broadly. There is also a reasonably strong case that can be made for using an environmental measure as a proxy when looking at a single country over time, as contextual understanding of what "environment" entails is likely to show less variation. However, when conducting cross-national research, the issue is that "environment" can have very different connotations between contexts and so a measure of environmental concern may not necessarily equally reflect climate change attitudes. If, for example, one country is not very concerned about climate change but very concerned about deforestation due to experiencing it more, this could be taken as equal to another country where respondents are highly concerned about climate change. It is hard to control for all potential national-level environmental indicators to isolate the true metric and because of this, a systematic measure of climate opinion would be more appropriate. Of course, climate change and

the concern associated with it can also have very different meaning across countries. But, in having a more direct measure this allows for a more accurate analysis of what is causing cross-national differences.

So, what cross-national measures of climate opinion are available? In conducting an extensive literature review of empirical research on climate change perceptions, Capstick et al. (2014) confirm that the literature is largely US-centric and/or focuses on a static point in time. They identify ten international studies, however, of the time-series studies, only three cover more than one country. Poortinga et al. (2013) looked at the impact of Fukushima on climate opinion for three data points in Britain and two in Japan between 2005-2011, using separate survey measures. Shum (2011) used Eurobarometer data to look at the impact of economic conditions and local temperatures on European climate attitudes in 2008 and two time points in 2009. Scruggs and Benegal (2012) use the same data to look at the impact of the recession in European countries, while also bringing in separate measures for the US. Since then, largely due to the increased salience of climate change, there has been an expansion of climate change research. However, there is still a lack of repeated cross-national measures. The few longitudinal cross-national climate change studies that do exist, and are thus used in this study, are discussed in the data section of this paper in due course. However, this highlights the extent of the data scarcity problem. This Chapter therefore contributes by extending our understanding of climate opinion to countries and time periods which are typically excluded from analyses.

2.2.2 Quantifying climate consciousness

Given the gaps in time, survey item, and country coverage, how can we therefore address this issue and measure aggregate climate consciousness? Stimson (1999) explains aggregate public opinion in terms of a "policy mood" which can be understood as an aggregate measure of a country's public preferences for government policy decisions. This is based on public preferences for particular issues tending to show similar movement over time, which suggests there is an

underlying unobservable measure (or policy mood) which reflects the aggregate trends in opinion. While "policy mood" better reflects support for different policy measures, this same concept can be extended to the idea of climate consciousness and we might similarly expect different measures of climate change concern to move together within countries over time, even if individual metrics of opinion differ slightly. This concept is supported by Chen et al. (2021), who find that while climate change question wording can produce different outcomes in the US, the observed differences in responses to question wordings have a similar distribution, suggesting that different measures are still robust. Therefore, while producing different outcomes, cross-national survey responses might be expected to show the same trends over time and reflect an underlying climate consciousness.

To quantify "policy mood", Stimson (1999) aggregates responses to policy questions in mass surveys using a dyad ratios algorithm, which combines multiple survey items by standardising them as a ratio of variation over time while also assessing covariation between different survey series. Brulle et al. (2012) applied this method to generate quarterly estimates of climate opinion in the US between 2002-2010, which they subsequently analysed the changes in. McGann (2014; 2019) has since built upon this by developing an item response theory (IRT) model which also controls for survey characteristics such as sampling methods and mode. While these methods have resolved much of the continuity problem, the issue is that they are only used to study opinion in one country over time and therefore cannot be used to model country-year panels of opinion. To address this, Claassen (2019) has more recently developed a dynamic Bayesian latent variable model, which is the one that is employed in this study. This model estimates public opinion on a given topic across multiple countries and points in time by modelling the probability of a pro-climate opinion as a function of the survey items and country-time effects. This method is discussed further in the subsequent section, however, there are several benefits to using this method; the model adjusts for different wording of survey items, it adjusts for varying contextual impact of different questions, and it smooths the estimates over time. While these are important

in any study, the former two are especially significant when looking at climate opinion as there are various reasons why different measures of climate opinion may not align between polls.

With regards to the first, question wording is significant when considering climate opinion as there are numerous indicators of climate beliefs and changing the wording can produce different results (Motta et al. 2019). For example if, for any given country, the public are asked whether they are *personally worried* about climate change, and whether they think climate change is an *emergency*, they may not provide the same response. If some countries are more or less climate conscious, we might expect these differences to hold regardless of question wording. But, given that certain wording can hold greater relevance for the public of some countries, it is vital that the model accounts for this differential contextual impact. For example, local versus global spatial framing influences how people respond to climate change questions (Scannell and Gifford 2013). As global identities differ between countries, and those with greater global identity are more likely to report higher concern and support the need for climate action (Devine-Wright et al. 2015), a question framing climate change as a *global* problem is likely to produce differential outcomes by country in a cross-national study. While any questions referring to climate change would be picking up some latent attitudinal measure, it is important to control for these subtle nuances as they could result in different conclusions regarding cross-national attitudes. Claassen's (2019) model therefore implicitly controls for house effects, which are systematic biases in the results of one pollster relative to others due to sampling methods, question wording, mode of collection and data processing (Smith 1978).

To summarise this section, existing data on climate change attitudes is limited by gaps in time, country-coverage, and changing question wording. Because of this, most studies have focused on environmental opinion or used this as a proxy for climate concern. Stimson's (1999) "policy mood" tells us that even if they are reflecting different aspects of concern, responses to polls on particular issues still represent some underlying latent opinion. Thus, by aggregating what available climate-specific data there is, this can facilitate better understanding of trends in climate

opinion by providing insight into climate consciousness – the extent to which the public recognise climate change as a problem. In doing so, we can include a broader geographic and temporal coverage by not restricting analyses to countries which have greater data availability.

2.3 Data

To compare climate consciousness between countries this research collates findings from seven cross-national opinion polls between 1998-2022. The process of selecting these is described below.

In line with the concept of climate consciousness, understood as the extent to which the public recognise climate change as a problem, only polls which ask about concern/worry/seriousness of climate change were used. Those asking about things such as its causes, scientific existence, or preferred policy solutions were not included as these represent a different dimension of climate opinion (cf. Franzen and Mader 2021). For example, climate consciousness is a unidimensional metric, whereby people are either more or less conscious. By contrast, support for climate policy is multidimensional, as this is heavily dependent on different policy solutions and contexts and people can be concerned and support one intervention measure but not others. Likewise, such measures are operationalised differently, for example categorically, whereby respondents are presented with multiple different causes or policy solutions to choose from (Kyselá et al. 2019). Relatedly, trends in knowledge of the causes of climate change should follow a different trajectory to concern as there is less reason for variation in this other than increasing education (cf. Fisher et al. 2022), while support for different environmental policy measures is also argued to be relatively stable (Druckman and Leeper 2012; Dennison and Kriesi 2022). Because of tangible differences in environmental knowledge, attitudes and behaviours, it is believed that measures of behaviour and knowledge should not be factored into concepts of environmental concern (Franzen and Mader 2021). Nonetheless, as repeated measures of these are similarly sparse when focusing on climate change, including such in analysis would not have provided much greater empirical insight.

After an extensive search to identify polls which reference climate change concern and have been conducted in multiple countries, this produced a database made up of twenty-seven items (survey questions) from fifteen polling organisations, covering twenty-one years. In order to be able to compare trends over time, items which only cover a single year of data were excluded from the dataset. This unfortunately means that if a survey is run in multiple years, but the question wording differs between years, the items for different years cannot be used unless the precise question wording is repeated. Note, there is no requirement for the methodology to be consistent across the different waves. It is common for organisations to use different polling methods depending on the country, however, the methodology of successive waves tends to be the same within countries.[3] Nonetheless, idiosyncrasies in methodologies between surveys are controlled for by the item parameters in the model, and differences within surveys by the item-country parameters, so this should not cause concern.

To increase estimate reliability countries with under five years of data coverage were also excluded. After removal of poll items that did not fit these criteria, this left thirteen survey items from seven polling organisations, covering 81 countries for 21 years between 1998-2022. The significant drop in coverage highlights the data scarcity problem, as it further signifies that there are very few repeated measures of climate opinion. Most of these come from large polling organisations such as Pew, Gallup, Eurobarometer and Latin American Public Opinion Project (LAPOP), which have reputational reasons to be accurate. Though they each have slightly different motivations, for example, Eurobarometer was historically commissioned by the European Union to measure attitudes to integration. The breakdown of each of the items can be found in Table 2.1. Note, the number of countries shown as included in each survey is the country coverage prior to any removal.

[3] For exceptions to this - the 2022 Pew survey in the US and Australia was conducted online, having previously been done over telephone, and for Malaysia in 2022 and since 2020 in Italy the survey has been conducted over telephone having previously been face-to-face. GlobeScan surveys have been online since 2019, having previously been a mixture of telephone and face-to-face.

Table 2.1: Climate change poll wording and number of countries covered for each year

	1998	2000	2003	2004	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
Globescan (very serious)	For each of the following possible global problems, please indicate if you see it as a very serious, somewhat serious, not very serious, or not at all serious problem (% very serious)																				
	9	9	9			9	9	9	9	8	9	7	9	19	19	9		25			31
Globescan (serious)	For each of the following possible global problems, please indicate if you see it as a very serious, somewhat serious, not very serious, or not at all serious problem (% very or somewhat serious)																				
													9	19	19			25	27	31	31
Pew (very serious problem)	In your view, is global warming a very serious problem, somewhat serious, not too serious, or not a problem? (% very serious)																				
						37	24		20					40							
Pew (major threat)	Do you think that global climate change is a major threat, a minor threat, or not a threat to [country]? (% major threat)																				
												39			18	38	26		14		19
Gallup[4] (serious threat)	How serious of a threat is global warming to you and your family – very serious, somewhat serious, not very serious, or not at all serious? (% very serious)																				
							98		110												
Gallup (serious threat)	Do you think that climate change is a very serious threat, a somewhat serious threat, or not a threat to the people in this country in the next 20 years? (% very serious)																				
																		142		121	
LAPOP	If nothing is done to reduce climate change in the future, how serious of a problem do you think it will be for [country]? (%very serious) (% average)																				
															29		16				
Eurobarometer (very serious problem)	How serious a problem do you think climate change is at this moment? Please use a scale from 1 to 10, with '1' meaning it is "not at all a serious problem" and '10' meaning it is "an extremely serious problem" (% very serious 7-10)																				
							30	58		27		28		28		28		28		27	
Eurobarometer (most serious problem)	Which of the following do you consider to be the single most serious problem facing the world as a whole? Which others do you consider to be serious problems? (% climate change as one of the most serious problems)																				
							30	57		27		28		28		28		28		27	
Eurobarometer (main env. issue)	From the following list, please list the five main environmental issues that you are worried about? (% climate change)																				
				25		27				27											
Eurobarometer (top four env. issues)	From the following list, please pick the four environmental issues which you consider the most important. (% climate change)																				
																28		28			
EIB[5]	What are the three biggest challenges citizens in your country are currently facing? (% quoting climate change)																				
																		30	30	27	
HSBC	Climate change and how we respond to it are among the biggest issues I worry about today - 1-7 scale where 1 means strongly disagree and 7 means strongly agree (% strong agreement 6-7)																				
						9	2	12	15												

[4] Gallup 2007/08 is treated as 2008 as this is the year used by the polling organisation for census estimates when weighting.

[5] European Investment Bank's (EIB) Climate Survey was also fielded in 2018 but the questionnaire was subsequently redesigned so comparisons to later years cannot be made.

2.4 Results and Analysis

2.4.1 A comparison of climate polls

This section scrutinises how comparable the identified climate polls are, with the aim of better understanding to what extent they are in line with one another, and whether they are in fact measuring the same thing.

Table 2.2 shows the correlation matrix between survey items, with the number of years and countries that each pair of surveys mutually cover shown underneath. As some surveys overlap in multiple years, the figure reflects their overall correlation across years. Higher correlations indicate a better straight line fit between the data, but despite this there can still be different variation in the range of pro-climate responses. Correlations range from 0.91 between LAPOP and GlobeScan, to 0.03 between Eurobarometer's "main environmental issue" and GlobeScan, albeit both are based on few observations. The results of Table 2.2 show that there are two groupings that emerge from the cross-correlations, as indicated by the two boxes. The survey items that fall *within* each box have relatively strong correlations with one another, particularly within the green box, but pairing items *between* the two boxes typically results in weaker correlations (i.e. comparing one from the yellow box with one from the green box, indicated by the space outside the boxes). For example, the latter three Eurobarometer measures, HSBC Climate Confidence Monitor and European Investment Bank (EIB) results have small and negative correlations with the other survey items, suggesting they are not well suited to be grouped. The Eurobarometer "very serious" problem measure intersects both groups, with a reasonable correlation with most of the other measures. These groupings are perhaps unsurprising, given that the latter four items reflect measures which rank climate change relative to other environmental or broader political issues, rather than a direct measure of concern, though Eurobarometer's "most serious problem" measure has some alignment with its "very serious problem" measure, as well as Pew's "very serious problem" measure. In considering how well the different measures of climate concern align, the first consideration is how well they do so *within* polling organisations. Comparing such provides

important insight as, except for the survey wording, sources of bias are minimised. Therefore, the following analyses consider congruence between measures with the aim of assessing whether aggregation is appropriate.

GlobeScan covers the greatest number of years as well as being the only organisation to overlap with every other item, with overlap meaning that survey organisations have results available for the same year for at least one same country (Table 2.1). As a result, any latent modelling would be largely reliant on the results of such. The two variables for GlobeScan are measured using identical question wording, however this is unfortunately by necessity broken down into two variables due to the way GlobeScan publishes the data. For some years (2014; 2015; 2016; 2019; 2020; 2021), responses are reported as the percentage reporting "serious" (either somewhat or very), while for others (1998; 2000; 2003; 2007; 2008; 2009; 2010; 2011; 2012; 2013; 2014; 2015; 2016; 2019) it is the percentage reporting "very serious". However, the correlation of 0.83 between these measures indicates they have reasonable alignment, despite the very different levels between the two. Fig. 2.1 shows the scatterplot for these two measures for the years in which they overlap. If showing the same cross-national differences, we should expect scatterplots to show all countries in a relatively straight diagonal line. The dashed line on the diagonal reflects equality – plots above this indicate the y-axis variable is greater than the x-axis variable in that country, while plots below indicate the x-axis variable is greater. A LOWESS line is also overlaid to show the smoothed relationship between measures. This shows there is a reasonable positive relationship between the measures, though they do skew towards higher values for "serious" which is inevitable given this captures both "somewhat" and "very" serious responses. Because of this, the extent of linear correlation looks like it is reduced by a ceiling effect, as when the percentage of "very" responses approaches 100 then the percentage of the combined measure has limited room to be much higher.

Table 2.2: Cross-correlation matrix between measures of climate opinion

	GlobeScan very serious problem	GlobeScan serious problem (very + somewhat)	Pew very serious problem	Pew major threat	Gallup CC serious threat	Gallup GW serious threat	LAPOP very serious problem	Eurobarometer very serious problem	Eurobarometer most serious problem	Eurobarometer main env. issue	Eurobarometer CC top four env.	HSBC worried	EIB CC biggest challenge
GlobeScan very serious problem	**1 (186; 15; 36)**	0.83 (80; 5; 35)	0.59 (39; 4; 18)	0.68 (12; 2; 7)	0.55 (25; 1; 25)	0.49 (18; 2; 9)	0.91 (3; 1; 3)	0.40 (24; 6; 6)	0.11 (24; 6; 6)	0.03 (4; 2; 2)	-0.48 (6; 1; 6)	0.46 (27; 4; 7)	-0.60 (8; 1; 8)
GlobeScan serious problem (very+somewhat)	0.83 (80; 5; 35)	**1 (138; 7; 35)**	0.38 (16; 1; 16)	0.65 (13; 2; 13)	0.45 (55; 2; 31)			0.77 (17; 3; 8)	-0.19 (17; 3; 8)		-0.58 (6; 1; 6)		-0.29 (26; 3; 10)
Pew very serious problem	0.59 (39; 4; 18)	0.38 (16; 1; 16)	**1 (115; 4; 47)**			0.66 (42; 2; 24)		0.72 (12; 2; 7)	0.72 (12; 2; 7)	0.35 (10; 1; 10)		0.39 (25; 3; 10)	
Pew major threat	0.72 (25; 3; 16)	0.61 (26; 3; 16)		**1 (154; 6; 50)**			0.92 (5; 2; 5)	0.75 (18; 2; 11)	0.19 (18; 2; 11)		0.27 (10; 1; 10)		-0.43 (10; 1; 10)
Gallup CC serious threat	0.55 (25; 1; 25)	0.45 (55; 2; 31)			**1 (158; 2; 81)**			0.50 (53; 2; 28)	-0.11 (53; 2; 28)		0.34 (27; 1; 27)		-0.10 (58; 2; 30)
Gallup GW serious threat	0.49 (18; 2; 9)		0.66 (42; 2; 24)			**1 (148; 2; 76)**		0.32 (22; 1; 22)	-0.04 (22; 1; 22)			−0.39 (26; 2; 14)	
LAPOP very serious problem	0.91 (3; 1; 3)			0.92 (5; 2; 5)			**1 (36; 2; 20)**						
Eurobarometer very serious problem	0.40 (24; 6; 6)	0.77 (17; 3; 8)	0.72 (12; 2; 7)	0.75 (18; 2; 11)	0.50 (53; 2; 28)	0.32 (22; 1; 22)		**1 (305; 8; 29)**	0.47 (305; 8; 29)	0.43 (27; 1; 27)	0.57 (56; 2; 28)	0.93 (9; 2; 3)	0.35 (55; 2; 28)
Eurobarometer most serious problem	0.11 (24; 6; 6)	-0.19 (17; 3; 8)	0.72 (12; 2; 7)	0.19 (18; 2; 11)	-0.11 (53; 2; 28)	-0.04 (22; 1; 22)		0.47 (305; 8; 29)	**1 (305; 8; 29)**	0.71 (27; 1; 27)	0.69 (56; 2; 28)	0.72 (9; 2; 3)	0.77 (55; 2; 28)
Eurobarometer main env. Issue	0.03 (4; 2; 2)		0.35 (10; 1; 10)					0.43 (27; 1; 27)	0.71 (27; 1; 27)	**1 (79; 3; 27)**		0.05 (3; 1; 3)	
Eurobarometer CC top four env.	-0.48 (6; 1; 6)	-0.58 (6; 1; 6)		0.27 (10; 1; 10)	0.34 (27; 1; 27)			0.57 (56; 2; 28)	0.69 (56; 2; 28)		**1 (56; 2; 28)**		0.42 (28; 1; 28)
HSBC worried	0.46 (27; 4; 7)		0.39 (25; 3; 10)			-0.39 (26; 2; 14)		0.93 (9; 2; 3)	0.72 (9; 2; 3)	0.05 (3; 1; 3)		**1 (57; 4; 15)**	
EIB CC biggest challenge	-0.60 (8; 1; 8)	-0.29 (26; 3; 10)		-0.43 (10; 1; 10)	-0.10 (58; 2; 30)			0.35 (55; 2; 28)	0.77 (55; 2; 28)		0.42 (28; 1; 28)		**1 (90; 3; 30)**

Figure 2.1: GlobeScan: serious problem (somewhat + very) vs very serious problem

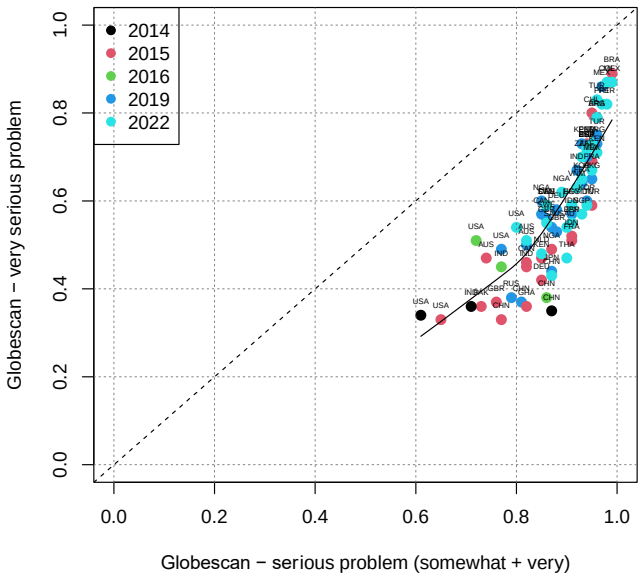
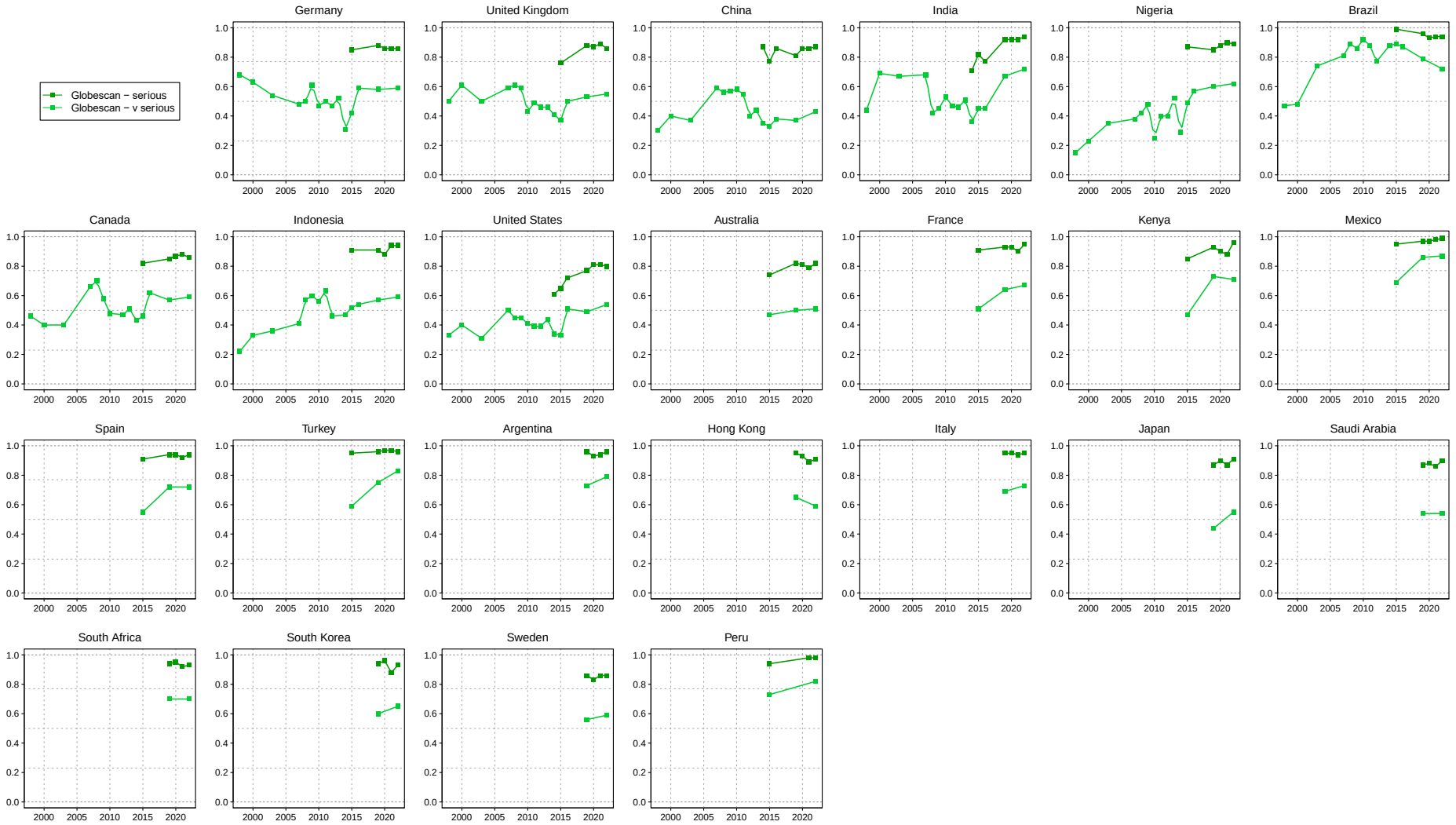


Fig. 2.2 plots the two measures over time for the 25 countries which have both measures and multiple years of data. The data points are connected by a line using simple linear interpolation. For most countries the "very" measure shows much greater variation while the combined measure shows very little within-country change and, as it is reaching the upper bound it unfortunately does not tell us much about variation over time in latter years of the series due to the ceiling effect. Because of the lack of variation in GlobeScan's "somewhat" measure (Fig. 2.2; Fig. 2.5), by including this variable this may be creating some insensitivity and flattening out trends as the sense of there being a single underlying pattern of change within a country is not really borne out when considering both of them simultaneously.[6] However, while the combined measure may not tell us much about patterns of change over time for the countries in which it is flat, it still tells us interesting information on cross-national differences. For example, the gap between the two series differs significantly between countries. If you compare Indonesia, the US and Australia, their "very" measure is relatively similar but the "somewhat" measure in Indonesia is well above the others.

[6] To test this, the Bayesian model that is used to combine the measures was run excluding the combined measure (see Fig. A10), the results of which suggest that substantive conclusions are largely the same regardless of inclusion.

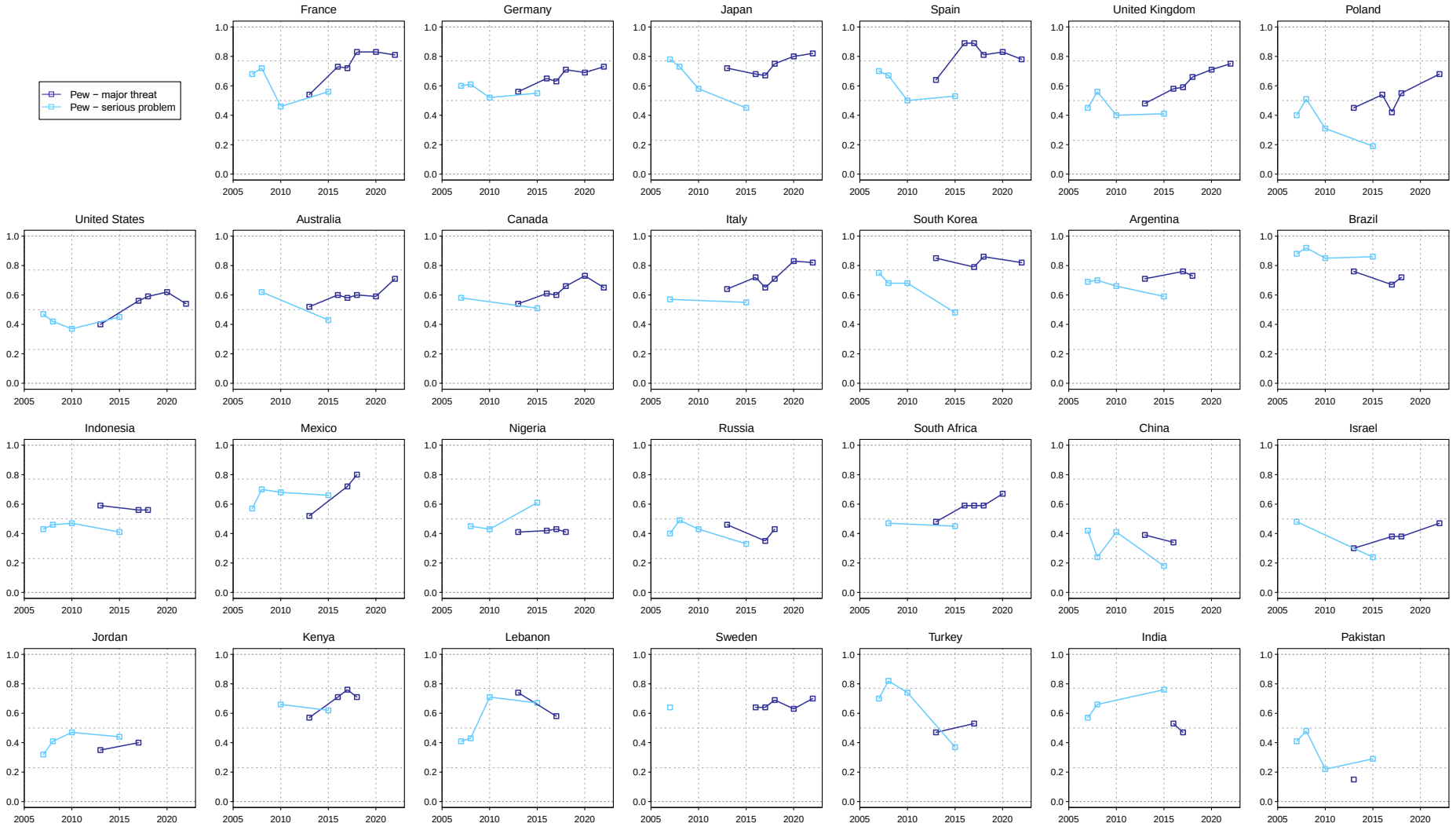
Figure 2.2: GlobeScan: climate change a serious problem (somewhat + very) vs very serious problem, by country

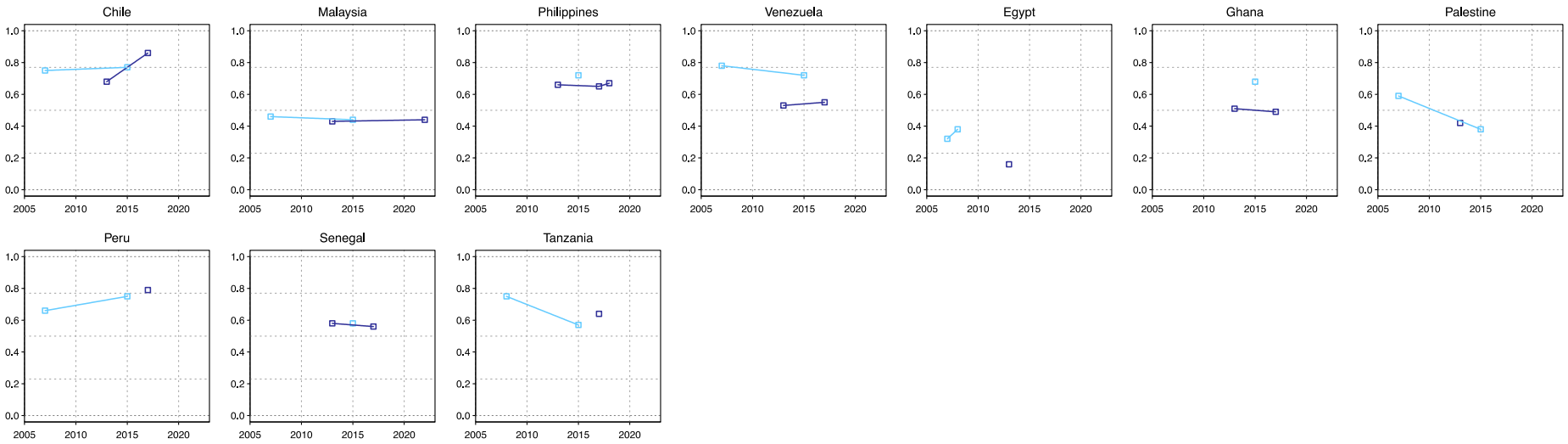


This indicates that people are more reluctant to say they are somewhat concerned in the latter two countries. Likewise, India's combined measure is very similar to Indonesia's, but the proportion saying they are "very" concerned is far greater. China in particular has a high combined measure but a low number of people saying it is very serious, which might indicate a cultural phenomenon whereby people are more reluctant to provide the most severe response.

The two measures from Pew are measured using different question wording and have no overlapping years, however, by plotting them against one another we can analyse whether they seem to be telling the same story. Out of those fielded by the same organisation, these measures are some of the most different in wording as one reflects whether climate change is a serious threat to the country, while the other reflects whether it is a very serious problem. Fig. 2.3 plots the 35 countries which have had both measures fielded and data for three or more years. Though we cannot know whether the "serious problem" measure would follow the same upwards trend in recent years, for the years where they are successive the measures track each other closely in most countries, with no systematic level differences between the two questions. This is particularly the case for countries such as Canada, Germany, Kenya, Russia and the US. Though the two measures do not overlap so we cannot compare direct correlation, as shown in Table 2.2, both have very similar correlations with other polls which further suggests they are behaving similarly with respect to other measures. This indicates that despite their different wording these two measures are capturing a similar underlying metric of climate opinion.

Figure 2.3: Pew: climate change a major threat vs a serious problem, by country




Chile
Malaysia
Philippines
Venezuela
Egypt
Ghana
Palestine
Peru
Senegal
Tanzania
1.0
0.8
0.6
0.4
0.2
0.0
2005
2010
2015
2020

The two Gallup measures likewise have no overlap due to the question wording changing over time from "global warming" to "climate change". While these terms are fairly interchangeable, the wording also changed from asking whether the issue was a serious threat to the respondent and their family, to whether it was a serious threat to the people of the country in the next 20 years. There are 68 countries that have all four years of survey data for Gallup, however, as highlighted by Table 2.1 there is a nine-year gap in-between the two, which means that plotting the two will not allow us to assess whether there is a structural break between the two question wordings.

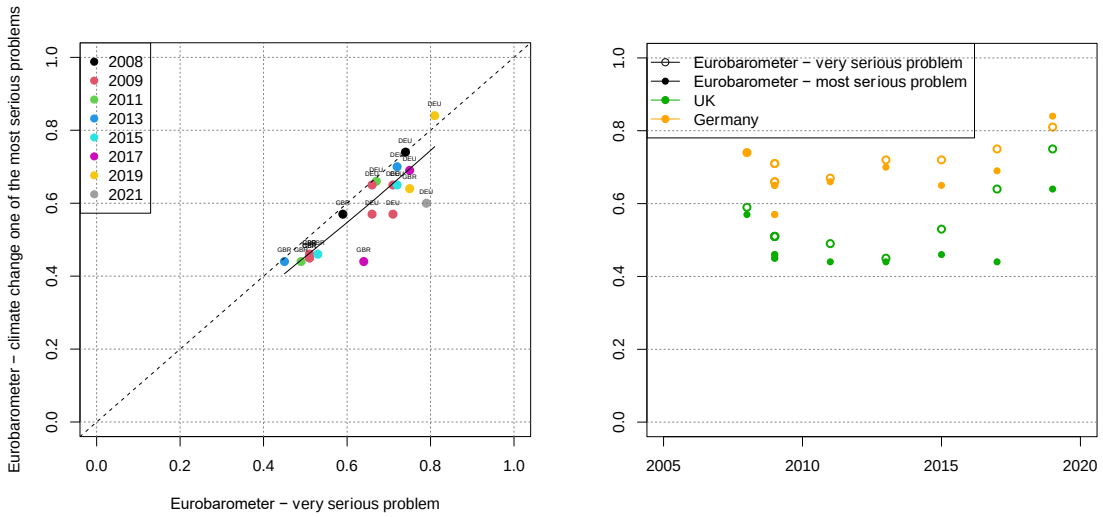
As the final survey organisation with multiple items, and also the item which overlaps the two groups shown in Table 2.2, Fig. 2.4 compares two of the Eurobarometer measures for the UK and Germany. Fig. 2.4 shows that, for the UK and Germany, Eurobarometer's "most important problem" (MIP) style measure is relatively well aligned to the measure of perceived seriousness of climate change. The exception to this is UK responses in 2017, where the proportion reporting climate change as one of the most important problem falls below the proportion believing it to be a very serious problem, indicating the measure may capture the issue being crowded out by other topical issues – particularly Brexit. The MIP style measure also slightly underestimates the perceived seriousness of climate change, though not for Germany in 2019. Nonetheless, it is a reasonably good reflection of broader concern, though this is not the case for all countries.[7]

It is worth noting that the Eurobarometer measure is far higher than usual "most important problem" style measures, with over 40% in the UK and over 60% in Germany reporting climate change as one of the most serious problems facing the world across the whole period. There are multiple reasons why this may be the case, and why the measure may produce different results to the "most important problem" measures used in later chapters. The first is the question wording, which is: *which of the following do you consider to be the single most serious problem facing the world*

[7] See Appendix A – Fig. A1 for a full comparison of these measures for all countries.

as a whole? Which others do you consider to be serious problems?, this differs to later measures both in reference to it being a global issue vs a country-level one, as well as it being "serious problems" compared to "most important issues".[8] Another significant reason for difference is that Eurobarometer respondents are presented a list of issues which they can pick from, while other measures are open-ended and unprompted. Finally, the Eurobarometer measure permits respondents to report up to three further issues that they consider to be serious problems, the final measure therefore incorporates anyone who lists climate change in their top four issues and thus will intrinsically be higher.[9]

Figure 2.4: Eurobarometer: climate change "very serious problem" vs "most serious problem", UK and Germany



Having considered how well survey items compare within polling organisations, the next consideration is to what extent are they moving over time within countries in the same way. For instance, when comparing survey items between countries, they should be stable relative to each other globally and given that, implied country differences should be similar across measures. In

[8] The public salience measures used in Chapter Three and Four ask respondents what the most important problem is facing Britain today, and in Germany at the moment, respectively. Both are unprompted.
[9] The British measure in Chapter Three allows two responses while the German measure in Chapter Four only incorporates two top issues.

considering such, any discrepancies give indication that features of the survey item have influenced results. Fig. 2.5 plots all core survey measures by country to assess whether they show broad patterns of change over time, particularly in countries where there are more data points.[10] Once again, countries are ordered by decreasing data coverage and poll data points are connected by linear interpolation.

Across countries the latter Gallup indicator tends to produce far less pro-climate responses. Interestingly, in over half of the countries the measure shows a decline in the perceived threat of climate change between 2019-2021, despite the rising concern that is evidenced by other surveys. This may be due to the negative effects of the pandemic, as environmental concerns are argued to fall during times of economic hardship (cf. Inglehart et al. 2017), as well as in response to other issues in line with the "finite pool of worries" hypothesis (Weber 2006). Though, this is not the case for all countries, with 34 countries reporting an increase in the perceived threat for this period. In countries where trends are not consistent across survey organisations, many of which are due to Gallup measures showing a downwards trend while other measures show an increase in concern.

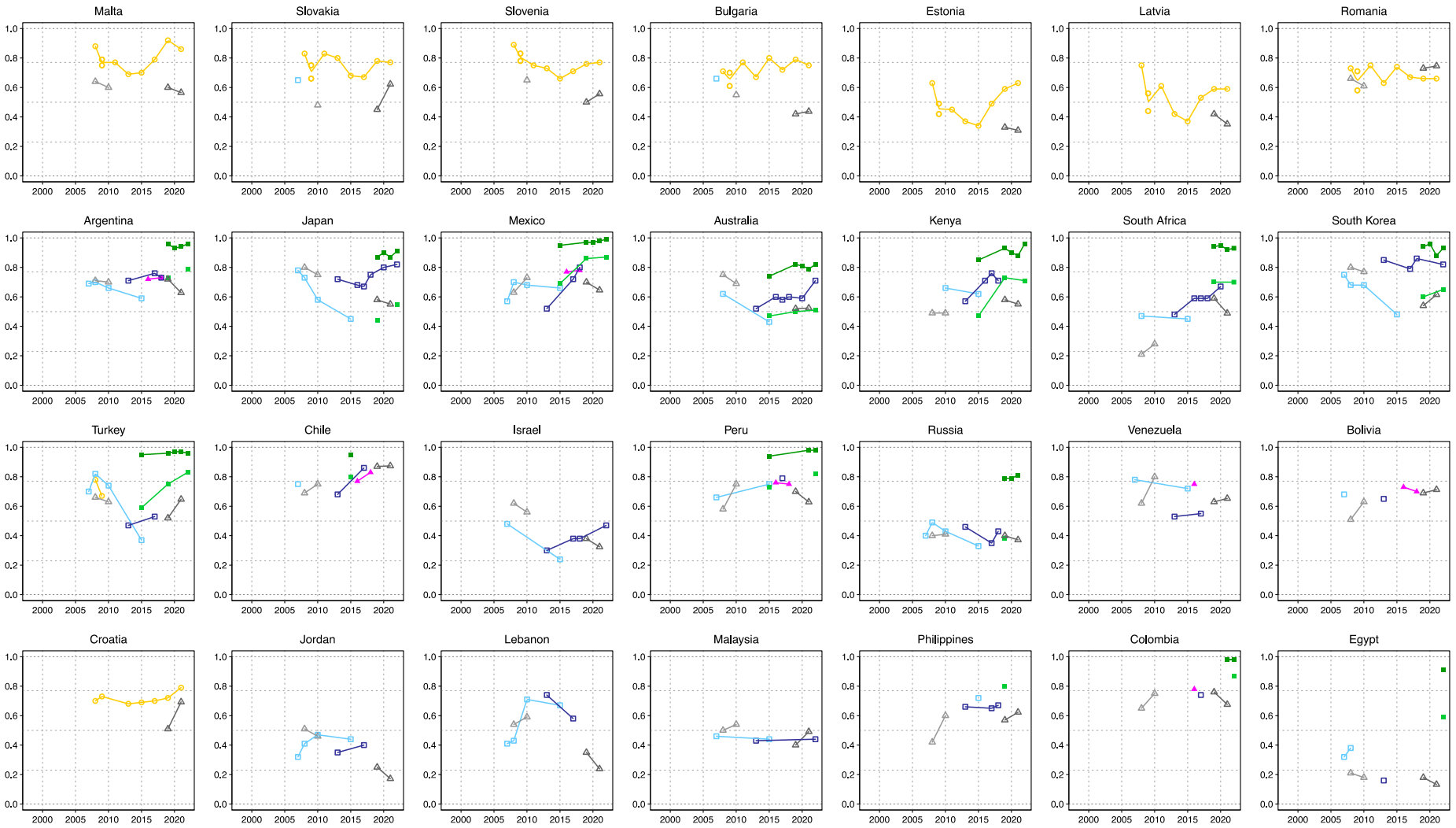
By contrast, Eurobarometer responses tend to produce more climate conscious responses than other counterparts. This may be due to it being measured on a scale, with "very serious" responses incorporating anything between 7-10. When comparing the dark blue line, which reflects Pew's measure of people thinking climate change is a "major threat", against the yellow line of Eurobarometer's respondents thinking it is a "very serious" problem, this highlights that the differences between the levels of these variables depends on the country which they are fielded in. For example, in Germany the Eurobarometer measure produces more pro-climate responses than the other, while in Greece and the UK this is not the case. In Italy, France and Spain this used to similarly be the case, but these measures have now converged. The fact that the relationship between measures is unstable and that the same measures are not relating to each other in the same

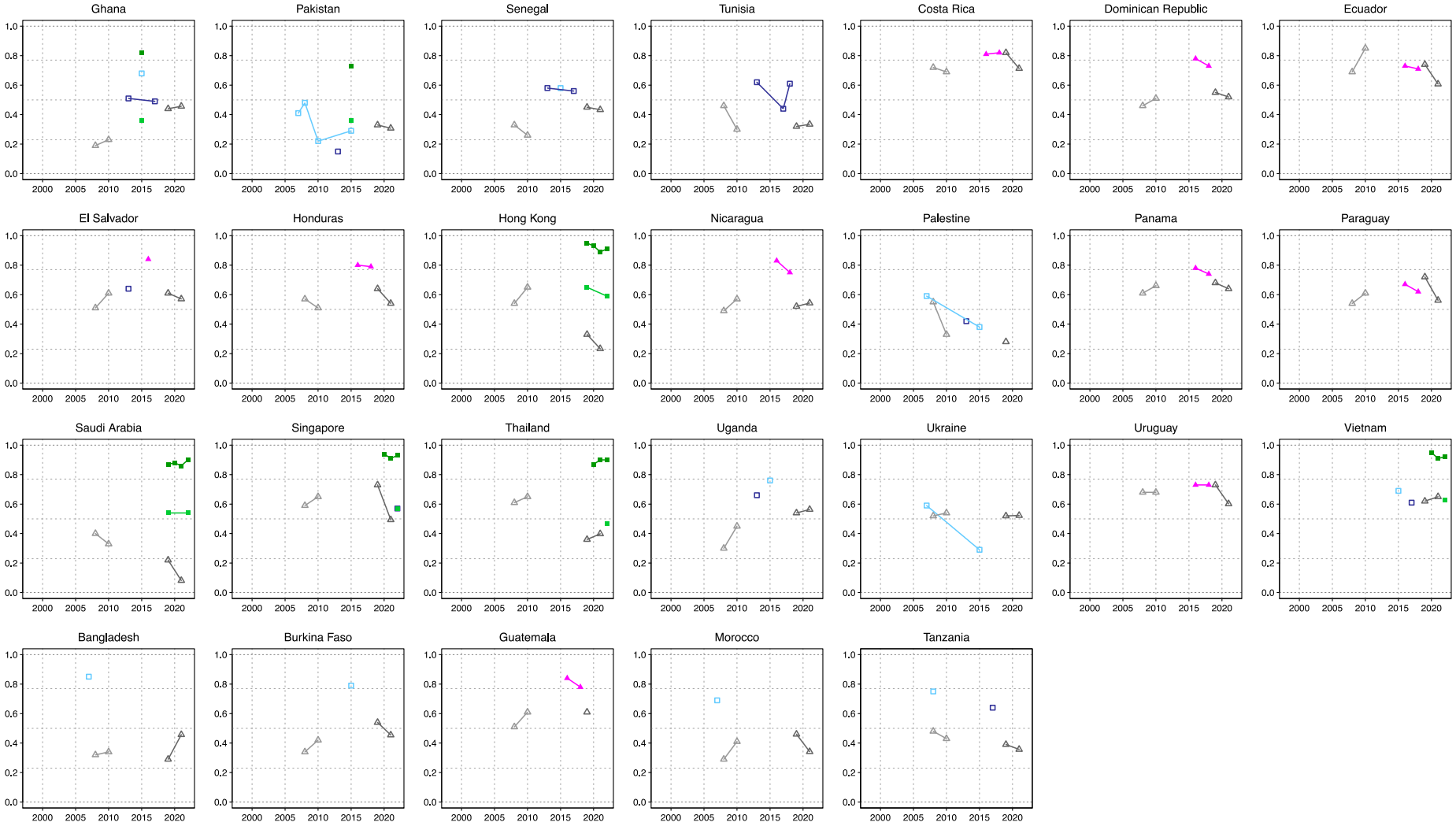
[10] A graph containing all the survey items in Table 2.1, including the "MIP" style measures, can be found in Appendix A – Fig. A12.

way in different countries is problematic, suggesting that underlying these measures might be important differences in how the surveys are run, both within and between survey organisations. For example, within Pew the methodology for Greece might be different to other countries. This may also be similarly caused by discrepancies in translation and different contextual interpretation of the meaning of the question.

With much research into climate opinion having been concentrated in the US, it is noteworthy that this is one of the countries that shows close alignment between polls. This fits with Chen et al.'s (2021) finding that different question wording produced similar outcomes for the US. The same measures are also available for other countries, however, the same story is not true of other countries, for which we instead cannot extrapolate that different measures of opinion similarly tell us about trends in public opinion. Some countries such as the US, the UK, Canada, Russia, and Argentina show close alignment between the different polls, with the plots close to one another and largely following the same trend over time. In Germany, all measures have shown a general pattern of a drift downwards followed by an increase in concern, despite there being some differences in absolute levels. Other countries such as Japan, Poland, and Sweden have far greater deviation between surveys, with the plots spaced apart and/or following divergent trends. This indicates that different polling firms in countries such as the UK mostly reach similar conclusions on attitudes of the public, while in countries such as Poland there is far greater sensitivity to the survey provider and/or measure. Likewise, in Indonesia and India there are mixed results between polls, making it hard to gauge the overall trend from Fig. 2.5 alone. In such cases it is perhaps not surprising that the quality of survey measures for different countries have led to different conclusions about time trends. This suggests that we cannot make the blanket decision to group survey items together without a careful consideration of country-level dynamics. Overall, these findings indicate that research needs to be cautious in solely relying on a single metric of climate opinion from one source, as variance between measures can result in different interpretations of cross-national differences and within-country change.

Figure 2.5: Climate poll comparison for 81 countries, 1998-2022


Malta
Slovakia
Slovenia
Bulgaria
Estonia
Latvia
Romania
Argentina
Japan
Mexico
Australia
Kenya
South Africa
South Korea
Turkey
Chile
Israel
Peru
Russia
Venezuela
Bolivia
Croatia
Jordan
Lebanon
Malaysia
Philippines
Colombia
Egypt
0.0
0.2
0.4
0.6
0.8
1.0
2000
2005
2010
2015
2020


Ghana
Pakistan
Senegal
Tunisia
Costa Rica
Dominican Republic
Ecuador
El Salvador
Honduras
Hong Kong
Nicaragua
Palestine
Panama
Paraguay
Saudi Arabia
Singapore
Thailand
Uganda
Ukraine
Uruguay
Vietnam
Bangladesh
Burkina Faso
Guatemala
Morocco
Tanzania
0.0
0.2
0.4
0.6
0.8
1.0
2000
2005
2010
2015
2020

2.4.2 A Bayesian model of cross-national climate consciousness

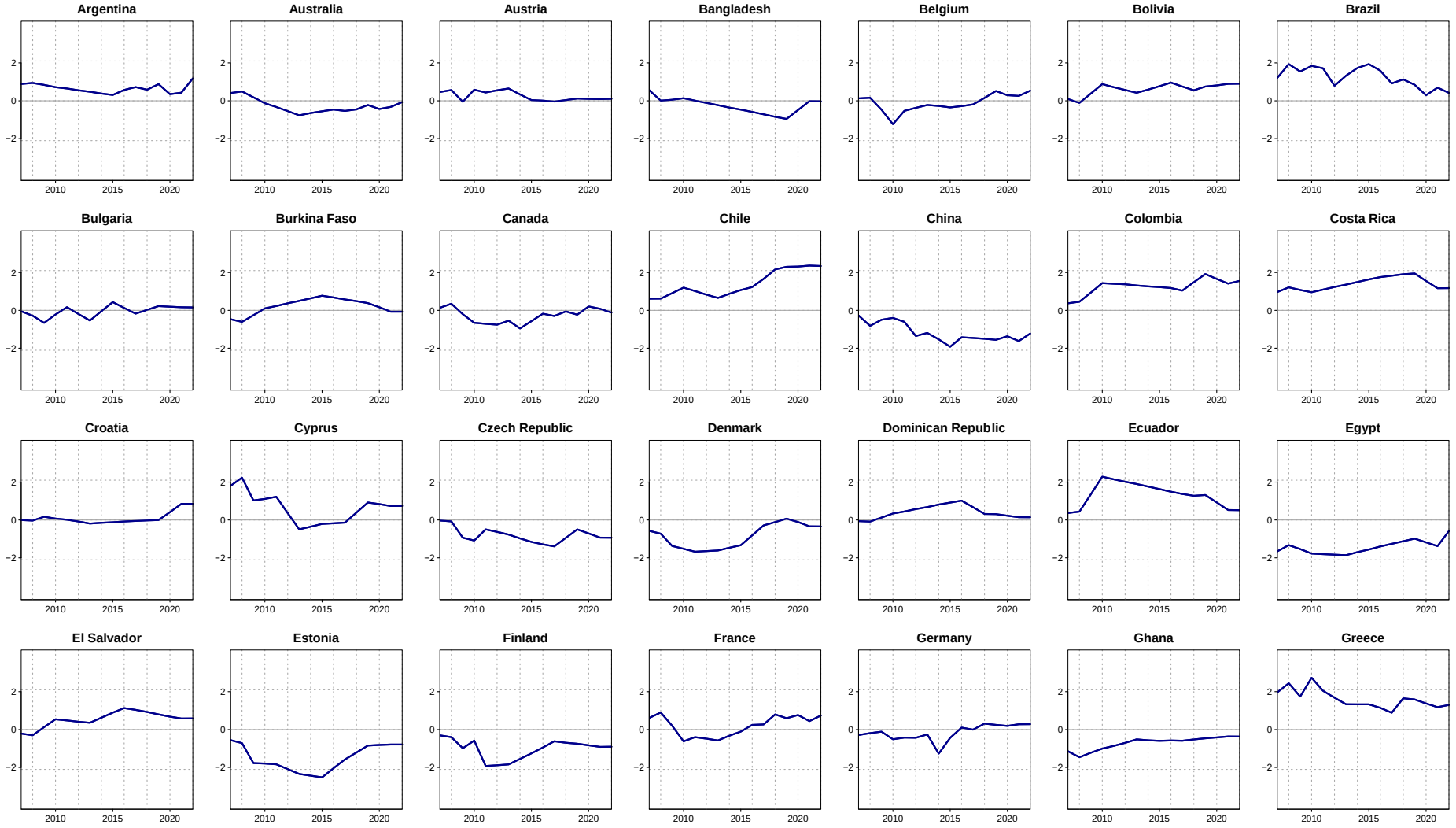
Given the gaps in coverage and the potential problems with relying on a sole survey item, to produce metrics of climate consciousness for each country-year in order to better understand trends over time, this paper utilises Claassen's (2019) dynamic Bayesian latent variable model. Under the binominal specification the probability parameters, that is the probability of a pro-climate response, are modelled as a function of country-year latent effects. The model also factors in item intercepts (to account for varying bias effects of different survey items), item-country intercepts (to account for varying item bias across countries), and item slopes (to consider the reliability of survey items and the covariance of item effects). These are modelled hierarchically, so that the specification 'shrinks the item intercepts toward the mean to the extent that data are scarce, which guards against small within-item samples producing extreme estimates' (Claassen 2019: 5). The estimates are then smoothed over time using a local-level dynamic linear model to predict any gaps within the series for each country. The model was run using data from 2007 onwards (as this is the point at which there is more than one data source available) and using all survey items other than the MIP style measures, due to these having low covariance with other key survey items in many countries and thus not being entirely useful metrics when considering climate consciousness as a whole.[11, 12] The model was also specified with four parallel chains which were each run for 2000 iterations, with the warm-up utilising and then discarding the first 500 samples and the model thinning the remaining samples of the posterior density by half after such. Post-diagnostics indicated that this allowed for convergence of the MCMC simulation, as well as the R-hat value falling between 0.95-1.05 for all parameters, confirming that the estimates of climate consciousness are reliable.[13]

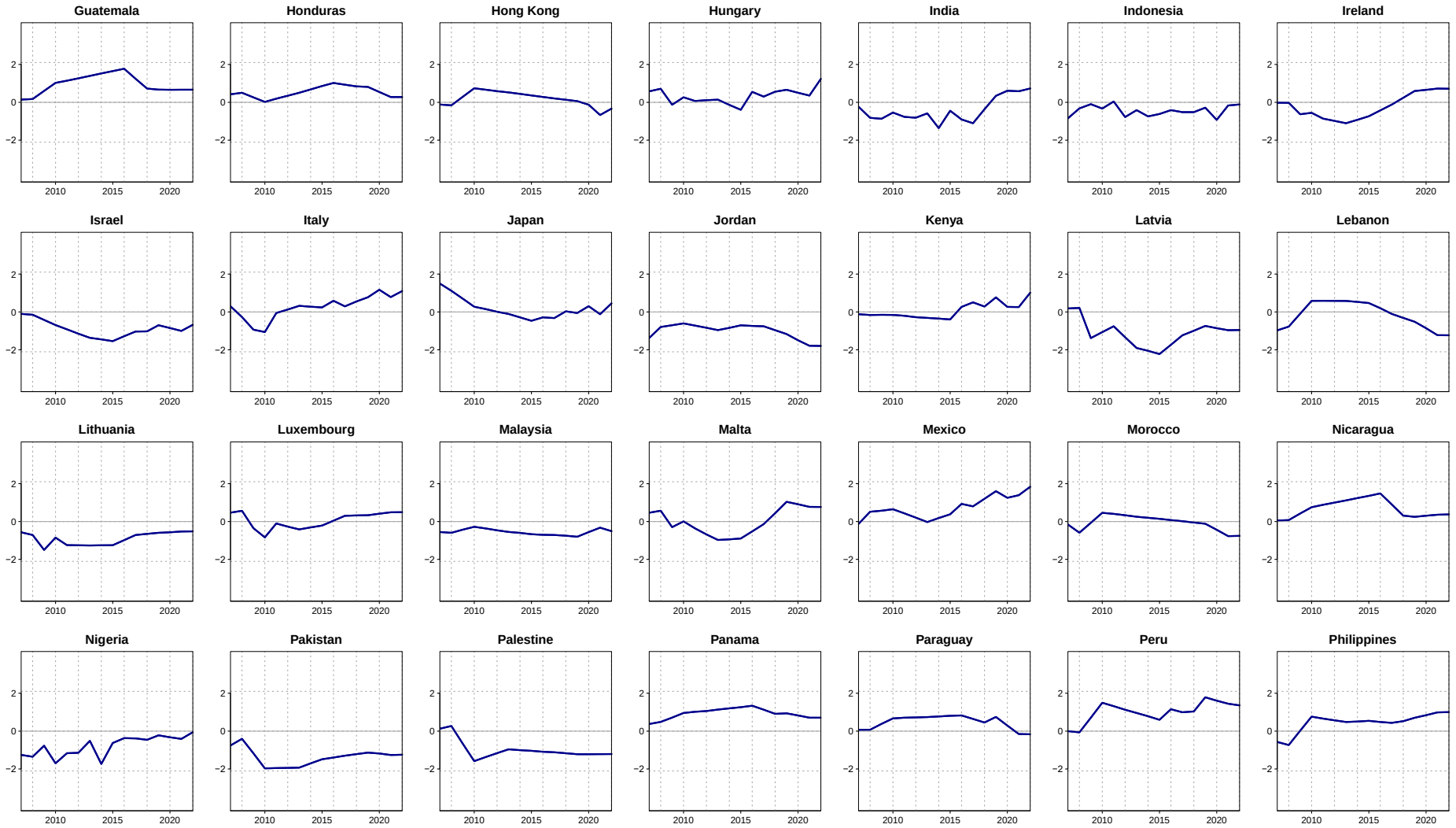
[11] Trying to model the data from 1998 onwards caused issues with uncertainty due to there only being data points for a smaller set of countries and from a single survey organisation.
[12] See Figure A11 for results of including all variables in the model.
[13] See Appendix A for diagnostics plots.

Cross-national distributions of the latent estimates of climate consciousness that were produced for each country-year are shown in Fig. 2.6. Estimates of climate consciousness (θ), that is the predicted probability of offering a climate conscious opinion, are shown by the dark line, which plots the posterior means for each country. The lighter lines show two-hundred random draws from the posterior distribution of θ and can be taken as highlighting the level of uncertainty in the data, with noisier estimates for countries where there is either little data, or disagreement between survey items. Countries are plotted on the same standardised scale to other countries with the cross-national mean over the whole period equal to zero so, while it may appear that some are not showing much change over time, if plotted on smaller scales they can show much greater within-country change. Though, the equal axis gives better indication of the central tendency of cross-national opinion, dispersion of differences, and the scale of change over time relative to other countries. Fig. 2.7 plots the estimates for a select number of countries which showed interesting dynamics, with the darker lines once again reflecting the posterior means for each country. The circles plot observed survey responses, which are standardised within survey items so that they can be plotted on the same scale. Survey questions with a weaker association with the underlying latent trait have less weighting, which is why there can be differences between observed and estimated plots.

Due to greater data coverage, Western countries are more likely to have their trends confirmed with less uncertainty in the estimates. The results are highly reliant on GlobeScan's findings in many contexts due to this having the greatest temporal and country coverage and, while this preliminary analysis is the best that can be carried out given the available data, conclusions must be taken in light of uncertainty in the estimates. Nonetheless, many of these countries have yet to be included in prior analyses and, while their datapoints are limited, the results of Fig. 2.5 and Fig. 2.6 give important insight into trends in climate opinion for countries which are not well documented.

Figure 2.6: Bayesian estimates of climate consciousness for 81 countries, 2007-2022




Guatemala
Honduras
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India
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Israel
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Japan
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Luxembourg
Malaysia
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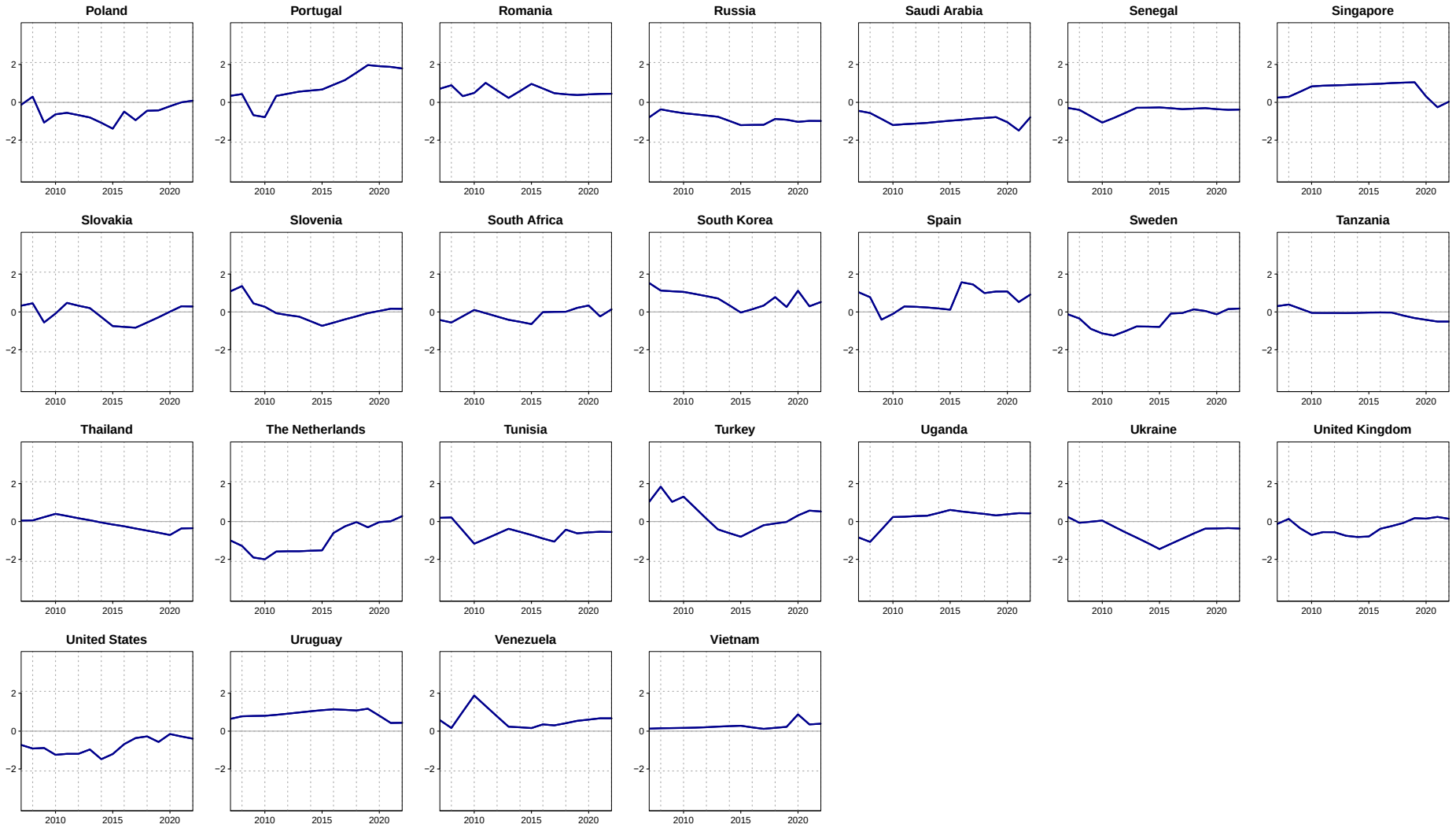
Poland
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South Korea
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The Netherlands
Tunisia
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2020

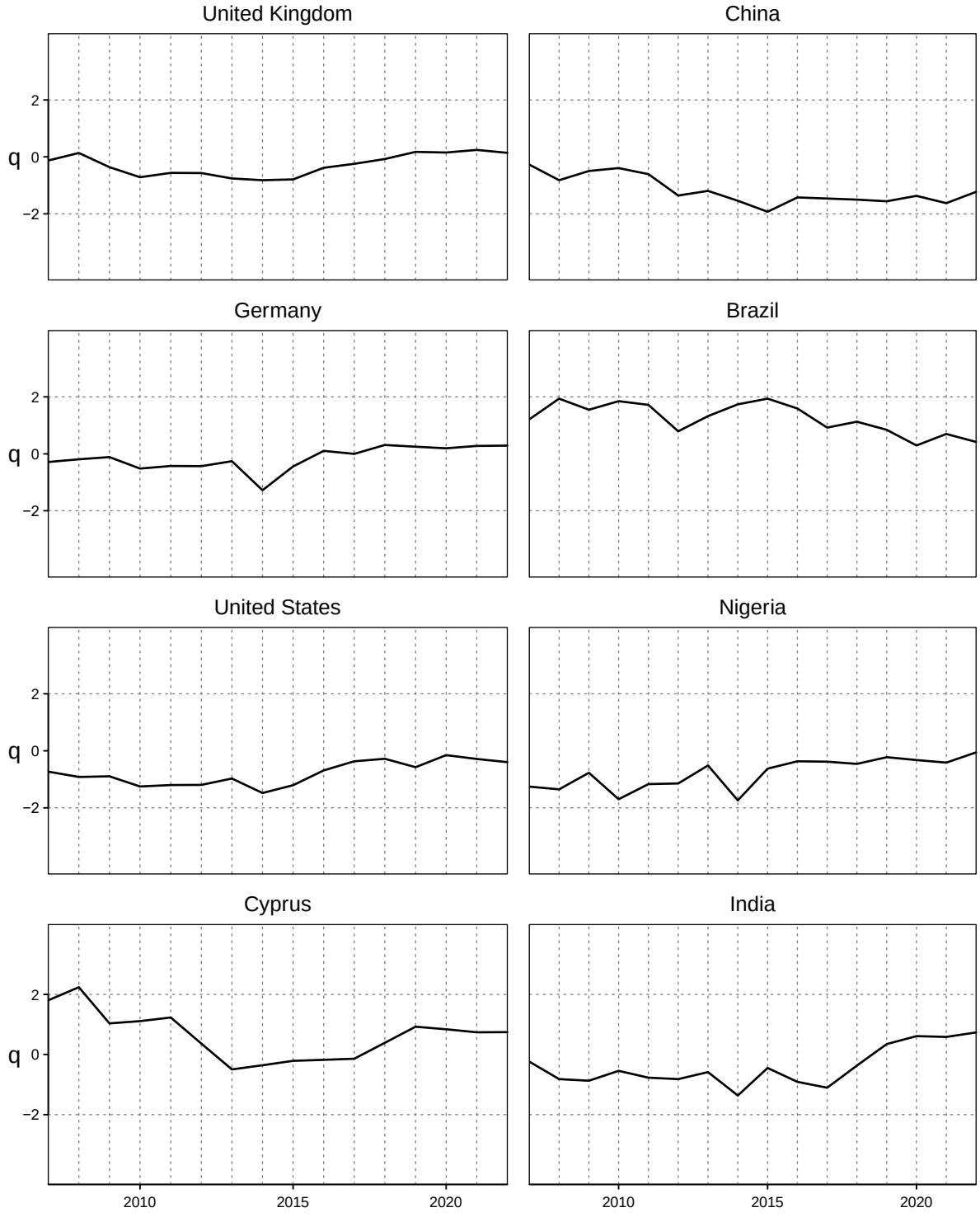
Existing literature emphasises that economic conditions influence environmental concern (Running 2012; Inglehart et al. 2017; Kenny 2019), so does change over time within countries give evidence in support of this? For the period following the 2008 financial crisis until recovery around 2013 there is a downwards trend and therefore evidence for economic effects in some countries, but not all. This effect is particularly pronounced for France, Greece, Portugal, the UK, Spain, Canada, Cyprus, the Czech Republic, Turkey, Finland, Ireland, and China. However, not all countries were negatively impacted by the recession, despite some having similar economic conditions. For example, Mexico saw a significant drop in GDP in 2008 but this appears to have had little impact on climate consciousness, though this may be due to unemployment not changing substantially (see Fig. A9). The dip in concern around this period is also heightened by the Climategate scandal in 2009, which increased climate scepticism (Kenny 2021).

When considering the period as a whole, however, levels of concern do not closely correspond to economic conditions, with climate consciousness being only weakly correlated with unemployment (-0.10), GDP per capita (-0.09), and GDP per capita growth (-0.02). This means that general economic conditions do not appear to explain cross-national differences in the absolute level of climate consciousness, with high consciousness in some countries such as Chile, Brazil and Mexico despite below-average economic conditions, and low consciousness in other countries such as China, the US and Australia despite economic conditions being more favourable (Table A4; Fig. A9). Though, for China while GDP growth is very high, GDP per capita is not, highlighting the need to consider economic inequality.

Prior studies on the determinants of environmental/climate opinion have by-and-large focused on Eurocentric countries, particularly the US, which is unsurprising given the data availability evidenced in Fig. 2.5. However, Fig. 2.6 highlights that the patterns in countries such as the US differ greatly to other less commonly polled countries, both in

terms of trends over time and alignment between survey items. Because of this, the factors which drive public concern over time may not impact all countries in the same way, and findings may not be generalisable across contexts, making contextual investigations necessary.

Figure 2.7: Climate consciousness with observed survey responses, 2007-2021



There has been significant focus given to climate change in recent years by the media, politicians and public, for example through large-scale climate protests which occurred from 2019 onwards. Given this, to what extent does the data support the idea of rising public concern across different countries? In many countries there is clear evidence for public consciousness having increased, with a spike in the number of the public recognising climate change as a problem around 2019. In line with the recent wave of environmentalism, some countries have experienced an upwards trend in climate consciousness in recent years, including the UK, Germany, Italy, France, the Netherlands, Turkey, the US, Canada, Mexico, India and Kenya. For some countries such as Japan, there is evidence for increased consciousness in recent years, even if those levels do not exceed prior peaks in earlier years. Other countries such as Brazil, Spain, and Greece have been some of the most conscious throughout the period, though they have instead seen a decrease in more recent years. Peru, the Czech Republic, Lebanon and Jordan have similarly seen a potential decrease in climate consciousness. By contrast, some countries have had consistently lower levels and have not evidenced much change in climate consciousness, including Romania, Russia, Indonesia and to some extent Australia and China. Note, this contrasts with EIB results which suggest that China is very concerned about climate change, with 73% of respondents saying climate change is one of the three biggest challenges facing citizens in China in 2019, though this fell to 61% in 2020 and 58% in 2021 (see Fig. A12). It may be that there are important methodological differences between conducting surveys via the internet (as done by EIB) and face-to-face (as done by Gallup) in China, as well as in some other countries. There may also be cultural tendencies to say "don't know" or not provide more severe responses to survey questions (as shown in Fig. 2.2), which may be misleading as to international differences in climate consciousness, and further research on this would be beneficial.

When looking at the period 2019-2021, there is also evidence for fallout from the pandemic.[14] Countries such as Mexico and Kenya saw a fall around the Covid-19 pandemic in 2020 and a return to higher levels in 2021, with climate consciousness continuing to rise afterwards. Indonesia saw a dip in 2020 and a return to its relatively flat level after such. Spain and Italy saw a dip in 2021 and a subsequent rise. By contrast, countries such as the UK, the US, Canada, Germany and India saw their highest levels of climate consciousness in 2019 but, while still exhibiting higher consciousness, they have not quite returned to those levels following the pandemic and recognition of climate change has flattened off. In particular, climate consciousness appears to have fallen in the UK, Canada and the US in 2022. The slump across many countries may give further evidence for economic factors having an impact, though whether this is purely due to negative economic conditions or rising worries in other policy areas such as healthcare is unclear. Nonetheless, this might give evidence for the "finite pool of worry" explanation, whereby existing concerns about climate change are pushed out by emergence of a new concern (Weber 2006).

If we assume that the metrics of climate consciousness in Fig. 2.6 are accurate, irrespective of varying uncertainty, what do these results tell us about the state of global recognition of climate change as a whole? United Nations' World Population Prospects estimates were used to assign a population weighting to each country-year in the analysis, based upon their proportion of the world's population for each year. This was then used to calculate an overall mean measure which reflects global climate consciousness. By including 81 countries in this analysis, the mean captures 83% of the global population as of 2022, giving a good understanding of climate opinion for a significant proportion of the world's population.

[14] This was particularly pronounced when running the model including "MIP" style measures.

As pictured in Fig. 2.8, between 2007-2022 global climate consciousness has been characterised by several changes. Globally, there was a dip in consciousness around 2008, with climate consciousness generally continuing to fall after this point until reaching the lowest levels of climate consciousness in 2014. A sharp rise in concern between 2017-2020 is also evident, as well as a dip in 2021 in line with occurrence of the Covid-19 pandemic, and a subsequent rise in concern in 2022. With the graph being centred at zero – which is equal to the simple mean across the 81 countries – it is worth noting that the global population-weighted average falls below this point.

Figure 2.8: Global climate consciousness, 2007-2022

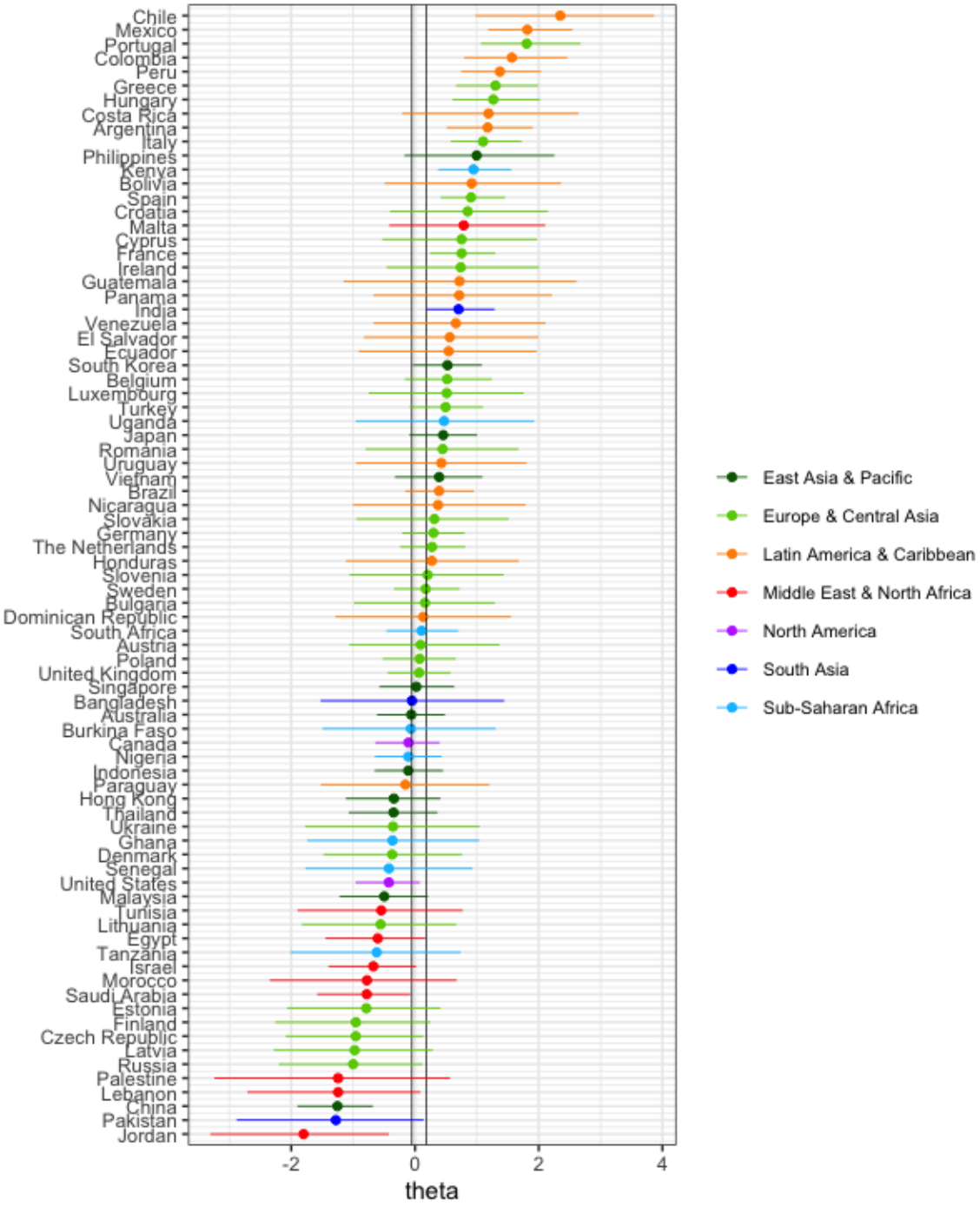
This is largely driven by China, which captures 18-20% of the world's population across the series and has consistently had lower levels of climate consciousness relative to the cross-country mean, as well as India, which has 17-18% of the global population and estimates below the midpoint until 2018 (Fig. 2.7). The third most populous country after this is the US, capturing between 4-5% of the world's population across the series and

having below average climate consciousness until 2017. Despite this, the trend confirms that global climate consciousness has been moving in a pro-climate way as a whole over the last eight years and is now at its highest ever level.

Given that climate consciousness is at its highest ever level, how does this play out in terms of cross-national differences? Fig. 2.9 plots the theta estimates for 2022 for each country, with the bars showing 95% confidence intervals (see also Table A5). The simple global mean for 2022 (0.18) and the population weighted global mean (-0.05) are shown by the two vertical lines. Fig. 2.9 shows that for 2022, the greatest number of the public recognise the issue of climate change in Chile, while the lowest number do so in Jordan. Though they are ranked by their mean theta estimate which shows variation between contexts, due to the large confidence intervals it is not possible to discern significant differences in climate consciousness for many countries which fall in the middle of the rankings.

World Bank Development Indicators (2022) were used to categorise countries by region and income groups. The countries shown in Fig. 2.9 include thirty in the Europe and Central Asia region, eleven in East Asia and Pacific, three in South Asia, two in North America, eighteen in Latin America and the Caribbean, nine in the Middle East and North Africa, and eight in Sub-Saharan Africa. In Fig. 2.10 the high income group comprises thirty-seven countries, upper middle income twenty-two, lower middle income twenty, and low income only two countries. There is no clear-cut distinction between the different regions, though many of the most climate conscious countries are Latin American and those from the Middle East and North Africa are less climate conscious on average (Fig. 2.9).

Figure 2.9: Estimates of climate consciousness by country and region, 2022

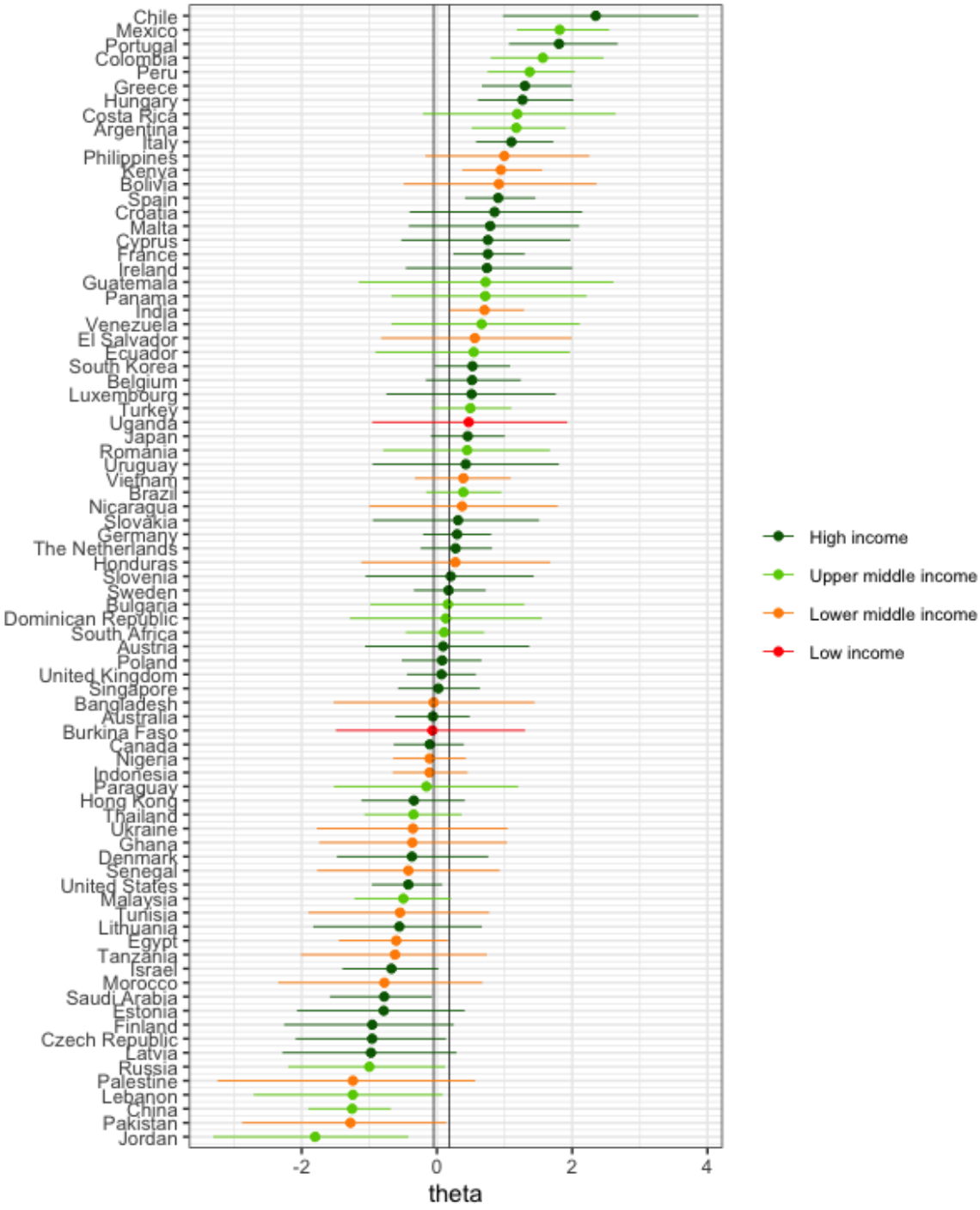


Breaking countries down by income group (whether countries are low, low-middle, upper-middle, or high income)[15], also does not show a distinct pattern between a country's level of climate consciousness and their income group (Fig. 2.10). However, the top ten

[15] Venezuela is "uncategorised" in the latest version of income groups so is categorised as its last classification of "upper middle income". Taiwan is not listed as a separate country for World Development Indicators but is coded as the Asia and Pacific region and as being high income - https://msf.org.uk/sites/default/files/2021-03/Country%20Income%20Classifications%20(1).pdf

countries are all high and upper middle income countries, and many of the countries that fall below the global average are lower middle income countries.

Figure 2.10: Estimates of climate consciousness by country and income group, 2022



Though, this does not preclude either group from being more or less climate conscious, with the least climate conscious country being an upper middle income country. The lack

of association might also be overemphasised by there being only two low income countries due to a lack of data coverage. Nonetheless, this provides important insights into cross-national climate opinion.

2.5 Conclusion

Understanding cross-national opinion is important given it is a cross-national policy issue. Yet, as a relatively novel topic which has not been commonly included in opinion polling there is not a substantial amount of data to tell us what the public think, and in addition, there is no universal means to gauge climate opinion. Whereas environmental concerns are often analysed using standardised "economic vs environmental tradeoff" answers, there is no equivalent question wording that appears across surveys and over time for climate change, as is also a common problem for many other topics of research interest. Despite the various theories on what motivates climate concern, existing research has thus been typically restricted to a small subset of countries, a shorter time period, or using an environmental measure as a proxy for climate concern.

If existing climate polls are an accurate reflection on country-level attitudes, the findings of different polling organisations should be relatively congruent. However there are also a number of reasons that results may not align, leading to comparison errors. To assess to what extent they are indeed comparable, this paper compiled the findings of existing cross-national measures of climate concern that have been fielded multiple times, resulting in a dataset of survey items for 81 countries between 1998-2022. As some of the included survey items have similar question wording and might be expected to reflect the same thing while others have varying wording, they were first inspected to examine their comparability and suitability for use as single metrics. The results of doing so show that while indicators align in some countries, in many they are not telling the same story regarding patterns of change over time and cross-national differences. Countries in which

they capture the same dynamics over time are typically more heavily polled, richer countries. Variance across methods and measures raise concerns regarding the ability to rely on a single measure of climate opinion as an accurate metric of cross-national differences, with this perhaps due to a reliance on research partners in different countries.

This study conceptualised climate consciousness as the extent to which the public recognise climate change as a serious problem. Existing findings tell us that the wording of climate surveys influences the extent to which respondents report concern (Motta et al. 2019). Nonetheless, if they are reflecting some latent underlying trait, in line with Stimson's (1999) "policy mood" literature, the different survey items should show similar movement over time, and cross-national differences should be relatively stable across polling organisations. Accordingly, Claassen's (2019) dynamic Bayesian latent variable model was used to produce country-year estimates of climate consciousness by modelling the probability of a pro-climate response. Examining these trends in climate consciousness confirms the phenomenon which has been evidenced in single-country studies, where there is a dip in concern following the 2008 financial crisis and an increase once again following recovery in most countries. There is also evidence for a recent spike in concern in recent years, in line with the occurrence of large-scale environmental protest movements. Though, this is not the case for all countries, with others having witnessed rising concern but not attaining peak levels of concern, or exhibiting unchanged or declining concern entirely.

This work is a preliminary analysis and has highlighted a need for much further research into this area. The data in this study only included survey questions which ask about climate concern and the perceived importance of the issue, as these best characterise climate consciousness. Future work could also expand this to include broader climate questions such as support for policy measures. While this would not provide much greater time or country coverage due to a similar lack of data, in doing so it would be possible to

examine the different factor loadings of question types to see how well each type captures the underlying latent climate opinion. Similarly, as future waves of survey data come out it would be beneficial to include them to better capture the dynamics of the recent peak in climate concern. For example, future work should seek to include data for 2016 and 2020 for European Social Survey's ESS8 and ESS10 once data for the latter becomes available. Likewise, from ISSP's 2020 round once available, though the metric that is available for multiple years may not be useful in this context due to the question asking to what extent respondents think climate change is a more important problem than other environmental problems, rather than the extent to which they recognise it as a problem absolutely.

In line with the recent peak in concern, and the dip following the Covid-19 pandemic, it would be interesting to examine the extent to which this was driven by economic factors or whether it was crowded out by other concerns such as health policy. Future research would benefit from examining the extent to which economic indicators explain both within- and between-country climate consciousness, as they appear to have different impact. In addition, given that China makes up a significant proportion of global climate consciousness due to occupying 18% of the global population, it would be useful to conduct a more in-depth investigation into how and why different survey organisations produce very different estimates of climate opinion for China. Finally, another avenue for future research would be to treat the lack of cross-national measures as a missing data problem and use multiple imputation, bringing in alternate measures such as unemployment, GDP and climate events as support variables. This would impute the missing points from the probability distribution implied by the model. This was not suitable for this research due to time constraints but doing so would further bolster our understanding of trends in climate opinion.

By bringing together what existing cross-national data there is on climate concern, highlighting the trends in such over time (particularly for countries which are not often included in cross-national analyses), and in identifying there is a problem regarding different indicators not telling the same story about patterns of within- and between-country change, this Chapter contributes to our understanding of public opinion on a major policy issue. These findings have important implications for future efforts to understand public opinion and concern about climate change. It is necessary that interpretations of cross-national analyses have a degree of pragmatism and acknowledge that the poll used can have significant impact on interpretations. This Chapter highlights a need for more consistent polling across a wider set of countries, in order to understand public opinion on climate change cross-nationally. Ultimately, these findings suggest issues for survey organisations to investigate in the comparability of their survey items within and across countries. Nonetheless, from the 81 countries included in this analysis (equivalent to 83% of the global population), the global public appear to have become increasingly more climate conscious since 2014, that is, they increasingly recognise climate change as a serious problem and this is now at a peak level.

Chapter 3
Modelling the Impact of Protest, Media and Parliamentary Debate on the Importance of the Environment to the British Public: 2006-2019

Attention given to the environment by the British public has fluctuated over recent decades. Having peaked in 2007 it declined, yet has recently risen dramatically. This raises questions about why public attention to the issue changes over time and to what extent this is driven by other actors and exogenous forces. This Chapter examines these processes at the monthly level through a system of simultaneous equations. Methodologically, protest is an important confounding factor when analysing the relationship between media and public salience. Substantively, protest itself can be predicted by prior public attention, but in turn, can be successful in increasing broader environmental salience.

3.1 Introduction

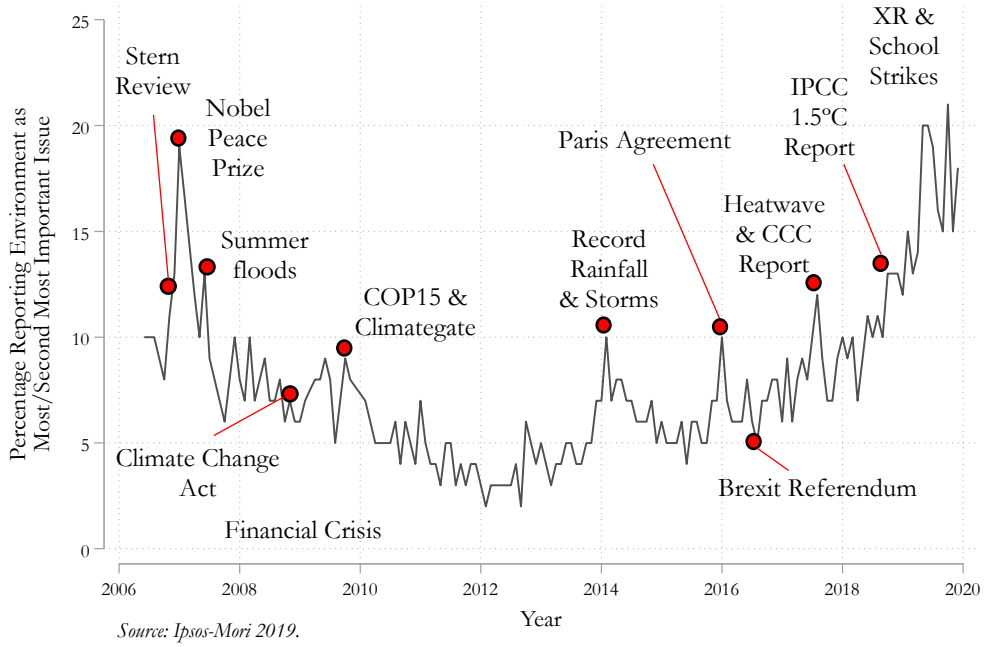
If public attention to the environment were driven by rationality it might be expected to shift in line with the increasing urgency of the threat from climate change, especially given that trust in scientists is high and has remained largely stable over time (Wellcome Trust, 2018). However, despite increasing cognition of climate change's seriousness, the proportion of the public ranking the environment as a political priority has been volatile in recent decades; exhibiting a non-linear trend with frequent fluctuations. This Chapter considers the mediating factors of these dramatic fluctuations by looking at monthly changes in public salience, which is defined as the attention given to an issue by the public, relative to other political issues.

Central to agenda-setting theory is the idea that attention given to issues by public, media and political actors are contingent on one another. In this way, shifts in public attention may be a reflection of respective media or political attention. However, as investigations into these dynamics are often at the annual level and have focused on different countries, sub-annual dynamics between these actors in Britain remain unclear.

Moreover, with much existing literature having been conducted in previous decades, it has yet to capture recent shifts in attention.

In 2019 Britain witnessed a wave of environmentalism, with unprecedented levels of public attention co-occurring with global environmental movements including Extinction Rebellion and Greta Thunberg's School Strikes for Climate. In light of their co-occurrence, rising public attention might partially be attributed to the success of recent protests. Previous literature says little on the power of environmental protest to change public opinion, so a key question for this research is what difference these recent movements made. They may have been vital to increasing public salience, but they may have alternatively been carried by a wave of public salience rather than created one.

Figure 3.1: Importance of the Environment to the British Public



Source: Ipsos-Mori 2019.

This Chapter highlights the striking fall and rise in the importance of the environment to the British public between 2006-2019, and empirically examines what may have caused it. In doing so, it contributes novel insight into public opinion dynamics in the British context, and the role of environmental protest. From a theoretical perspective, it also identifies

how mechanisms of influence, which are often studied separately, may interact when modelled in unison. While it is commonly discussed that protest could be of importance, with environmental protest it is hard, if not impossible, to point to other studies to confirm this. This Chapter presents the first systematic study to show significant links between occurrence of environmental protest and how important the public perceive the environment to be. Considering such, protest necessitates inclusion as an endogenous force, which can both shape, and be shaped by, other actors.

Although this Chapter pays particular attention to climate change as a highly salient environmental issue, this is tested using a broader measure of environmental public salience. This is due to a lack of consistent data at the monthly level but, nonetheless, Eurobarometer surveys show the British public have consistently ranked climate change as their top environmental concern for the period of study, and there is also high correlation between concern for climate change and the environment more generally. In order to analyse these monthly changes in the amount of attention given to the environment by the public, Zellner-Aitken Seemingly Unrelated Regression (SUR) estimations are used. Relationships are established through Granger-causality, whereby a variable can be said to Granger-cause another if its values in the preceding months (lagged values) are useful in predicting the value of the secondary variable for any given month, while also controlling for the latter variable's lagged values. For many of these variables, there are strong autocorrelation effects so, if public salience is high one month, it is likely to be high the next month. Granger-causality therefore tells us if, for example, protest activity in any month affects public salience in the following months, even controlling for that tendency for levels of salience to persist.

Findings indicate multi-directionality between protest and public opinion; protest activity can be predicted by public attention levels, but in turn, is successful in increasing broader environmental salience. Evidence suggests media coverage moves in response to

public attention rather than the reciprocal, and that public attention may fall following heightened political attention. Findings also suggest that short-term exogenous factors influenced media coverage but did not consistently impact aggregate public attention over the time period.

3.2 Theory

In considering the changing importance of the environment to the British public in recent decades, this Chapter draws upon two distinct, yet complementary, bodies of literature. The first relates to agenda-setting, which largely focuses on how the public agenda is intertwined with media and political agendas and is more pertinent to aggregate-level salience. The secondary brings together research on exogenous factors which influence public opinion, which are typically analysed at the individual-level.

3.2.1 Agenda-setting

Under conditions of competition and finite resources, the amount of attention that can be given to any set of issues is limited, requiring some issues to be prioritised over others. Agenda-setting research explores this process by examining what causes changes in the relative salience of issues across public, media and political domains. The following subsections consider how media and politicians may have influenced public salience in Britain, as well as considering the potential role of protest.

Media

The media is argued to be influential due to the public looking to the media for information on global and domestic occurrences (Carvalho and Burgess, 2005). As newspapers have finite publishing space, they must determine which issues to prioritise coverage on and so, publication signals relevance and the extent to which attention should

be directed towards an issue (McCombs and Reynolds, 2002). In line with this, some studies have found shifts in public priorities to be a reflection of media coverage (e.g. McCombs, 2004). Although, findings are mixed, with other scholars arguing media reflects, rather than drives, changes in public opinion (e.g. Hopkins et al., 2017). On the issue of the environment more specifically, while some evidence from the US suggests media influences the public agenda at the annual level (Ader, 1995), this relationship has also been found to be bidirectional when controlling for simultaneous relationships, which will be discussed in due course (Bakaki et al. 2020; Jenner, 2012; Soroka, 2002). Although most studies have been conducted in different decades and countries, and have not focused on the environment, the recent fall and rise in public salience in Britain might reflect the respective attention given by media over time.

Political Representatives

Another central set of actors in agenda-setting are political representatives. Downs' (1972) issue "attention-cycle" model proposes that environmental interest of the public and politicians goes through waves of surges and declines. This cyclical process is argued to repeat until political action is taken, highlighting how political action may lead to an adjusted level of public salience. Although there have been studies into environmental politicisation and issue salience within party politics in Britain (e.g. Carter and Little 2020), there has been less empirical research looking at how the actions of political elites may affect public attention. Soroka and Wlezien (2004; 2005) looked at public-policy relations and find evidence of "public responsiveness" and "policy representation", with public preferences simultaneously being influenced by, and influencing, government spending. Indeed, there is greater evidence for an inverse relationship, with scholars finding environmental policymaking following public demand in European countries at the annual level (Anderson et al., 2017; Bakaki et al., 2020). Others have shown that while elite cues

influence public concern, media coverage plays a mediating role (Carmichael and Brulle, 2017). Overall, existing findings suggest public attention may shape, and be shaped by, levels of political attention in Britain, although it is not evident whether these explain monthly fluctuations in recent decades.

Simultaneous Relationships

Despite theoretical and empirical justifications for endogenous relationships between public, media and political actors, few studies have looked at these in conjunction. Soroka (2002) looked at Canadian dynamics at the monthly level between 1987-1995, finding public attention to positively impact policymaking and media coverage, as well as bidirectionality between political and media attention. Although, direct effects of policymaking on the public were not modelled. Jenner (2012) extended this to the US with further inclusion of the news photographic agenda, finding a negative effect of congressional committee meetings on public salience, and bidirectionality between public attention and print media, with each having a positive effect on the other. More recently, in a study of European dynamics which included the UK, Bakaki et al. (2020) found that, at the annual level, heightened public concern about pollution had a positive impact on renewable energy policymaking the following year. The authors also find bidirectionality between media and public concern, with public attention increasing media coverage, and media coverage reducing public concern. Bakaki et al.'s (2020) study provides one of the most comparable cases, with it being the only such study pertaining to UK dynamics. Yet, as country-year is the unit of analysis, it remains unclear whether these dynamics hold for periods below the annual level. In addition, as the study covered the period between 1983-2012, it does not necessarily capture newer developments which have since occurred in Britain, as evidenced by Fig. 3.1. Importantly, despite analysing dynamic relations between actors, none of these studies have considered the effects of protest.

Protest

Although not typically included under an agenda-setting framework, given recent global environmental movements, the role of protest in shaping public attention deserves consideration. As protest has historically been characterised by a motivation to shape the political agenda, much research has analysed its success in driving policymaking (see Walgrave and Vliegenthart, 2012). Although not omitted from such analyses, public opinion is often considered an external factor to control for. Despite contemporary movements having also been concerned with shaping public opinion, there has been substantially less empirical research into protest's cultural effects. Indeed, there are also theoretical justifications to believe the relationship between protest and other actors may in fact be reciprocal. Banaszak and Ondercin (2009) highlight that policy analyses which merely control for public opinion incorrectly assume independence from protest. Even so, looking at the US feminist movement between 1945-1985, they find greater evidence for protest leading public opinion than vice-versa.

Empirical findings around environmental protest are likewise limited. Giugni (2004) found protest's influence on environmental policy to be contingent on public opinion, but testing protest's "indirect effects" indicated minimal influence on public opinion. In looking at determinants of protest and congressional hearings, controlling for media salience and environmental conditions, Olzak and Soule (2009) similarly find no relationship between protest and public opinion. However, these studies were conducted in the US, for decades prior to the millennium, and with little consideration of endogeneity. More recently, using sporadic opinion polls Barasi (2019) highlights that in April 2019, following environmental protests in Britain, there was a surge in media coverage. At the same time, levels of public concern, having already been at their peak, rose even further. This indicates association between these actors, although whether public salience

responded to heightened media coverage, or protest itself, is unclear. Existing, albeit limited, findings would suggest environmental protest might influence the public agenda, but at present, causal relations with British public opinion remain largely indeterminate.

3.2.2 Exogenous determinants of environmental concern

In addition to being shaped by other actors, short-run changes in public salience that have occurred in recent decades may also be influenced by exogenous factors. For example, as a physical phenomenon, climate change is frequently associated with environmental indicators, with the "objective problems" explanation arguing that concern increases with environmental degradation (Inglehart 1995; Echavarren 2017). However, while attention might be expected to rise in accordance with the issue's increasing urgency, prior findings suggest little influence of long-run developments (Kaufmann et al., 2011). In contrast, individuals express greater environmental concern when directly confronted with the issue, for instance during periods of extreme weather or after natural disasters (Zaval et al., 2014). Flooding across the UK in 2013/2014 influenced the perceived importance of climate change (Capstick et al. 2015) and so, public attention might similarly respond to environmental indicators over time.

Another well-documented mediator of individual-level concern is economic performance as, in accordance with value priorities, economic concerns often take precedence over environmentalism (Inglehart et al., 2017). In studying the 2008 recession, Kenny (2019) shows rising unemployment, rather than falling GDP, led to the public giving lesser priority to the environment. On a sub-annual level, Brulle et al. (2012) constructed quarterly measures of US public concern between 2002-2010 and found elite cues and economic factors to influence perceived threat of climate change. Although most studies have been conducted annually, British public attention may also be shifting in response to changing economic conditions over shorter time-periods.

There are several other factors which have been linked with increased attention to the environment, but their effects have typically been analysed for media coverage. For instance, international meetings between government officials have been associated with drawing attention to climate change, particularly United Nations Climate Change Conferences (UNCCC) (Saunders et al. 2018; Schäfer et al., 2014). In line with this, Bakaki and Bernauer (2017) analysed whether the 2014 UNCCC may have affected American public opinion, with their experiment finding that media cues influenced public awareness, but not policy preferences. Publication dates of Intergovernmental Panel on Climate Change (IPCC) reports are also found to coincide with increased media attention to climate change in the UK (Hulme, 2009). Individuals who are external to political processes might also be influential, for instance feedback from scientists or environmental non-government organisations (ENGOs), although only the latter is found to influence media coverage (Schäfer et al., 2014). Factors such as these might similarly influence public opinion, either directly or indirectly through media coverage, although such effects have yet to be studied over time.

Cultural forces such as film premieres may also be important in understanding changes in attention given to the environment as they grant further legitimacy to the issue. Leiserowitz (2004) finds *The Day After Tomorrow* generated greater response than the IPCC report, which can perhaps be explained by cultural forces being less scientific and more accessible to the general public. The peak in attention around the time of the award of a Nobel Peace Prize to Al Gore and the IPCC in 2007 has also been highlighted (Barkemeyer et al., 2017; Schmidt et al., 2013). However, in practice there is little empirical support of such and, looking at cultural events over time, Schäfer et al. (2014) find no influence on media coverage. Therefore, while these might shape public attention, it is unclear whether they are a consistent predictor.

To conclude this section, from reviewing existing research it is apparent there lacks consensus on the dynamics of public attention to the environment. This is further reinforced by an absence of research into public salience in the British context, with recent changes in attention yet to be explained. Few studies have considered simultaneous effects of other actors and exogenous factors, and there has also been little research into environmental dynamics at the sub-annual level, which can largely be attributed to obstacles in systematic measurement. Despite this, agenda-setting theory indicates shifting public attention may be linked with media and political actors. Existing empirical literature on protest, albeit limited, suggests environmental protest might also be influential, although this has yet to be included under an agenda-setting framework. Exogenous environmental and economic indicators may hold individual-level influence, although it is unclear whether these apply at the aggregate or sub-annual level. There are also factors such as cultural forces and political events, which influence media coverage and might similarly shape public salience.

3.3 Data

To better understand public attention to the environment in Britain a large-scale dataset was compiled from a variety of sources, encompassing the period of thirteen and a half years from 1st June 2006 to 31st December 2019. Analysis is conducted at the monthly level, covering a total of one hundred and sixty-three months. This period was selected based upon data availability, to ensure comprehensive inclusion of relevant variables and allow for time-series analysis, which requires variables to be observed over the same, uninterrupted period of time.[16] Nonetheless, the little work that has been done on earlier

[16] Uninterrupted digitalised parliamentary records are only available from June 2006.

decades in Britain has shown only minimal change in environmental attitudes (Norris 1997).

3.3.1 Endogenous variables

A common estimate of public salience is the "most important problem" measure (Dennison, 2019). Taking a similar approach, this research utilises Ipsos-Mori's "Issues Index", which records unprompted responses to: "what do you see as the most important issue facing Britain today?" and "what do you see as other important issues facing Britain today".[17] The variable comes from the coding of free text, so mentions of any environmental issues, including climate change, are coded under the environment category. The final measure represents the combined stratified percentage of respondents who reported environmental issues as of either primary or secondary importance. Six instances of missing data were imputed by averaging prior and sequential months. While a more direct measure of climate change concern might be favoured, given this reflects environmental salience as a whole, unfortunately this does not exist at the monthly level and using such would constrain analysis to sporadic polls, which would not permit detailed information about fluctuations in public opinion over shorter periods. Despite this, theory on climate change attitudes should still be expected to impact attention to the environment. This is partly justified by the recent time frame, as well as results of previous Eurobarometer surveys on the environment which show climate change consistently ranking top of environmental concerns in Britain for the period of study.[18] For example, in the 2019 Eurobarometer 65% of British respondents reported climate change as one of the three most important environmental issues, followed by 53% waste, and 52% air

[17] While there are slight differences between measures of most important "*problem*" compared to "*issue*", response patterns remain relatively similar (Jennings and Wlezien 2011).
[18] Eurobarometer environment surveys were conducted in 2007, 2011, 2017 and 2019. There was also a survey in 2014, however, climate change was omitted from response options for this year.

pollution. Of those that reported waste or air pollution, 62% and 66% respectively also reported climate change. This indicates the majority reporting the environment as an important issue are referencing climate change, however, even if doing so in reference to other environmental issues, individuals are likely to be concerned about climate change. Although imperfect, due to being a less direct measure it makes it a stronger test of mechanisms and lends further strength to results.

In analysing media, this research uses Boykoff et al.'s (2020) dataset which details the number of news articles referencing "climate change" or "global warming". This tracks coverage across six national newspapers; broadsheets *The Guardian*, *The Times* and *The Telegraph*, and tabloids *The Daily Mail*, *The Daily Mirror* and *The Sun*. The measure reflects aggregate articles published across platforms. Whilst this allows for an inclusive range of political leanings and journalistic styles, unfortunately it excludes BBC coverage. Nonetheless, as news platforms follow similar cycles, the measure provides a reasonable proxy of mainstream media content. This is further strengthened by the environment being an exogenous issue, so attention is expected to differ less across platforms, as well as it being a monthly measure, whereby there is likely convergence between platforms (Vliegenthart and Walgrave 2008). Another limitation is that this measure only reflects print media. However, in line with intermedia agenda-setting, legacy media influences other media forms and the content of traditional media and other media, including social media, are found to be interlinked (*ibid.*; Conway et al. 2015). As a result, particularly at the monthly level, we can assume the measure is reasonably representative of other media forms and wider media trends.

To reflect monthly political attention to climate change, this Chapter focuses on the behaviour of Members of Parliament (MPs). This is quantified by the number of references to the issue during debate in the House of Commons, calculated using the UK Parliament Hansard archives. This measure also incorporates the number of divisions and

publications by default, due to these typically co-occurring, thus providing a comprehensive measure of political saliency.

Protest events were selected through comprehensive searches of major climate organisations' archives, and those which had been reported online elsewhere. Information on participation numbers was partially established using Mass Mobilisation Data (Clark and Regan 2016), however, events not listed by the latest version of the dataset were established by averaging media and organisers' estimates. Given many events occurred over a sustained period, the final protest index was generated through multiplying attendance by duration (in days) and taking the monthly sum of such. As a key approach of Extinction Rebellion is civil disobedience (Berglund and Schmidt 2020), the number of protest arrests were also recorded in order to proxy disruptiveness.

3.3.2 Exogenous variables

To test for responsiveness to long-run indicators of environmental conditions, in line with the "objective problems" explanation, two objective indicators of climate change were included: changes in global temperatures (NASA 2020) and carbon dioxide levels (CO2) (Dlugokencky and Tans 2020). Measures of domestic temperature were accessed through the Met Office's climate summary archive, with anomaly measures calculated as variance from thirty-year averages. Domestic and European natural disasters were recorded using the International Disaster Database (EM-DAT 2019).[19] Measures on deaths, number affected, and extent of damage (cost in $) were standardised and used to calculate a monthly index of severity.

Two measures of labour market conditions are utilised; quarterly GDP per capita growth and unemployment rate from the Office of National Statistics. Political event

[19] While it would have been preferable to include a third variable to reflect international disasters, as done by Schäfer et al. (2004), this was not possible due to paywall restrictions.

variables were created to record dates of general elections, as well as a cumulative variable to reflect the official election campaign. Intergovernmental events were recorded to incorporate occurrences of G8/G7 Summits, EU Summits, and number of days of UNCCCs per month. Release dates of IPCC reports were also documented. To measure cultural events, release dates of documentaries on environmentalism were recorded as binary variables. The premieres include those in Schäfer et al.'s (2014) study; *An Inconvenient Truth*, *The Great Climate Swindle* and Live Earth concerts, and more contemporary premieres; *Blue Planet II*, *Planet Earth II, Cowspiracy* and *Our Planet*. Using the Institute of Scientific Information Web of Science database, scientific articles on climate change published in British journals were accumulated to reflect scientific feedback. To measure ENGO activity, press releases published by international and UK branches of WWF and Greenpeace were indexed.

3.3.3 Data transformations

To retain information on long-run trends, this Chapter follows the established method of prior scholars in analysing endogenous variables in level form (Soroka 2002; Jenner 2012). Likewise, exogenous variables which were found to be non-stationary were transformed through differencing, on the basis that actors are expected to respond to changes in such rather than absolute values. Protest is modelled in square-root form to enhance model stability due to it having large variance.

3.4 Results

To illustrate changes over time and allow direct comparison, series were standardised and aggregated at the annual level. Fig. 3.2 shows how, after peaking in 2007, public prioritisation of the environment was largely in decline until 2012. This is despite it being a period of mounting evidence for the existence and seriousness of climate change. From

2012, the percentage of people rating the environment as a top issue has been characterised by an upward trend, reaching its apex in 2019. Data at the monthly level, plotted in Fig. 3.3, show frequent oscillations over time, highlighting the significance of conducting analysis at the monthly level. On a monthly basis, public salience peaked in October 2019, with 21% of the public ranking the environment as either the primary or secondary most important issue facing Britain. Prior to 2019, the highest levels of attention in the period of study were during the first quarter of 2007, raising questions as to what has driven changes between this period.

Figure 3.2: Annual trends in attention in Britain, 2006-2019

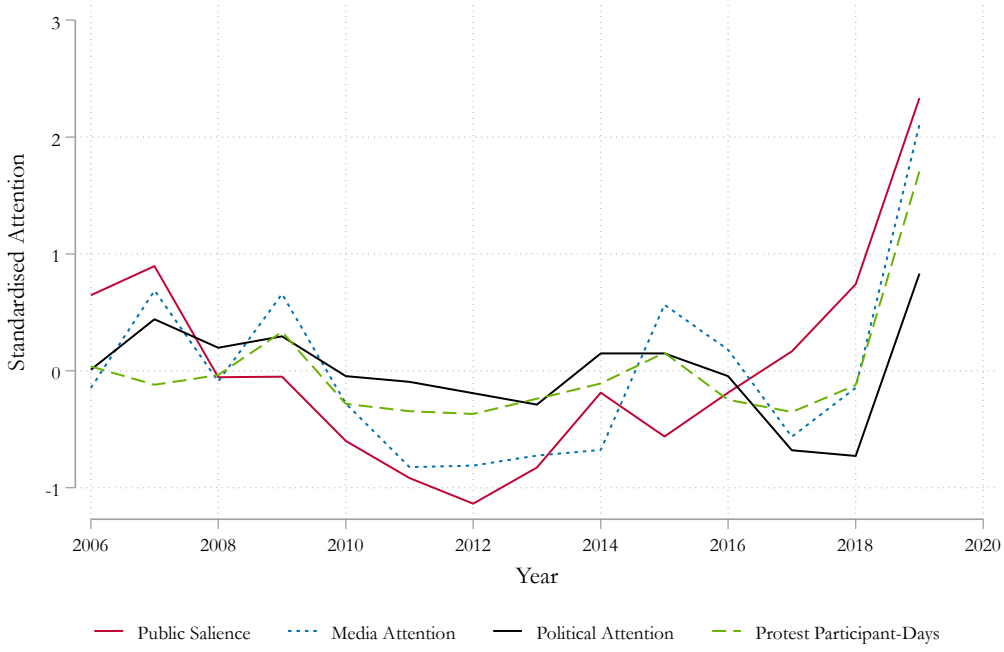
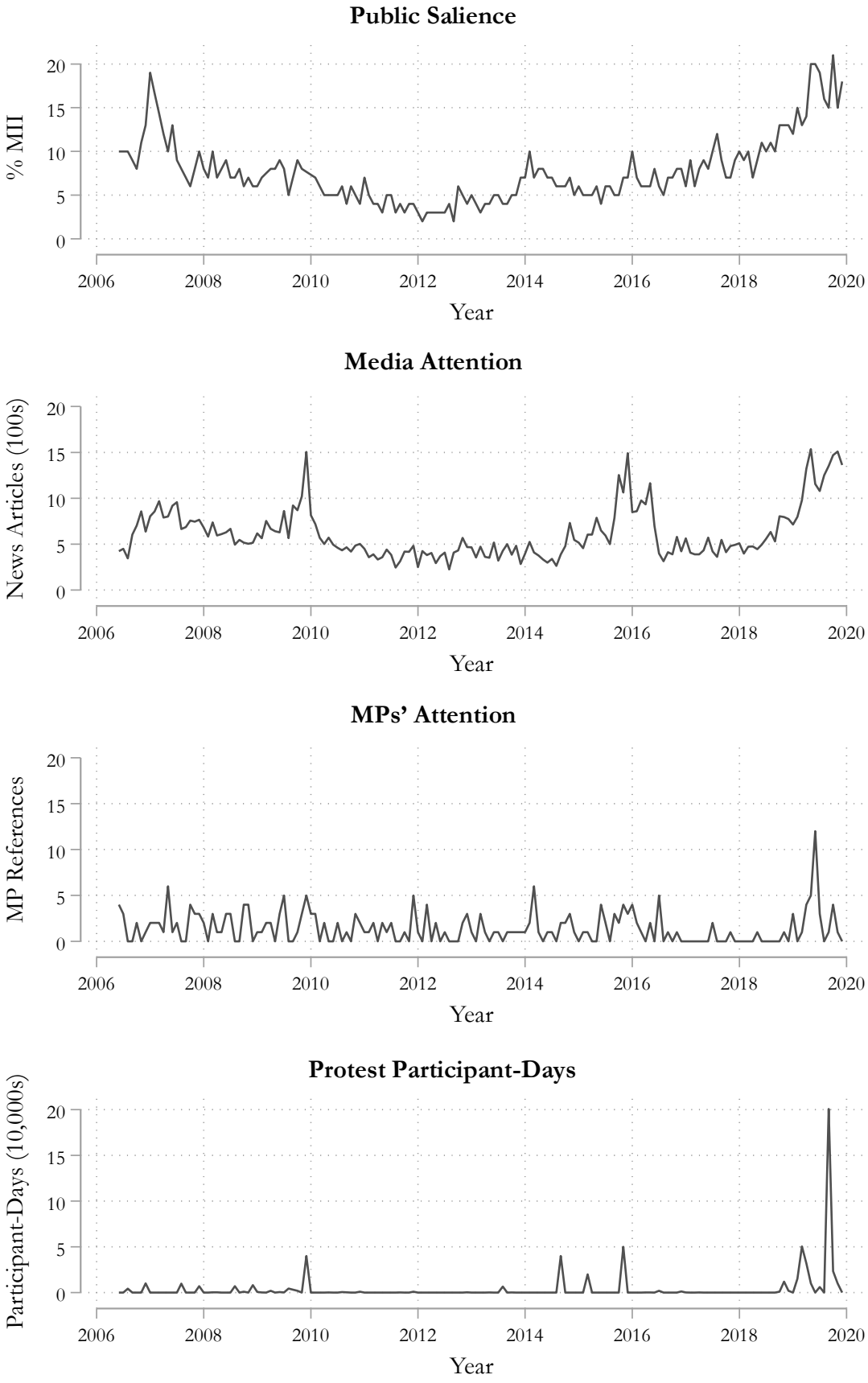
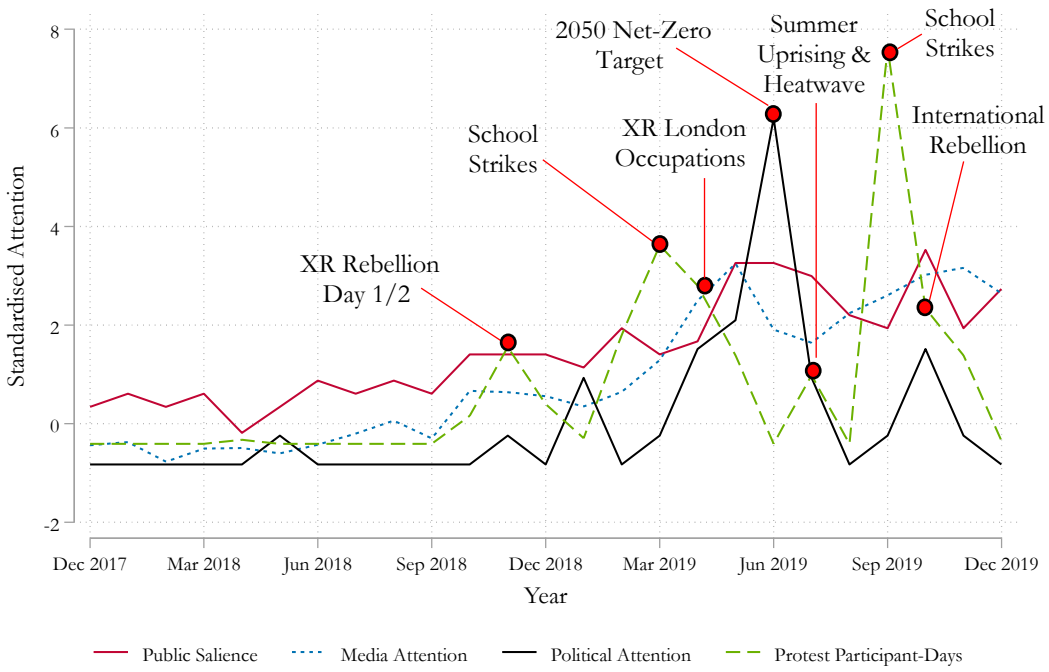


Figure 3.3: Environmental attention in Britain, 2006-2019



Overall, the period of study exhibits far greater variability than has previously been highlighted for prior decades. However, while Norris' (1997) study showed there was little change in environmental concern in the 1980s, short-run changes can similarly be linked with key events. Temporal changes fit patterns of prior studies, particularly the peak in attention following the 2009 Conference of the Parties (COP15) and the award of a Nobel Peace Prize to Al Gore and the IPCC in 2007. The 2009 media spike may also be explained by its co-occurrence with "Climategate", whereby leaking of scientists' emails resulted in debate surrounding climate change's credibility.

Figure 3.4: Trends in attention, 2018-2019



The Paris Agreement delineated at the 2015 UNCCC is accompanied by a similar peak, under which a continuation of the 1992 Kyoto Protocol was established for greenhouse gas emissions and mitigation.[20] The 2008 Climate Change Act did not generate much

[20] Response to these events is non-uniform across platforms, as highlighted by Saunders et al. (2018). Breakdown of individual newspapers shown in Appendix B.

attention, which can perhaps be attributed to coinciding with the financial crisis, which is associated with a trough in attention (Fig. 3.2). Likewise, falling attention between 2010-2014, prior to the 2015 Paris Agreement, might reflect change to the Conservative-Liberal Democrat coalition government in 2010 and associated austerity policies, as well as politicisation of the issue (Carter and Clements 2015). The trough between 2016 and 2018, particularly for political attention, is likely the result of politics being dominated by Brexit negotiations. Note, however, these are all one case examples, and while some of these events appear to be linked to spiked attention in some instances it is necessary to test their effects across the whole period.

Comparing measures of attention over time gives initial indication of complex inter-relationships between agenda-setting actors. At the annual level, attention has moved across all actors at around the same time, however since 2015, public salience has grown prior to, and to a greater extent, than other actors. In contrast, protest did not rise substantially until 2019, perhaps in consequence of heightened public salience the preceding year. The striking peak witnessed in 2019, which has not been captured by previous research, highlights a shift in concern. On examination of this period, shown by Fig. 3.4, it is evident that changes in attention across actors occurred around the time of protest events. This is also coupled with measurable political change, with government amending the 2008 Climate Change Act to implement a new target of making greenhouse gas emissions net-zero by 2050. Although relations are evident across monthly trends, these graphs are characterised by far greater variation so it is harder to discern a systematic pattern. In addition, as exogenous occurrences and events can be linked with changes across actors, this raises questions as to what extent measures are driven by one another or simultaneously moving in response to real world events.

3.4.1 Modelling British attention to the environment

To model environmental salience, Zellner-Aitken Seemingly Unrelated Regression (SUR) estimations are used. This methodology controls for dynamic interrelationships by solving a system of equations through generalised least squares, based on an assumption of correlated error terms (ε) between equations. In doing so, it includes a vector of dependent variables as a lagged function of one another and captures linear interdependencies as follows, where (t) represents the value for a given time point (i.e. each month) and (L) is the number of lags specified within the model

$$\begin{bmatrix} Public\ Salience_t \\ Media\ Attention_t \\ MP\ Attention_t \\ Protest_t \end{bmatrix} = \beta_0 + \beta_1 \begin{bmatrix} Public\ Salience_{t-1} \\ Media\ Attention_{t-1} \\ MP\ Attention_{t-1} \\ Protest_{t-1} \end{bmatrix} + \cdots + \beta_L \begin{bmatrix} Public\ Salience_{t-L} \\ Media\ Attention_{t-L} \\ MP\ Attention_{t-L} \\ Protest_{t-L} \end{bmatrix} + \begin{bmatrix} \varepsilon_{1,t} \\ \varepsilon_{2,t} \\ \varepsilon_{3,t} \\ \varepsilon_{4,t} \end{bmatrix}$$

Where $\varepsilon_{1,t}$ is an unobservable white noise process (independent of prior values of Y): $E(\varepsilon_{1,t}) = 0,\ E(\varepsilon_{1,t}\varepsilon_{2,t}') = \sum$. For example, under a 2-lag model specification with exogenous variables added (X), public salience would be determined as follows:

$$public_t = \beta_0 + \beta_{1,1}public_{t-1} + \beta_{2,1}media_{t-1} + \beta_{3,1}MP_{t-1} + \beta_{4,1}protest_{t-1} + \beta_{1,2}public_{t-2} + \beta_{2,2}media_{t-2} + \beta_{3,2}MP_{t-1} + \beta_{4,2}protest_{t-2} + \gamma_{1,1}X_{1,t} + \gamma_{1,2}X_{2,t} + \varepsilon_{1,t}$$

The method is much like vector auto-regression (VAR), with the added benefit of being able to control for different exogenous variables across equations, allowing more efficient estimation (Enders 2010). This enabled controlling for parliamentary recess in the political equation, and general elections in media and public equations. Exogenous variables are excluded from the protest equation as variables should not directly impact protest and should instead manifest through public attention. This makes fewer assumptions about plausible causal mechanisms of protest, and information criterion tests indicated that doing so provided a higher quality model.

Due to endogenous relationships and inclusion of multiple lags, it is well documented that, whilst SUR models accurately estimate relations between variables, individual coefficients are likely inaccurate (Freeman et al. 1989). Instead, it is traditional to use results in calculating Granger-causality and impulse-response functions (IRFs), which offer greater statistical utility. Granger-Causality tests provide a more robust understanding of whether causality persists as a whole; a variable can be said to Granger-cause another if the lagged values of the former (values of that variable in the preceding months) can be used to predict the latter in the present month, while also controlling for the lagged values of the latter (Granger 1969). For example, Granger-causality tells us whether protest activity in the previous months helps explain current perceptions of the environment as a problem, even controlling for how much the environment was previously considered a problem by the public. IRFs visualise relations between variables in terms of their moving average representation, highlighting the effect magnitude over time by showing the effect of a shock in one variable on a response variable over consecutive months. IRFs were calculated using a Bernanke-Sims decomposition which restricts the effects of innovations such that a shock in each variable can affect its own model residual contemporaneously but others' after one. Put simply, they show what the model predicts would happen to public salience in the following months, should there be a sharp increase in, for example, protest activity or media coverage of the environment in the month prior.

The number of endogenous lags to include were established through tests of joint significance, which determined a lag of three months to be the most appropriate. Given the high-dimensionality of potential exogenous variables and their lags, and four models to specify, a step-wise method was used to prevent model overspecification. Variables were first examined for reverse or bidirectional causality, and removed from the pool of candidates if Granger or Toda-Yamamoto tests indicated such. This was unfortunately

evident for cultural events, IPCC reports and ENGO publications. Whilst of interest, investigations into these dynamics are beyond the scope of this study. After this, a least absolute shrinkage and selection operator (LASSO) was used in model specification to determine which covariates should be included for each dependent variable. Exogenous variables were only considered at a maximum lag of one, on the basis that influence is not expected to occur beyond the concurrent or previous month.[21]

3.4.2 Agenda-setting dynamics in Britain

Table 1 outlines Granger-causality results while IRFs are shown in Fig. 3.5.[22] Fig. 3.6 combines and visually summarises both of these.

Table 3.1: Granger-causal relationships in 2006-2019 British model

	Public	**Media**	**MPs**	**Protest**
Endogenous				
Public Salience	330.28***	9.15*	–	8.07*
Media Attention	–	112.74***	11.38**	12.93**
MPs' Attention	11.72**	–	–	8.09*
Protest Participant-Days	12.08**	24.09***	–	–
Exogenous				
Temperature Anomaly	–	–	–	
Domestic Disaster	–	4.62*	–	
European Disaster	–	7.47**	–	
CO2	–	7.56*	–	
UNCCC	–	24.33***	–	
EU Summits	–	–	–	
G7/G8 Meetings	–	–	–	
GDP Growth	–	–	–	
Campaign	–	–		
Recess			23.02***	

*Figures show chi2 value. Only significant figures shown. Significance level: *0.05, **0.01, ***0.001.*
Endogenous lags = 3. - indicates variable included in model but not significant.

[21]Exceptions to this are GDP per capita which is reported quarterly, and general elections which were also considered up to two months prior.
[22] Only IRFs of interest are shown for reasons of space; full results can be found in Appendix B.

Public salience and media attention are found to be autoregressive processes, meaning they can be predicted by their prior levels. Results confirm the importance of analysing protest endogenously, with protest having a significant bidirectional relationship with both public salience and media attention. This indicates that the magnitude of protest is partially being driven by levels of concern in the public body, which is logical given that the protest index is a function of participation. In a longer-term sense, the idea that public salience leads to protest is also supported by graphs at the annual level (Fig. 3.2). However, in turn, public attention to the issue can be predicted by preceding protest (x^2=12.08, p=*0.007*). Fig. 3.5iii further highlights this by showing a shock in protest has a sustained positive impact on public salience.

Given that recent large-scale environmental movements only emerged in 2018, to test the robustness of these effects the model was additionally run for the period 2006-2017. When doing so, protest had no relationship with public salience or MPs' attention in either direction, although the bidirectional relationship between protest and media attention remained significant (see supplementary material – Table B1). This is in keeping with research from prior decades which found no influence of environmental public opinion on protest (Olzak and Soule 2009) or protest on public opinion (Giugni 2004). This indicates results are largely being driven by recent protest, highlighting their effect magnitude and changing dynamics over time. While protest has been argued to hold little political influence due to infrequency (Burstein and Sausner 2005) and representation of only a small minority of individuals (Giugni 2007), the converse is now true of the environmental movement which might explain its success. However, this is not to say that environmental movements did not hold influence before 2018, and it is worth noting that conventional tactics of lobbying and interest group behaviour are not captured by the measure of protest used in this study. Moreover, given the environmental movement has

previously focused on raising awareness, a different measure of public opinion, such as belief in climate change, might be better expected to be influenced by earlier protest. As Extinction Rebellion have made a point of their willingness to be arrested to drive political change, a further model was run using the number of protest arrests instead of participant-days (see Appendix B - Table B2). Doing so indicated that arrests did not Granger-cause public attention but could predict levels of media coverage. The fact arrests are not associated with shifting public salience but participant-days are might suggest that the mechanism of protest's influence is not in its disruptiveness, and is rather the result of social influence with increasing participation and duration.[23]

Of particular note, is that results of Granger-causality tests and IRFs provide no evidence for public attention systematically following changes in media coverage (x^2=1.53, *p=0.675*). Instead, the model indicates reverse causality between public and media attention; public salience is found to Granger-cause media (x^2=9.15, *p=0.027*), and a shock in the proportion of the public perceiving the issue to be important results in a sustained positive impact overall (Fig. 3.5iv). Conversely, IRFs additionally show no sustained impact of shocks in media coverage, with 95% confidence intervals eclipsing the y=0 reference line (Fig. 3.5i). Overall, results are congruent with theory which argues media responds to changes in public opinion, rather than driving them. Although, as the media measure reflects the number of articles published by traditional print newspapers, future investigation into these dynamics across different platforms and media types may be necessary.

As agenda-setting studies have not typically considered protest's effects, a further model was run excluding protest variables for comparison. Doing so resulted in significant bidirectionality between media and public opinion (see Appendix B - Table B3). Under

[23] One reason for this null finding might be changing policy on protest arrests, which is not captured by the measure.

this specification, media is found to Granger-cause public salience (x^2=9.15, *p=0.027*), but as with the association between protest and public salience, this relationship does not hold when only looking at years prior to 2018. As the effect of media on public attention disappears once controlling for protest (x^2=1.53, *p=0.675*), this indicates a confounding effect, with protest simultaneously causing public and media attention to increase. This highlights the importance of accounting for protest endogenously, as not doing so can lead to incorrect conclusions as the result of confounding effects. This is not to say media coverage of protests will not have shaped public awareness and attention given to the issue, and results do not exclude the possibility of influence occuring over shorter time periods, in the days or weeks following heightened news coverage. However, lack of meaningful association suggests that even if this is the case, it is not sustained past the concurrent month.

MPs' attention is found to Granger-cause public salience (x^2=11.72, *p=0.008*). The IRF in Fig. 3.5ii indicates a negative adjustment, with the proportion of individuals viewing the environment as a most important issue falling for around four months following a spike in parliamentary debate. This effect is likely being driven by the net-zero policy in June 2019, after which public attention dropped (Fig. 3.4). Whilst part of the explanation for declining public salience is issue fatigue, the negative movement might also indicate that the public are responding to policy change as they think politicians are dealing with the issue or that it has been resolved (Downs 1972). This is in keeping with Soroka and Wlezien's (2004) "public responsiveness" model, with the public expressing lesser concern when politicians are acting on an issue. Conversely, there is no direct influence of public salience on MPs' attention. Although this contrasts with prior theory which suggests political attention is driven by changes in public demand (Soroka 2002), it is likely political attention follows demand over time periods above the monthly level.

Figure 3.5: Impulse response functions from 2006-2019 model

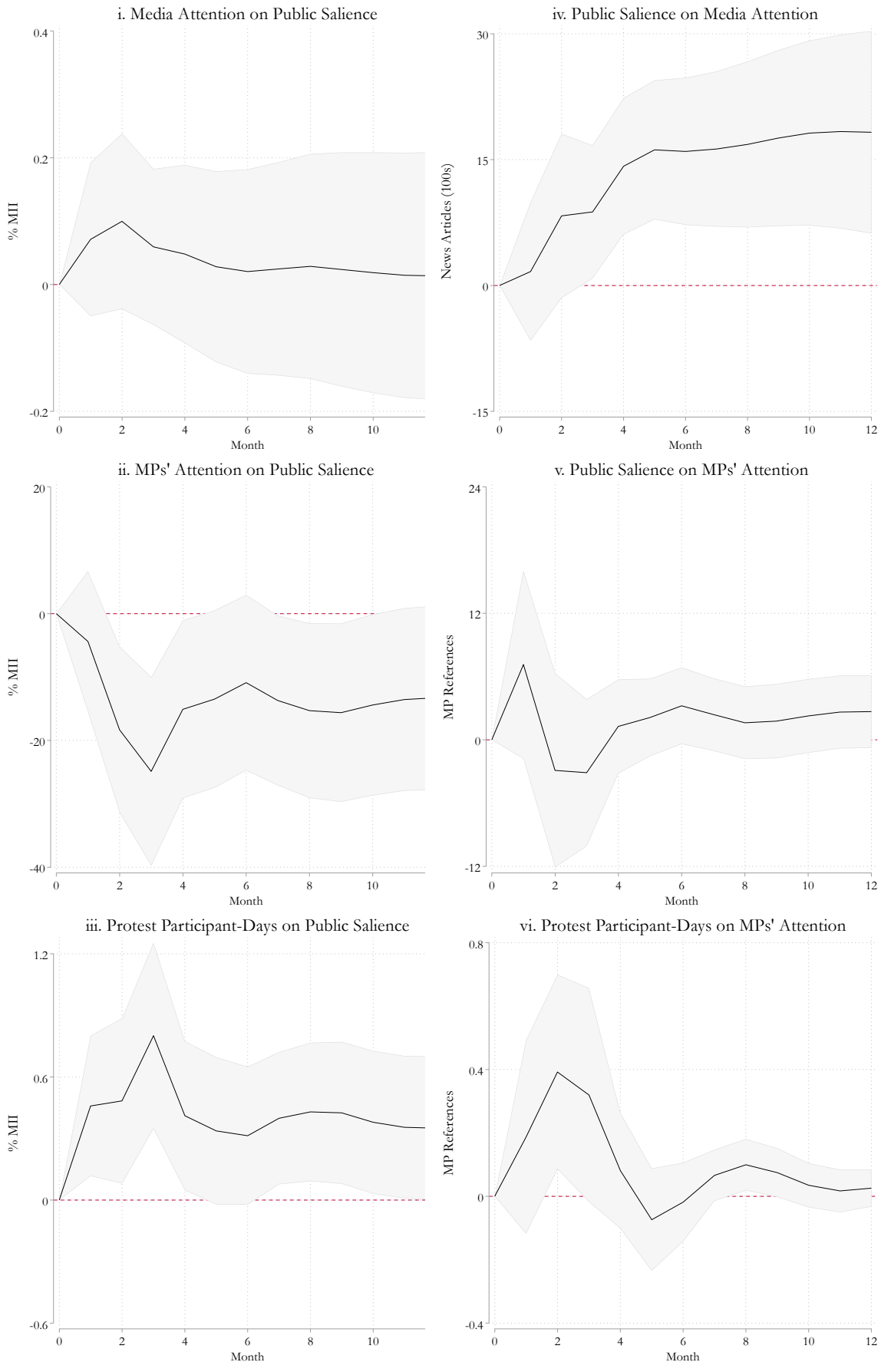
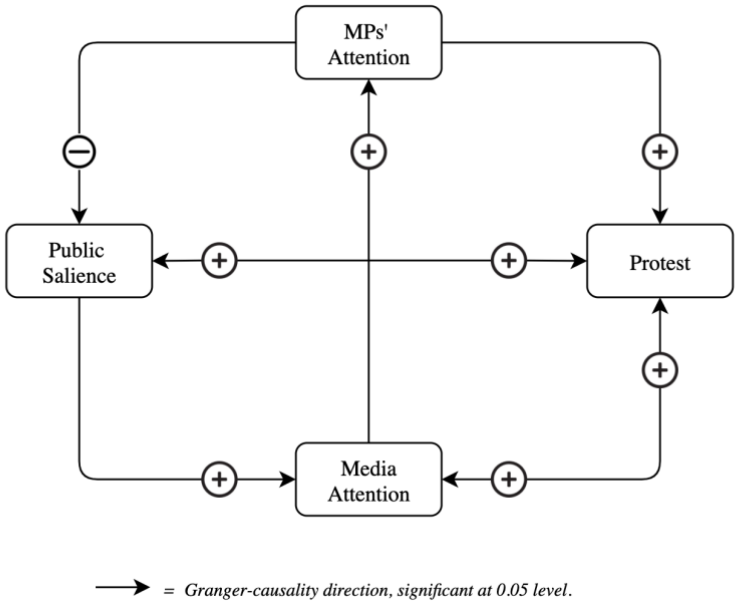


Figure 3.6: Granger-causality and IRF direction, 2006-2019



As public salience and protest Granger-cause media which in turn, Granger-causes parliamentary debate (x^2=11.38, *p=0.010*), it may be that indirect influence is occurring with media playing a mediating role and politicians responding to media coverage as a reflection of public opinion. This is supported by protest shocks increasing parliamentary debate (Fig. 3.5vi). However, as before 2018 MPs' attention had no relationship with either public salience or protest (Appendix B - Table B1), this association is largely being driven by the spike in political attention in June 2019. This can ultimately be explained by the government decision to introduce new net-zero legislation, facilitated by the Prime Minister's desire to achieve a legacy policy. Regardless of whether this was driven by protest and public opinion, this highlights how, although the measure of political attention reflects individual MPs' reference in parliamentary debate, ultimately the political process is constrained by government.

As a whole, there is remarkably little direct influence of exogenous factors on aggregate public salience. In contrast, media coverage on climate change is found to be

responsive to UNCCC events, changes in CO2 levels, and both domestic and European natural disasters, fitting with prior theory which suggests media coverage to be largely event-driven. Absence of effects for environmental factors suggests they are not being linked to climate change at the aggregate level. Likewise, public attention is not shifting in accordance with objective measures of rising global temperatures and CO2 levels. In line with findings of Schäfer et al. (2014), in months that United Nations Climate Change Conferences occur there are increases in media reporting, which can be explained by a large number of journalists being invited to such as well as inter-governmental environmental treaties sometimes being established during the events. However, public salience is not receptive to intergovernmental events, which suggests that even if successful in driving initial public engagement, they are largely failing to drive aggregate changes in the perceived importance of the issue. This is in fitting with Bakaki and Bernauer's (2017) findings that media cues on the 2014 UNCCC influenced public awareness, but not policy preferences.

Of the political events considered in this study, general elections were the only other event which indicated a potential association with public attention. Analysis showed correlations of increasing magnitude and significance in months leading up to general elections over time. That is to say, elections prior to 2017 had no significant association with levels of public attention, whilst correlations with the 2019 election were larger and more significant than those of 2017. Although this might indicate the environment is playing an increasing role in elections, the direction of correlations were inconsistent, suggesting time-varying volatility. Despite heightened environmental concern, there was no significant relationship found for election campaigns as a whole, which suggests the environment is crowded out by other election issues. Lack of association with 2010 and 2015 elections can be explained by the former being dominated by the economic crisis, in

addition to cross-party consensus on climate change, resulting in an absence of party incentives (Carter and Little 2020).

GDP growth and unemployment rate are not found to impact aggregate public salience, which contravenes prior theory suggesting economic conditions have a mediating effect on environmental concern. This is perhaps surprising, given the period of study includes the 2008 recession. However, prior research showed only unemployment influenced prioritisation (Kenny 2019) and, as the British crisis did not result in huge unemployment, with it also being lower than other countries (Coulter 2016), the effects may have been lesser. Regardless, unemployment will have undeniably driven public opinion during this period, irrespective of whether any effects on environmental priorities hold across the period of study. This also raises a broader point that it is hard to capture the intense focus on debt, the deficit and austerity which occurred at the time which shaped public perceptions (Barnes and Hicks 2018). It is also conceivable that economic measures would have greater impact at the annual level, wherein aggregate changes in economic performance are more widely understood. As evidenced by Fig. 3, at the time of the 2008 recession there was no substantial changes in monthly aggregate opinion, but Fig. 2 shows annual-level decline. This is because the public may not necessarily be cognisant of GDP or unemployment levels, rather, of changes in general economic conditions, which is in part perpetuated by media or government narrative (*ibid.*).

Results show changes in attention are not linked to rising global temperatures or CO2 levels, indicating the proportion of the public who view the environment as an important issue is failing to respond to climate change's increasing urgency. Although, findings do indicate media coverage is associated with the latter. Given public attention has not increased in a linear manner, this is unsurprising, fitting with prior theory which suggests that factual developments which evolve over long periods do not drive environmental concern. In terms of short-term environmental stimuli, natural disasters are

found to be associated with media coverage on climate change. However, once again, these effects are not found for public salience, which might suggest the public are not linking natural disasters with environmental issues. Moreover, there is no evidence to suggest seasonality in public salience, with no effects found for temperature changes. As a whole, findings do not support the existence of environmental risk perceptions, or theory which posits the public express greater environmental concern due to being confronted with the issue.

Absence of association with exogenous variables is largely unsurprising, given the lack of evidence to suggest such variables influence aggregate public attention over time. This indicates that, whilst some exogenous factors may influence individual-level attitudes, the number of people being influenced is insufficient to cause aggregate changes in salience. Due to the nature of time-series analysis, effects of variables at a static time point may also not hold over monthly changes, or the effects of variables may occur in conflicting ways across time. For example, climate policy negotiations at some EU Summits will have been associated with increased attention to the issue, whilst other summits have focussed on, or occurred at the same time as, other political issues such as Brexit, which will be associated with reduced attention to climate change. Overall, these findings suggest that if public attention is indeed being influenced by these exogenous factors, either they are not having a consistent influence across occurrences, or influence is not sustained beyond the contemporaneous month.

3.5 Conclusion

Despite both rising seriousness and acceptance of environmental issues such as climate change, the perceived importance of the environment to the British public has fluctuated dramatically over time. Having been at the forefront of the public agenda in 2007, the environment became less salient, with the proportion of the public ranking it as a political

priority not returning to the same levels until 2019. This Chapter aimed to better understand the short-run driving factors of these aggregate shifts in public attention, by analysing monthly changes between 2006-2019. In doing so, it contributes to theory on agenda-setting, protest movements and public attitudes.

This Chapter provides the first systematic study to show that environmental protest is important for understanding public salience. Findings suggest recent social movements have played a significant role in shaping public attention to the environment, warranting inclusion of protest as an endogenous, dynamic force. There is multi-directionality between protest and public opinion; protest activity can be predicted by levels of public attention but in turn, is successful in increasing broader public environmental salience. However, whilst these effects hold across the period of study, this is largely the result of strong inter-dynamics from 2018 onwards, coinciding with the rise of novel environmental movements. Contrary to the supposed effectiveness of civil disobedience and disruption that Extinction Rebellion aim for, analyses suggest it is the scale of recent protest, rather than the number of arrests, that seems to shape public salience. This contributes to our understanding of how protest can, but not always, influence public opinion on a major policy issue.

This particular issue in Britain raises an important consideration about the misattribution of protest's effects, with protest shown to have a confounding effect. As the media report on protest, and protest is associated with increased public salience, if protest is uncontrolled for then analyses might mistakenly find media effects on the public. Although findings suggest media is linked with other actors in the dynamic process, it is not playing a significant role in leading attention to the environment, rather, it can be predicted by preceding changes in public demand and protest. Although there is likely intermedia agenda-setting, the media measure is limited by it only reflecting print media and particular platforms. Future research could look more carefully into differences

between newspaper platforms, or other media forms, to see if effects vary, both for the environment and other political issues more broadly.

This analysis is limited by the fact that it was not possible to include occurrence of cultural events, IPCC reports or ENGO activity in the model due to problems with reverse or bidirectional causality which would invalidate the results. This suggests that the publication of materials on climate change, and cultural events such as film premieres can be predicted by levels of public salience. Tests suggested that these variables were not predictive of general levels of public salience for the period as a whole, and thus their exclusion did not make a significant difference. Nonetheless, while they may be one case studies it would be beneficial to further investigate the dynamics of cultural forces such as Al Gore's *An Inconvenient Truth* and more recent premieres such as *Blue Planet*, to see the impact these had and to what extent their effects, if any, were sustained.

In measuring political attention, this Chapter focused on MPs' behaviour in parliamentary debate, finding that a spike in attention leads to decreased public salience. This negative response is largely being driven by the changes which occurred following the legislation introduced in June 2019, which aims for net-zero carbon emissions by 2050. This pertains to Down's (1972) issue attention-cycle model, with public salience falling in response to political action being taken. This speaks to a broader debate that if governments make future commitments to net-zero legislation this might not be constructive as it not only distracts from attending to policy action now, but may also make the general public less concerned about the environment as they believe action has been taken. Nonetheless, in the end to resolve environmental problems such as climate change, what matters is not the level of concern, rather what is done in response to such (cf. Wiertz and de Graaf 2022).

This also raises a broader point that the interpretation of results relies on a contextual understanding of variation in models and individual variables. Without such

one might be tempted to interpret variables such as MPs' attention as a generic measure of attention, when much variation is driven by particular events and circumstances. For instance, the measure includes debate on legislation, which can ultimately be explained by government decision-making and circumstances such as the Prime Minister's desire to achieve a legacy policy, requiring interpretation of models to be sensitive to such.

These results provide some explanation as to why public attention to the environment has fluctuated over time and they have important implications in terms of public environmental perceptions. Although, by and large, few variables are able to consistently predict change over time. For example, whilst exogenous events are associated with spikes in attention in some instances, effects do not hold over the period of study. The decline in attention between 2007-2012 is also evidently linked with the financial crisis to some extent, but is likely the result of the fiscal narrative of media and politicians, rather than monthly labour market conditions. Likewise, the upwards shift in public attention in 2012 is unexplained by the model, with it not reflecting changes across media or political actors.

These findings may suggest shifting dynamics between actors, bringing into question the pertinence of traditional agenda-setting theory in explaining levels of attention to environmental issues. They also indicate that protest can be important, both substantively and methodologically. As protest is becoming increasingly widespread, its role in shaping public attention and the political process more broadly in years to come, should not be discounted.

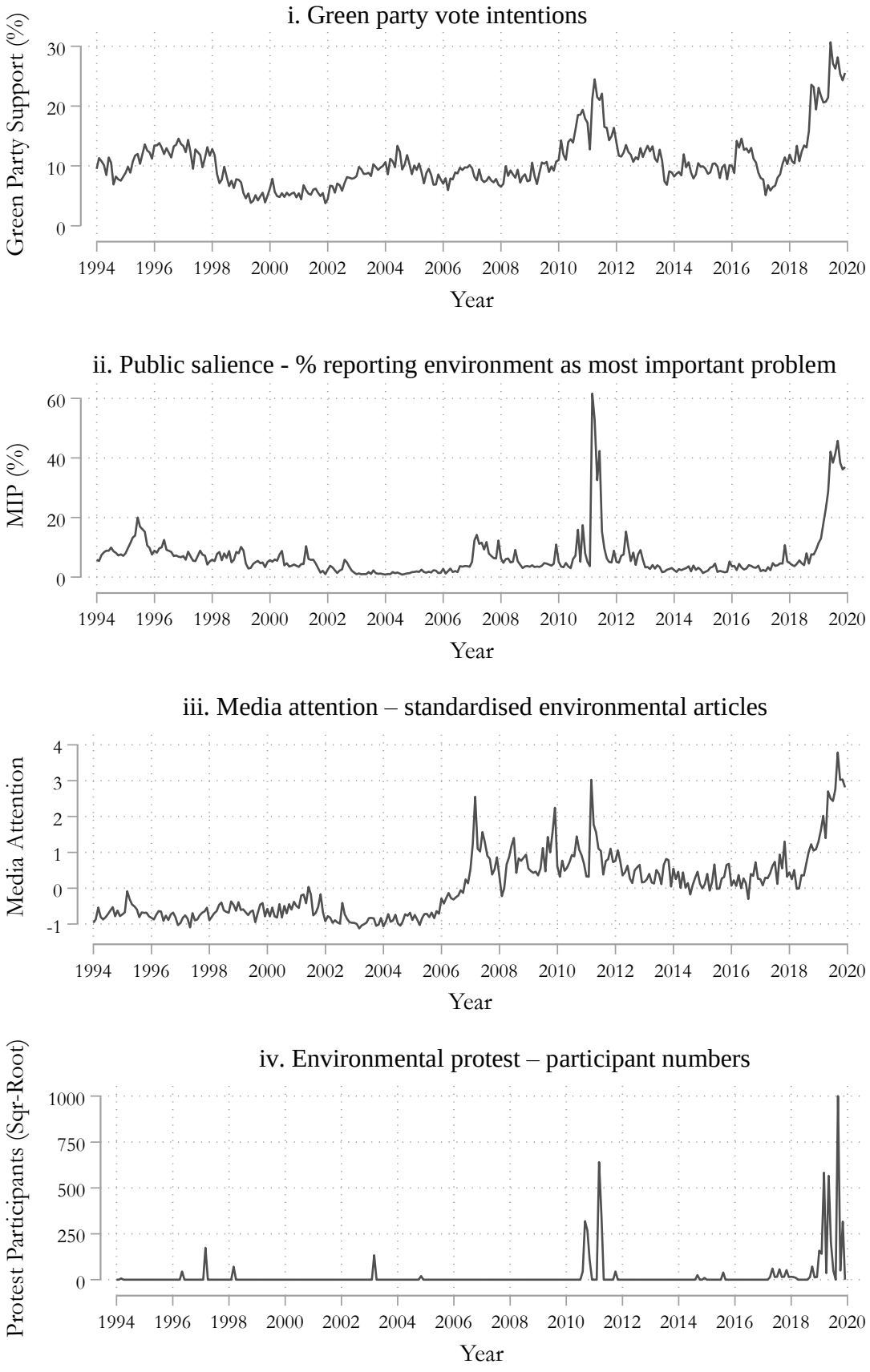
Chapter 4
Agenda-Setting and Protest as Drivers of German Green Party Support: 1994-2019

Despite being largely unanticipated, in recent years there has been a substantial surge in environmentalism and rising green party success across many countries. This Chapter examines the causes, and also the potential consequences, of this changing green support. Looking at monthly changes between 1994-2019 using Germany as a case study, this study builds theoretical arguments for linkages between green party support, environmental protest activity, and what is traditionally considered agenda-setting more broadly. Monthly changes in party support are found to be linked to the occurrence of environmental protest and, prior to 2018, there is evidence of priming effects, with the perceived importance of the environment predictive of levels of green support. By contrast, rather than a contributing factor, media coverage appears to have been purely responsive to changing green voting intentions.

4.1 Introduction

There has been a surge in environmental concern and rising green party success across Europe in recent years (Pew 2019). However, despite having the potential to impact both national and intergovernmental institutions, this changing niche party performance was largely unanticipated and is still not adequately understood. Demand-side theory would suggest green party support increases during periods of economic prosperity and/or as environmental degradation worsens, as these drive voters' appetite for pro-environmental policy (Grant and Tilley 2019). Theory on political opportunity structure would also imply that green success is determined by the response of mainstream parties (Meguid 2005). Yet, the scientific evidence for climate change has not changed dramatically in recent years, nor have economic conditions, and mainstream parties have been predominantly pro-environmental in many countries, playing into an accommodative strategy in Meguid's (2005) terms. Therefore, recent shifts in green support remain largely unexplained by these traditional explanations, raising questions about how we understand rises and falls in green voting more generally.

Figure 4.1: Environmental attention in Germany, 1994-2019



As a major European country with monthly data availability, Germany presents an interesting case study to examine these changing dynamics. In the 2021 German federal elections, the green party (Bündnis 90/Die Grünen) saw the greatest upwards vote swing of any party (+5.9%), coming in third overall and entering a coalition government as kingmakers. This followed the striking rise in support that had occurred since 2018, with green voting intentions reaching their highest level (Fig. 4.1i). This Chapter draws attention to trends in green party support in Germany and seeks to examine the causes, and potential consequences, of this changing environmentalism.

If the recent upswing in green support has not seemingly been driven by economic or environmental conditions, nor the response of other parties, how else might we understand it? One important consideration is that green party support may be driven by the amount of attention being given to the environment by the public and media. This speaks to agenda-setting theory, which dictates that media coverage may be linked with public salience (McCombs 2004), and priming theory, which suggests this may in turn shape voting intentions (Iyengar and Kinder 1987). If, for example, media coverage increases this may draw greater public attention and, if the public attach greater importance to the environment, we might expect green party support to subsequently rise. Fig. 4.1 shows that, not only have there been changes over time in green party support in Germany, but also in the number of environmental news articles, and the salience of the environment to the public – measured as the proportion reporting the environment as a most important problem. This might indicate some temporal relationship between these measures. However, voting intentions have not been commonly linked with issue salience or agenda-setting dynamics (for exceptions see Dennison and Geddes 2019; Dennison 2020a; Dennison and Kriesi 2022) and, despite that rising green support may also fuel media coverage or public concern more generally, green support in particular has yet to be simultaneously modelled alongside measures of media and public salience. This Chapter contributes by linking these theories together to better understand voting intentions. In doing so, it not only simultaneously tests the effects of public opinion and media coverage on green support, but also allows for dynamic and reciprocal effects.

What is more, despite German environmentalism and the green party itself being rooted in protest, little has been done to assess the social and political implications of such over time. This is particularly significant for recent years which have witnessed heightened environmentalism, with rising concern partnered with global environmental movements such as the Climate Strikes and Extinction Rebellion (XR). Given their simultaneity, the rise in green support might be attributed to the success of recent movements, although it is unclear whether such changes are a driving force, or consequence of, the general rise in environmental salience. This study is the first to build protest into an agenda-setting framework and to apply this to better understand green party support.

Looking at monthly time-series data from 1994 to 2019, lag-augmented seemingly unrelated regressions (SUR) are used to simultaneously model changes in green party voting intentions, public salience, news articles and protest participants, whilst controlling for a range of environmental and economic indicators, as well as political events. Protest is found to both predict, and be predicted by, green support and public salience. Prior to 2018, the perceived importance of the environment to the public is found to predict green support, evidencing priming effects. However, when extending the data to include more recent spikes this is not the case, with changes in voting intentions occurring prior to public salience. Moreover, results show media coverage of the environment is not leading party support, suggesting it is instead responsive. The analysis also shows that natural disasters can be linked to increased green support, and that party support fell, and was at its lowest since post-reunification, when the greens went into government between 1998-2005. Overall, these findings highlight reciprocal causation and suggest mutually reinforcing dynamics, providing novel insight into changing niche party support.

4.2 Theory

This section outlines literature on green party support and agenda-setting, while also considering the potential role of protest. While these theoretical components are not individually novel, this Chapter contributes by bridging these to enable a more in-depth understanding of why green party support changes over time.

4.2.1 Green party support

While it is generally understood at the individual-level that certain demographics are more likely to vote green (e.g. Schumaker 2014), at the aggregate-level there is lesser empirical evidence for the driving factors of change within a single country over time. Much has been said about the development of green parties, including the German greens (see Carter 2018 for an overview), and studies with a comparative focus have highlighted cross-national differences in green success (e.g. Müller-Rommel 1998a; Grant and Tilley 2019). Grant and Tilley (2019) summarise three major explanations for varying vote share which are dominant in this literature: institutional, demand-side and political opportunity structure. Given this research focuses on one country, institutional factors are of little utility when seeking to explain changes in support over a period of relative institutional stability. Although, it should be noted that the electoral and political systems of Germany have enabled the rise in green support due to the higher chance of electoral success (Müller-Rommel 1998a; Carter 2018). The latter two factors – demand side and political opportunity – may explain within-country changes as they exhibit far greater variability.

With regards to demand-side predictors, countries with greater material wealth are found to have higher green party support as, in line with post-materialism, existential security leads individuals to emphasise quality-of-life values over economic values (Inglehart 2008; Dalton 2014; Grant and Tilley 2019). Müller-Rommel (1998b) evidences this in finding greater green success in the 1980s-1990s in countries with lower unemployment. Considering a single country, we might

expect support for the greens to increase over time due to intergenerational value change and cohort replacement. However, Inglehart (2008) also notes the existence of period effects, whereby short-term conditions such as economic downturn may lead all cohorts to prioritise economic values over environmentalism. This is in line with the "finite pool of worry" hypothesis, which argues that public concerns regarding the environment fall as other issues become more prominent (Weber 2006), and is evidenced by prioritisation of the environment falling during the 2008 recession due to rising unemployment (Kenny 2019). Taken together, changes in support for the greens might be reflect fluctuating economic conditions.

Another demand-side consideration is issue presence, as a greater number of people support environmental policies and thus, green parties, as the issue becomes increasingly prominent. This is in line with the "objective problems" explanation for environmental concern. For example, extreme temperatures have been found to be associated with higher levels of environmental concern and green voting at European elections (Hoffmann et al. 2022), while occurrence of flooding to increase referendum voting for pro-climate measures (Baccini and Leemann 2020). In line with this, if being driven by concern over climate change, green support may rise in accordance with objective environmental indicators.

Political opportunity structure explanations centre around the idea that green success can be predicted by how major parties respond to the issue of the environment. Looking at European countries between 1970-2000, Meguid (2005) argues when major parties are adversarial (opposing) of green policies, this benefits the greens as they are distinct in their policy stance. In contrast, if major parties are dismissive (ignoring) or accommodative (adoptive), this suppresses the green vote. However, there has been mixed findings on this. For example, Van Spanje and de Graaf (2018) find that niche party voting is only suppressed if the party in question is also ostracised by the rival mainstream parties, which they note has not been the case for green parties. Grant and Tilley (2019) find opposite effects to Meguid (2005) in their cross-national analysis between 1970-2015, with an increased green vote if parties are accommodative, which they argue results from

age and establishment of the green party. Dennison (2020b) also argues that electoral success depends on how the niche party subsequently responds to mainstream parties taking ownership of their issue.

Relatedly, the performance of green parties whilst in government may shape support for the party going forward (Carter 2018) and, given that the German greens have been in coalition governments in the majority of sixteen states, regional government involvement might also influence national-level support. Political parties' policy stances are typically established using manifesto measures, however, this only captures election periods and does not allow continual measurement over time. While parliamentary questions might potentially proxy for this, for the purpose of this study such a measure would provide little utility. While they represent an aspect of the policy process in Germany (Breunig and Schnatterer 2019), they capture only a small number of politicians and only minor opposition parties. Since both Christian Democrats and Social Democrats have been in government for the period of study, parliamentary questions do not elucidate how mainstream parties are responding to niche party challenges.

So, from green party literature we might expect changes in green support to mirror economic conditions, issue prominence, or the relative attention given to the environment by other parties. However, there are numerous things that are neglected by green party literature. For one, while the aforementioned factors are useful in explaining change over time at the annual level, it is not immediately obvious why green support exhibits such variability over short-run periods. In addition, given economic conditions and the severity of environmental issues (at least to some extent) have not changed markedly in recent years, the reasons behind party support having seen such a striking rise remain largely unexplained by these traditional explanations. What is more, greens, in many countries, are increasingly a case of a niche party where major parties all supposedly play an accommodative strategy, so Meguid's (2005) theory does not necessarily tell us why their support goes up and down.

Another important consideration is the role of protest, as Germany has a long history of ecological and anti-nuclear movements and these are also linked with the emergence of the green party itself (Müller-Rommel 1985; Baukloh and Roose 2002). The greens have since moved away from this through professionalisation and normalisation of the party. However, this is particularly significant when looking at the recent wave of environmentalism, as this co-occurred with global climate change movements. Studies analysing these recent movements have shown how they influenced media discourse (Marquardt 2020), party reactions (Berker and Pollex 2021), and how protest is linked with public opinion (Kirby 2022). As protest is not usually included in models of party support, nor under an agenda-setting framework, there is limited understanding regarding its potential effects on green voting. However, if we accept the potential for protest to shape media coverage and public opinion, then it may also be linked with support for the green party either directly or indirectly. These multiple streams of, potentially reciprocal, influence make it difficult to understand green party support in a simple linear manner and for this reason, it is useful to consider agenda-setting theory.

4.2.2 Agenda-setting

Agenda-setting centres around the idea that the amount of attention given to issues by public, media and political actors is contingent on one another (Dearing and Rogers 1996). Accordingly, shifts in the amount of attention given to environmental issues by one actor can cause changes in, or "set" the agenda of, another. These inter-relationships can work in a variety of directions, with prior empirical findings having highlighted public-media (e.g. McCombs 2004; Hopkins et al. 2017), media-policy (e.g. Carmichael and Brulle 2017), and public-policy links (e.g. Soroka and Wlezien 2005). Often studies have focussed on only two actors, and many have failed to consider that reciprocal influence may be occurring (for exceptions see Soroka 2002; Jenner 2012; Bakaki et al. 2019; Kirby 2022). Perhaps in consequence, by comparison of findings, there lacks consensus as to whether influence occurs, which direction it occurs, and/or whether it is bidirectional. Because

of this, and also as there is little agenda-setting research that applies to Germany, this study proceeds on the basis that relationships between any of these actors can be expected.

So, agenda-setting theory tells us that the amount the environment is mentioned in the media might shape the extent to which it is viewed as an important issue by the public and, vice versa, if the public becomes increasingly interested in an issue, the media might pay more attention to it. Scholars such as Moser and Dilling (2012) also tell us that the *way* the media communicate climate change in terms of the framing of the issue is hugely important. Yet, how can these interdependencies be linked with the level of green party support?

The key here is priming theory, which extends agenda-setting and dictates that individuals use the most available information and the most prevalent issues when making political evaluations (Iyengar and Kinder 1987). Therefore, if the media publish a lot of stories on an issue, thus making the public believe it is important, the public will subsequently use this knowledge when making political decisions such as who to vote for. In line with issue voting and ownership theory, green parties typically benefit from a rise in environmental salience, understood as the level of attention given to the environment by the public (Walgrave and de Swert 2007). This is evidenced by Rüdig (2012) finding that recalling the environment as a "most important problem" positively affected likelihood of green voting in the 2011 German elections. This would suggest that changing support for the green party can be explained by the relative amount of attention given to the environment by the public over time.

However, while theories of party support have an implicit underlying assumption of public opinion being the driving force, by and large, studies have not explicitly included such in models (Carter 2018; Dennison 2018). The few studies that have directly looked at the impact of issue salience on voting patterns have highlighted that voting in Europe can be explained by changes in how important the public perceive different issues to be (Dennison and Geddes 2019; Dennison 2020a; Dennison and Kriesi 2022). For green parties in particular, Dennison and Kriesi (2022) find that, for the period between 2012-2019, green voting increases with environmental salience and

decreases as the salience of unemployment increases. This is in line with the "finite pool of worry" hypothesis (cf. Weber 2006), though the changing importance of immigration to the public is not found to impact green voting. Dennison and Kriesi (2022) also link issue salience to "real world" factors, finding that temperature anomalies increase environmental public salience, though this is not significant when controlling for the previous wave. At the individual-level, high environmental salience is also found to make individuals more likely to vote green (*ibid.*). This is the only study to have empirically tested how changes in the perceived importance to the environment may affect green voting, and it is thus highly insightful. This present study therefore builds upon these findings by conducting analysis at the monthly-level, thus providing a more detailed understanding of short-run changes in opinion and voting behaviour, extending the analysis to cover the period 1994-2019, and also considering the potential role of protest and the extent to which the media cover the issue.

Priming theory tells us that the perceived importance of issues will influence vote choice (Iyengar and Kinder 1987) and the media is commonly linked with priming because of its role in information provision. This process is typically studied in relation to political evaluations rather than voting intentions, however, though not purely focused on environmentalism, party support has been shown to follow trends in media attention (Thesen et al. 2016). This suggests green party support may be being driven by the relative attention given to the environment by the media. Though, as such studies have not included a measure of public opinion it is unclear whether this process occurs directly or indirectly through public salience.

The only study to simultaneously consider party support, media attention and public salience is Sheafer and Weimann's (2006) analysis of four Israeli elections. The authors find that real world factors influence media coverage (agenda-building), which in turn influences public salience (agenda-setting). They also find that public salience has a significant effect on party support (priming). Due to the limited data points, the authors do not consider these processes in unison. However, given that agenda-setting theory indicates that media coverage itself may be

shaped by public forces (Hopkins et al. 2017), arguably priming studies have incorrectly assumed a linear path from media coverage, to public salience, to party support. It is also plausible that party support could, in turn, fuel changes in media coverage or issue salience. For example, increased green party support may drive media coverage which may, in turn, fuel public salience. Or simply, green support itself may drive public salience as a greater number of people want action on environmental policy. Thus, there are theoretical justifications for party support to be influenced by, and/or influence, public salience and media coverage. However, these dynamics have yet to be simultaneously considered and, importantly, this has yet to be applied to explain green party support.

Agenda-setting theory has some overlap with green party literature in terms of the explanatory variables that are used. For example, economic conditions have also been linked with other actors, with environmental reporting found to fall during times of economic hardship as it is "crowded-out" by economic news counterparts (Djerf-Pierre 2012). In line with demand-side issue presence, extreme weather events are also found to influence environmental concern (Capstick et al. 2015), and natural disasters to influence media coverage (Schäfer et al. 2014). As Fukushima was found to affect public opinion and media coverage in Germany (Arlt and Wolling 2016), we might similarly expect this to have influenced party support. Political events such as United Nations Climate Change Conferences (UNCCCs) have been found to influence media coverage and public awareness (Bakaki and Bernauer 2017), and IPCC reports to draw media attention to the issue (Hulme 2009). If we accept an interaction between green support and agenda-setting, this means that factors which influence other actors may also influence party support. Given these are not typically modelled together, it is unclear what the pathway of influence may be. However, by controlling for agenda-setting dynamics, this facilitates a better understanding of whether party support is influenced by a variety of factors, and whether such influence occurs directly, or indirectly via other actors.

To summarise, theory on agenda-setting and the role of protest have yet to be applied to explain green party support over time, however, existing findings would suggest that when attention to the environment among the media and public goes up, so too does green voting. Traditional explanations for green support emphasise the importance of demand-side predictors and issue prominence, but these are also found to shape media coverage and public opinion. By using time-series modelling, this study allows for the potential direct and indirect effects of real-world conditions and events. Importantly, this investigation allows for the possibility of multidirectional or inverse relationships, given that these phenomena have yet to be simultaneously modelled and the pathway of influence is unclear. Party support may be being driven by the perceived importance of the environment to the public, media coverage of the environment, or environmental protest. But equally, there is also the potential for interactions between these variables and for these to be being driven by green party support itself.

4.3 Data

In analysing green support in Germany, this research uses monthly-level data between 1994 and 2019. A major benefit of using monthly data is that it permits a more detailed micro-level understanding of the drivers of change, particularly when considering exogenous factors. In addition, many studies of electoral behaviour use annual data that is restricted to election periods, however, due to election cycles and electoral systems differing greatly between countries, this does not provide the best measure of how green party support differs, both over time and between countries. The period of study was chosen for several reasons. Firstly, as this allowed for the most comprehensive inclusion of data whilst also ensuring their continual measurement.[24] This additionally omits the period of post-reunification in 1990 which restructured the political system. In consequence, 1994 was the first year in which the German greens stood for election nationally

[24] Articles are only available on online archives from 1994. At the time of research, Politbarometer data was only available up until 2019.

as they are currently known, having previously run separately as Die Grünen (West Germany) and Bündnis 90/Die Grünen (East Germany). The following sub-sections describe how variables used in analysis are derived.

4.3.1 Endogenous variables

Agenda-setting theory tells us that the amount of attention given to issues by the public, media and politicians are contingent on one another. Thus these measures are endogenous in the sense that they are interdependent and determined by each other. To measure agenda-setting effects, this study includes four endogenous variables.

Green party support

Two measures of support for the German green party are used, both derived from Politbarometer survey data which is weighted for representativeness (Forschungsgruppe Wahlen 2020). The first, "Green Party", reflects the proportion of respondents who reported Bündnis 90/Die Grünen as the party they would vote for. Respondents also rated their perceptions of each party leader on an 11-point scale, accordingly, "Green leader perceptions", reflects the mean for the green leader. For both, "don't know" is included in the baseline and refusals/invalid responses treated as missing. Three non-consecutive missing dates at the beginning of the series were linearly interpolated.

Public salience

Public salience is similarly quantified using Politbarometer data, using an open-ended most important problem measure which records responses to the question "what do you think is currently the most important problem in Germany at the moment." Respondents may report up to two issues, and responses are grouped into topics by the survey team. Monthly values were calculated by taking the weighted proportion of a binary variable which reflected respondents

reporting the "environment" or "nuclear" topic as either their first or second most important issue, with responses of other topics or "don't know" included in the baseline.

Media attention

Media attention is measured by the number of newspaper articles on the environment in Süddeutsche Zeitung (SZ) and Frankfurter Allgemeine (FAZ). These platforms include a range of editorial positions and follow those chosen by prior scholars (Schäfer et al. 2014; Schmidt et al. 2013). The monthly number of print articles was established using LexisNexis for SZ and the website archive for FAZ, as articles for the latter are only available from 2006. Search terms were based upon those used by prior scholars (Grundmann and Scott 2012) and comprehensive keyword searches.[25] The two series were standardised and indexed to create an overall "media attention" variable.[26] A limitation of this measure is that it only reflects two traditional newspapers and no other media forms. However, in line with intermedia agenda-setting, legacy media influences other media forms and the content of both are found to be interlinked (Vliegenthart and Walgrave 2008). As a result, particularly at the monthly level, whereby there is likely convergence between platforms, we can assume the measure is reasonably representative of wider media trends.

Protest

To measure protest the Mass Mobilisation dataset (Clark and Regan 2020) was used to record the date and participant number of protests which included reference to environmental issues in the notes.[27] Occurrences of Climate Strikes, Ende Gelände and Extinction Rebellion (XR) were also added as these were not all included in the dataset. Events were selected using the scheduled dates

[25] See Appendix C for list of search terms.
[26] Between January 1999-November 2000 there is an abnormally low number of articles on LexisNexis for SZ. This period is treated as missing and only values for FAZ are used.
[27] In December 2019 farmers protested by blocking roads with tractors, this is not included due to being in opposition to environmental measures.

and recorded by averaging participant estimates that were reported by media and organisers. The final variable reflects the total number of protest participants per month, however, due to large variance this is modelled in square-root form.

4.3.2 Exogenous variables

Based upon existing green party literature, and findings of studies into public and media environmental attention, several exogenous indicators and events are also included, with exogeneity implying their value is not influenced by other included variables. To reflect long-run environmental conditions and to test whether there is any movement in line with objective climate change indicators worsening over time, change in seasonally adjusted global carbon dioxide (CO2) levels are included from NOAA (Dlugokencky and Tans 2021), as well as global temperature changes (NASA 2021). Three variables were created to indicate the severity of domestic, European and international natural disasters. These were calculated using the International Disaster Database EM-DAT, and reflect an index of standardised deaths, number affected and damage in USD ($). Domestic temperatures were recorded using Climatic Research Unit data (Harris et al. 2020) to reflect mean monthly temperature as well as temperature anomalies (deviation from the 1901-2016 average). To control for economic conditions quarterly changes in unemployment rate were recorded from the Eurostat Labour Force Survey, with the quarterly figures assigned to the middle month of each quarter and cubic spline interpolation used to generate monthly estimates. Release dates of IPCC reports were recorded as a binary variable. Finally, multiple political event variables are included to reflect federal election dates (seven in total) and intergovernmental events; United Nations Climate Change Conferences (UNCCCs) – measured as days of conference per month, EU Summits, and G8/G7 meetings. A variable was also included to control for the period between 1998-2005 when the greens were in government.

4.4 Results and analysis

4.4.1 Trends in party support

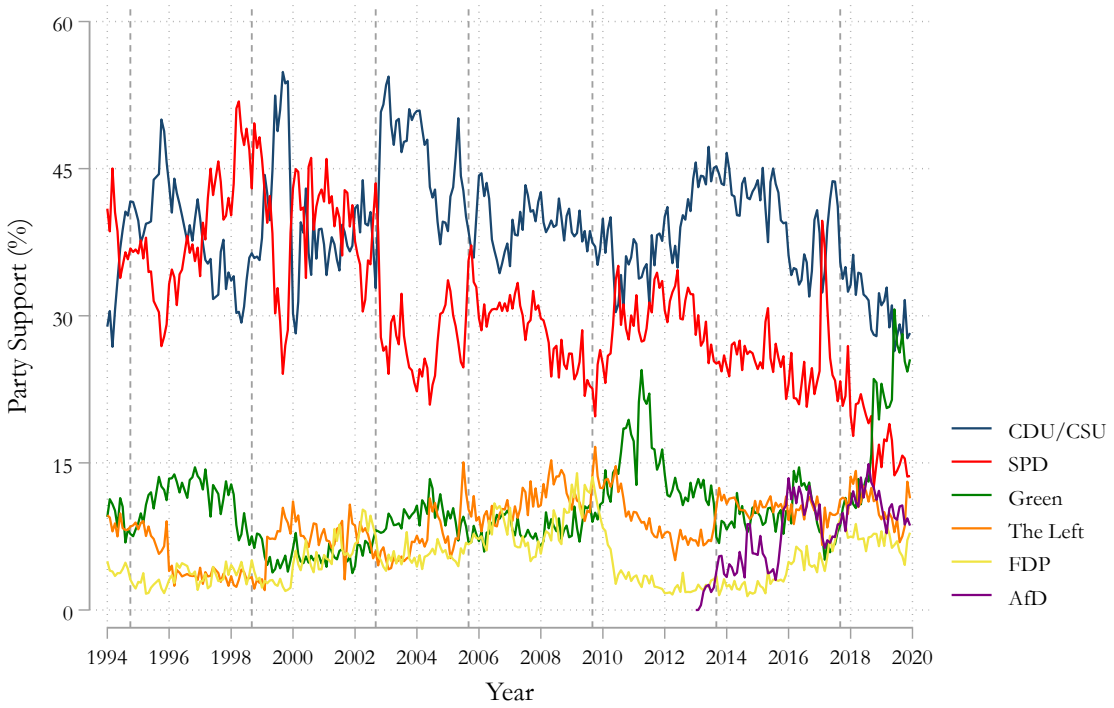
Although this Chapter does not include other German parties in empirical analysis, in discussing changing support for the greens it is worth situating this in the context of broader party support. In considering trends in green support as shown by Fig. 4.2, it noteworthy that there appears to have been trendless fluctuation in green party support, rather than cohort replacement as predicted by post-materialist theory (cf. Inglehart 1977; Inglehart 2008). As shown by Fig. 4.2, support for the greens has increased slowly since its lowest point in 1999, although in a non-linear fashion, with sharp peaks and declines over time. Before 2021, the greens previously performed best in 2009, winning 10.7% of the vote, which has been attributed to heightened environmental concern and nuclear opposition (Rüdig 2012). The decline in support following 2011, with vote share in 2013 and 2017 elections at 8.4% and 8.9% respectively, may be partially due to the CDU/CSU announcing the *Energiewende;* the plan for nuclear phase-out and transition to a low carbon economy with a focus on renewable energy, thus effectively taking ownership on one of the greens' core issues.[28] Although, this has also been highlighted to be driven by intra- and inter-party relations and a failure to establish a coherent party platform (Franzmann 2015). This highlights a paradox within support for the green party, particularly in Germany, as the greens have historically been rooted in the anti-nuclear movement (Müller-Rommel 1985; Baukloh and Roose 2002). However, now the rise of climate concern is at odds to opposition to nuclear power, which is one of the energy sources with the lowest greenhouse gas emissions.

This also raises a broader point that support for the green party is not purely driven by environmental motives, with the German greens having pushed for stronger measures on a variety of issues (Carter 2020). One suggestion is that green support is rising in response to far-right support, particularly due to the green party positioning themselves as pro-EU, anti-racism and

[28] When in power in 2002, the greens reached agreement for denuclearisation by 2020. This was reversed by the subsequent government, but nuclear exit was reinstated and made final following Fukushima.

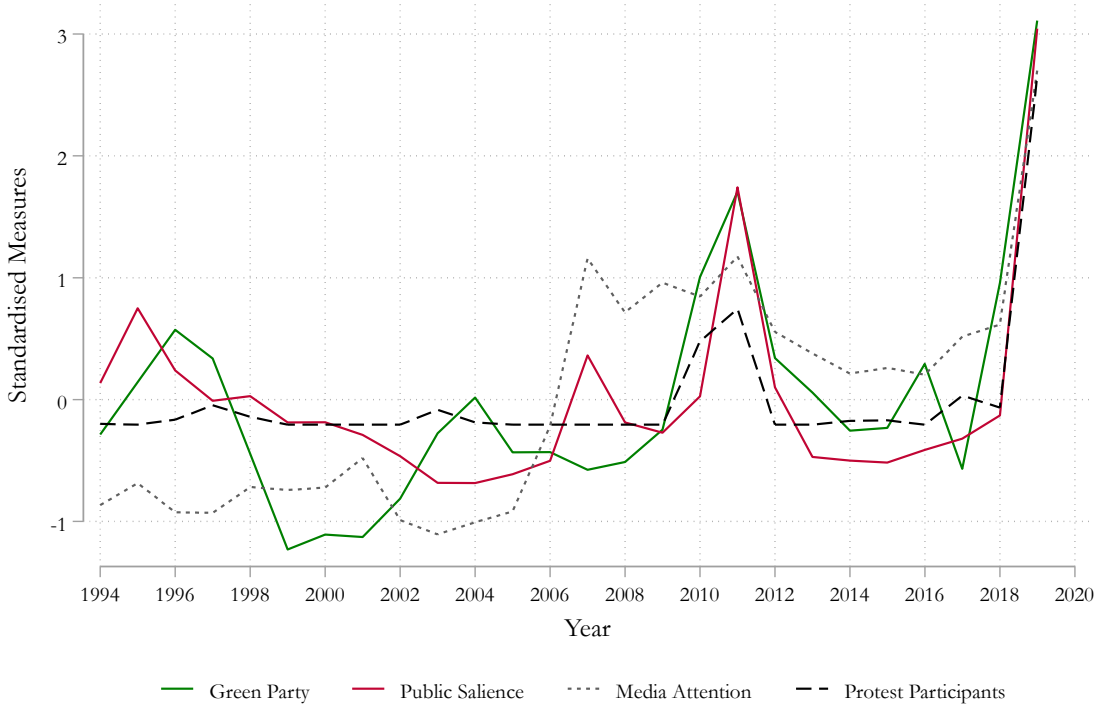
anti-far right. However, though opposition to extremist parties may have aided their growth, green vote intentions continued to rise even though AfD support has subsequently declined. While the greens benefitted in 2009 from SPD voters shifting (Rüdig 2012), the recent rise in support appears to have been paired with a decline in support across both major parties, suggesting it might be driven by discontentment (Müller-Rommel 2007). The greens have also likely benefitted from intra-party dissent in Die Linke (The Left), their far-left competitor. The period between 1998-2005 when the greens were in power is the only period in which perceptions of the green leader indicated negative attitudes (see Appendix C - Fig. C1). Green support also fell during the first half of this period. This was, in part, due to government members having to support policies they once opposed, particularly Foreign Minister Joschka Fischer supporting NATO's military action in Kosovo.

Figure 4.2: German party support, 1994-2019



Vertical dashed lines show federal election dates.

Figure 4.3: Annual trends in attention in Germany, 1994-2019

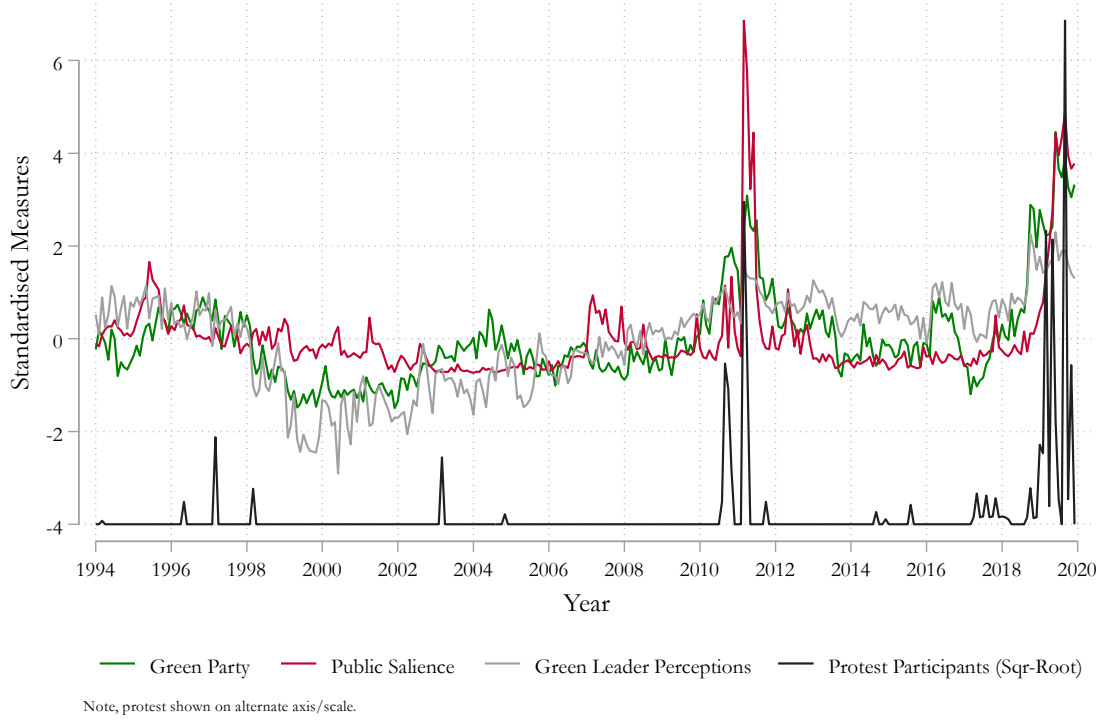


Changes in the attention given to the environment by the public and media are also presented here to enable comparison of trends before turning to model green support. Looking at annual data shows party support is following a similar pattern to other phenomena over time, which gives initial indication of endogenous measures being interlinked (Fig. 4.3). As well as party support being at its highest, all variables saw their greatest levels of attention to the environment in 2019. Although, it should be noted that since then, levels of public salience fell markedly, with the perceived importance of the environment to the public replaced by concern for the pandemic.

Fig. 4.4 presents the three standardised measures of public mood: green party support, green leader perceptions and public salience, alongside occurrences of protest. Spikes across all public measures can also be linked with occurrences of protest events, which might indicate environmental movements are driving changes in party support and public opinion. Changes in party support largely follow public salience trends, and there is also significant correlation of 0.68 between these measures ($p=0.00$). However, from around 2018, it appears that green support rose prior to public salience. Plotting party support alongside media attention similarly indicated the

recent rise in green party support occurred prior to changes in media coverage (see also Fig. 4.1). This can be found in Appendix C, along with a more in-depth discussion of one-case events that can be linked with media spikes.

Figure 4.4: Co-movement of green party measures, public salience and protest, 1994-2019



4.4.2 Modelling attention to the environment in Germany

Due to frequent oscillations, it is difficult to establish anything other than an association between these variables from graphs alone. Therefore, to model changes in green party share over time, the Chapter uses Zellner-Aitken Seemingly Unrelated Regression (SUR) methodology which allows for dynamic relationships between variables by solving a system of equations simultaneously. This method is appropriate when there are correlated error terms between regression models and is much like VAR but with the ability to specify exogenous variables across equations (Freeman et al. 1989). The basis is that each endogenous variable influences one another, with each variable modelled as a function of its past values, and also the past values of the other series.

As Augmented Dickey-Fuller (ADF) tests indicated protest and public salience variables were stationary, while party support and media coverage were integrated of order one, this study employs the "lag-augmented" approach of Toda and Yamamoto (1995). This method prevents spurious regression by ensuring the Wald test statistics are asymptotically chi-square distributed, thus eliminating the problem of integration and/or cointegrating rank. The original VAR(n) model is augmented with m lags, where n is the true model lag length and m is the maximum order of integration, with the final model specified as VAR(n+m). Granger-causality is calculated as usual by testing the initial n coefficients. While LA-VARs have been found to perform best (Ashley and Verbrugge 2009), results of modelling the variables in levels (as advocated by Sims et al. 1990), and in differences (another option as ARDL bounds tests indicated no cointegration), can be found in Appendix C. However, regardless of which form the variables were in, substantive conclusions were found to be largely analogous.

To specify the model, Akaike information criterion (AIC) tests determined eight lags to be most appropriate, meaning the model accounts for each of the endogenous variable's values in the preceding eight months. Diagnostics tests confirmed this lag length ensured the model was stable and had no residual autocorrelation. In line with the lag-augmented approach, the final model is augmented using nine lags. Exogenous variables which were found to be non-stationary by Dickey-Fuller tests were differenced, with the transformed variable reflecting monthly change.[29] Having done so, a least absolute shrinkage and selection operator (LASSO) was used to determine which variables were likely to have a significant relationship with each of the endogenous variables and thus, which should be included. With many exogenous variables (many closely related) and four equations to specify, this established suitable lag-lengths for each variable (e.g. whether they were likely to have an impact in the concurrent or subsequent month[30]) and ensured parsimony.

[29] This resulted in global temperature changes being excluded from consideration as it was non-stationary and could not be differenced further.

[30] The only exception to this were election dates, as the months prior to elections occurring were also considered due to campaign effects.

Nonetheless, main relationships between endogenous variables were robust regardless of which exogenous variables were included. To prevent making assumptions about plausible mechanisms of influence, exogenous variables are not included in the protest equation. Information criterion tests indicated this provided a higher quality model, but likewise, doing so had no effect on substantive conclusions, with results robust to inclusion of exogenous variables in the protest equation.

As is common, SUR model estimations are not presented as they have many parameters and individual coefficients can be hard to interpret due to systemic indirect effects which result from endogeneity and inclusion of lags (Freeman et al. 1989). Instead, model results are used to calculate Granger-causality, which better evidences whether causality persists between variables. This is a slightly different notion of causality, whereby one variable can be said to Granger-cause another if the lagged values of the former can be used to predict the latter whilst also controlling for its own lagged values (Granger, 1969). Put simply, Granger-causality tells us if, for example, protest activity in previous months helps explain current levels of green party support, even controlling for previous levels of green support.

As green party support, as well as media and public attention, deviated dramatically from around 2018 onwards (Fig. 4.1), the time-series is broken down to enable comparison between periods. The first period that is modelled covers the full period of 1994–2019, and the second restricts this to exclude the wave that occurred from 2018 onwards. Granger-causality results for the period 1994-2019 are presented in Table 4.1 and summarised graphically in Fig. 4.5. All endogenous variables are found to be autoregressive processes, meaning that their value in any given month can be predicted by their values in the preceding months.

Of note, is that levels of green party support can be predicted by the occurrence of environmental protest in preceding months. This indicates that protest movements can be linked to the recent rise in green support, as well as changing public attention to the issue. In addition, there is reciprocal causation, with bidirectionality found between green support and protest, as

well as protest and public salience. This suggests these measures are mutually reinforcing, with the occurrence of protest linked to the perceived importance of the environment to the public, as well as this in turn being shaped by protest.

Table 4.1: Granger-causality results, 1994-2019

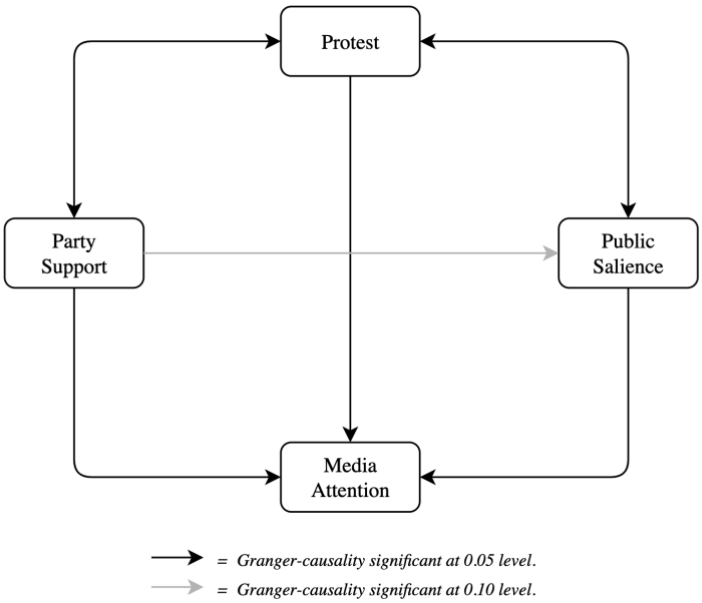
	Party	**Public**	**Media**	**Protest**
Endogenous				
Green Party	606.57***	13.62º	21.05**	51.35***
Public Salience	–	147.02***	23.64**	43.27***
Media Attention	–	–	337.35***	–
Protest Participants	33.03***	74.66***	30.10***	132.40***
Exogenous				
Temperature Anomaly	–	–	7.56*	
Domestic Disaster	–	–	2.75º	
European Disaster	4.03*	3.15º	–	
International Disaster	–	8.61*	–	
D.CO2	–	–	2.90º	
UNCCC	–	6.32*	32.53***	
EU Summits	–	–	–	
G7/G8 Meetings	–	–	–	
IPCC	–	–	–	
D.Unemployment	–	–	7.48º	
Green Government	7.35**	4.58*	2.75º	
Election	6.85*	–	12.05**	

Period 1994:1 - 2019:12. Observations = 302. Endogenous lags = 9.
*Figures show chi2 value. Significance level: º0.1, *0.05, **0.01, ***0.001.*
Dash indicates variable included in model but not significant.

Another important observation is that the level of media coverage of the issue is not found to be predictive of party support, nor any of the other variables. Although the number of news articles on the environment is driven by multiple indicators and events, which will be discussed in due course, this does not subsequently translate into changes across other measures. Instead, media attention can be predicted by levels of party support, as well as protest and public salience, which

indicates that, at least at the monthly level, it is responding to changes in green salience rather than driving party support.

Figure 4.5: Granger-causal relationships, 1994-2019



However, upon examining the impulse response functions for this model, which show the predicted effect over time in one variable after a shock in another in the month prior, these imply rising public salience has a negative impact on the extent to which newspapers give climate change coverage (Fig. C5). This effect is unexpected, and a more careful examination of these dynamics is needed in future research. It is likely that this is being driven by the sharp increase around the Fukushima disaster in March 2011, when public salience was at its greatest across the whole period of study, as following this spike levels of public and media attention dropped substantially (see Fig. 4.1). This might indicate it is capturing an adjustment effect, whereby the news market becomes oversaturated with reporting on the issue and it subsequently loses its newsworthiness, resulting in a fall in interest through issue fatigue (Djerf-Pierre 2012). Nonetheless, the fact that the dynamic model allows for media coverage to be following public salience is an important control mechanism, as when considering the effects there is no danger of reverse causality. Regardless of

the effect of public salience on media, the results show that media coverage is not leading public opinion, nor green voting. Overall, this signifies importance of taking reciprocity into account, as well as the utility of bringing agenda-setting and protest into models of vote choice, as these variables are proven to be vital in understanding the dynamics of green support.

Having considered the determinants of green party support for the whole period, how do these dynamics compare when excluding the recent wave of environmentalism that occurred from 2018 onwards? Results of this model are shown in Table 4.2 and Fig. 4.6. For the period between 1994 and 2017, changing green party support in Germany remains Granger-caused by the occurrence of environmental protest. However, in addition to this, green support can also be predicted by the perceived importance of the environment to the public. Media coverage is not predictive of party support for earlier time periods, with results still suggesting it follows changes in green voting. This remains the case regardless of the time period, as robustness checks indicated that using different cut-off points for the former resulted in the same substantive conclusions. However, while media is not found to predict public attention to the issue when looking at the whole period, it does when looking at earlier time periods. This provides some evidence of priming effects prior to 2018, with media coverage influenced by exogenous factors (agenda-building), public salience predicted by media coverage (agenda-setting) and in turn, green party support predicted by public salience (priming).

As media coverage does not explain the recent surge in public attention to the issue, nor voting intentions, this indicates a potential weakening of media effects. Moreover, as public salience cannot predict levels of green support when the latter two years of the series are included, this suggests the recent upswing in green support cannot be predicted by the perceived importance of the environment to the public. Although, as public salience is predictive of protest, and protest of party support, it may be that effects may be occurring indirectly via protest. Instead, in recent years public attention to the environment are predicted by changes in green support (Table 4.1). This indicates that changes in aggregate voting intentions occur first, highlighting the importance

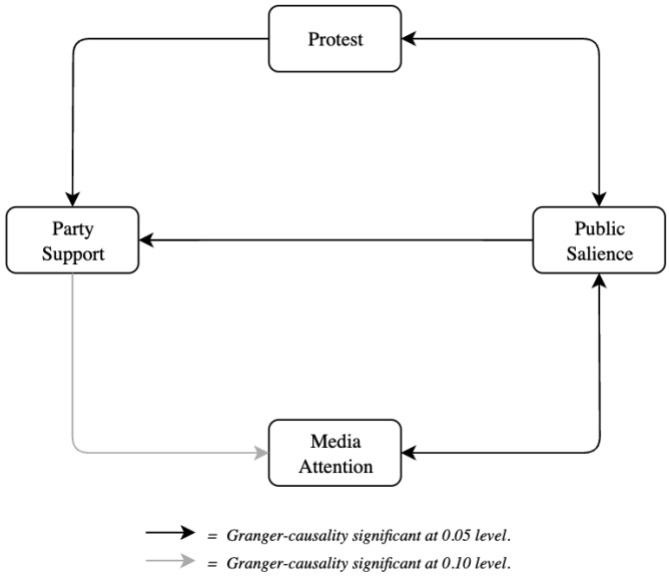
of taking reciprocity into account. This fits with the fact that green voting appeared to rise prior to changes in public opinion (Fig. 4.3-4.4). There are several reasons why green voting might not be explained by how important the public perceive the environment to be. Given the lag specification of the model, it may be that public salience has shorter-run impact on green voting, for example in the concurrent or subsequent month, but that this is not substantial enough to be significant over the longer-term. Another key consideration is context and broader political opportunity structure as, though rising green support has been partnered with heightened environmental concern, it has also been impacted by inter-party competition and public opinion/party stance on other issues. Therefore, while voters may have previously been driven by environmental concerns, this different relationship may partly reflect the shifting paradigm of the green voter base.

Table 4.2: Granger-causality results, 1994-2017

	Party	**Public**	**Media**	**Protest**
Endogenous				
Green Party	422.95***	–	14.33°	–
Public Salience	17.16*	212.33***	31.26***	77.30***
Media Attention	–	17.35*	272.26***	–
Protest Participants	21.89**	105.22***	25.59**	153.09***
Exogenous				
Temperature Anomaly	–	–	5.11°	
Domestic Disaster	–	–	2.94°	
European Disaster	5.69*	5.11*	–	
International Disaster	–	–	–	
D.CO2	–	–	–	
UNCCC	–	7.60*	32.26***	
EU Summits	–	–	3.11°	
G7/G8 Meetings	–	–	–	
IPCC	–	–	–	
D.Unemployment	–	–	9.58*	
Green Government	11.92***	6.91**	5.00*	
Election	5.11°	–	11.29**	

Period 1994:1 - 2016:12. Observations = 279. Endogenous lags = 9.
*Figures show chi2 value. Significance level: °0.1, *0.05, **0.01, ***0.001.*
Dash indicates variable included in model but not significant.

Figure 4.6: Granger-causal relationships, 1994-2017



The final consideration is whether exogenous indicators and events have played a role in shaping German green voting in recent decades. These generally have little utility for predicting green support, though changes in green support are found to correspond to the occurrence and severity of natural disasters in Europe, with the regressions suggesting that natural disasters increase green voting. Unsurprisingly, election periods can also predict party support. Months in which the greens were in government, encompassing the coalition period between 1998-2005, are also found to predict party support, media attention and public salience. For each of these there is a negative coefficient in the underlying regressions, which is to be expected given the period covers the lowest levels of green support (Fig. 4.2), however, this highlights the potential for party support to fall if the greens are successful at elections. Although, running a further model found the number of regional states with green coalitions was not a predictor of green support, nor levels of public and media attention.[31]

Party support is not found to be directly linked to unemployment, though there is evidence that this predicts media coverage. This result is unsurprising given that the greens saw their best

[31] See Appendix C for a graph of regional green coalitions and green support over time.

election performance in 2009, despite the economic downturn following the recession. Germany was of the countries in Europe where public concern about climate change was least affected in response to the recession (Kenny 2021). Although not captured within the period of study, this is further strengthened by the German greens succeeding in the 2021 election, despite rising unemployment resulting from the pandemic. This is inconsistent with the "finite pool of worry" hypothesis, which predicts that climate concern will decrease as other concerns, such as economic and health, increase. In terms of other processes, domestic disasters are found to predict media coverage and international and European disasters are found to be associated with public salience. This geographical pattern might be due to there being fewer recorded domestic disasters, reducing their predictive ability for public salience. Alternatively, it may be that natural disasters are not always linked to climate change/the environment in articles (and thus not captured by the search terms) or, as news coverage is finite, they crowd out articles on such. Other environmental indicators which are found to predict changes in media coverage include temperature anomalies and changing CO2 levels. Media attention is also predicted by numerous political events including UNCCCs, EU Summits and elections. This is in fitting with media being event-driven, however, ultimately the amount of media coverage does not have any consistent, sustained impact on party support. Overall, these findings suggest that even if green party support was influenced by any of these factors during the period of study, they are not able to consistently predict change over time. Absence of direct effects of economic conditions and environmental indicators on changing green support gives indication that traditional demand-side explanations for green party success may not necessarily apply.

4.4.3 Comparing German and British agenda-setting dynamics

Considering the findings of Chapter Three, a further model was run for 2006-2019 (the period covered by the data for Britain) to facilitate comparison between the two contexts. The full results of doing so can be found in Appendix C – Table C6). It is important to note that it is hard to

directly contrast the results of the two countries due to the variables being measured differently as well as inclusion of different variables. However, there are few things to note from comparing the results of the two countries.

The most significant thing is that for both countries there is a bidirectional relationship between public salience and protest, meaning that protest is important in understanding public opinion dynamics in both Britain and Germany. A surge in environmental protest is found to result in an increase in the perceived importance of the issue to the public in both contexts. When MPs pay more attention to climate change in Britain this causes a fall in the perceived importance of the environment to the public, whereas in Germany, as green party support goes up, so too does public salience. This difference is likely because parliamentary debate is a more direct measure of political action being taken (or being perceived to be), whereas party support is a measure of public mood and support of green policies, amongst others. Another key finding is that in both countries, the media is not predictive of public perceptions of the issue, giving no evidence for media effects as a whole. Finally, in both Britain and Germany, media coverage of climate change is impacted by occurrence of United Nations Climate Change Conferences (UNCCCs) as well as changing CO2 levels, though the public appear to be more responsive to exogenous factors in Germany than in Britain. These findings do not necessarily mean that included indicators hold no influence over public salience in either context. However, results suggest that either the number of individuals being influenced is insufficient for aggregate changes to occur, or that influence is not sustained past the contemporaneous month.

4.5 Conclusion

Recent years have seen a striking wave of environmentalism across many countries, with rising public concern about climate change and increased vote share for green candidates in elections. The wave that occurred from around 2018 onwards was largely unanticipated, given that traditional explanatory factors such as economic conditions and environmental degradation have not

substantially worsened during this period, nor have the structural patterns between countries. Also the dominant political science framework for explaining variation in niche party support does not help since mainstream parties have all been notionally pro-environmental in recent years, playing an accommodative strategy in Meguid's (2005) terms. This raises questions about how rises and falls in green party support, within countries and over time, are understood.

While Germany has a long history of pro-environmentalism, the level of support for the greens and the relative attention given to the environment by the public and media have varied over time. This Chapter sought to better understand these changes, by looking at monthly changes over the period between 1994 to 2019 using Germany as a case study. In doing so, it highlighted theoretical linkages between literature on green party support and agenda-setting, while also considering whether changes in voting patterns have been driven by environmental protest. While the contribution of this Chapter is largely empirical and the theoretical components are not individually new, these findings highlight some theoretical development in the need to consider these bivariate processes, that are often considered separately, in conjunction with one another to understand the dynamics of green party support.

Although this Chapter's analysis is very German-specific, the trends in environmentalism are not. These findings may have broader implications across several countries which have also witnessed rising environmentalism and spikes in green party support over time. However, given the varying degrees of green success across European countries, it is not immediately clear how generalisable these findings truly are. This is also true of the potential role of news articles under different media landscapes. This study leaves it for future research to produce similar studies in other countries to examine how patterns of green support and/or green governance apply across different national contexts, although precisely the same analysis may be unable to be produced because of the nature of data availability at the sub-annual level. This also highlights the importance of analysing individual countries, as it is not immediately possible to produce a cross-national analysis in a comparative way using panel data.

This investigation does not try to model the effects of party competition or consider that patterns of green party support might also be affected by public opinion and party stance on other issues which shape political opportunity structure more broadly. Indeed, more work needs to be done in this area to fully understand the dynamics of party competition more generally, and to explicate whether party support indeed being driven by climate concern or other issues such as the greens' stance on foreign policy, economic and/or social issues. As the way the media frame the issue of climate change is important in determining how the public response (cf. Moser and Dilling 2012), future research should examine whether particular types of news coverage are more likely to drive green voting. As this research only focuses on two mainstream print newspapers, future research would also benefit from more closely examining the dynamics of different media forms and sources. Given varying levels of green success in regional government compared to federal government, further analysis could consider how these processes differ.

German environmentalism and the green party itself have historically been rooted in protest, but there is little evidence regarding the potential implications of such over time. This Chapter finds that occurrence of environmental protest in prior months can be linked to changing green support across time periods, suggesting protest should be considered under future models of vote choice. What is more, in recent years protest and the perceived importance of the environment can also be predicted by levels of green support, highlighting the importance of taking reciprocity into account as there is mutual reinforcement between public salience, protest activity and green party support.

Up until 2018, green support could be predicted by how important the public believe the environment to be. Between 1994 to 2017 there is evidence of priming effects, with media coverage of the environment predictive of how important the public think the environment is (agenda-setting) and, in turn, this being predictive of green voting (priming). However, when extending analysis to include the recent wave of environmentalism this is no longer the case. Looking at the period 1994 to 2019, media coverage is not predictive of public salience, and any

impact of the perceived importance of the issue is only indirectly through protest. These findings speak to the utility of using measures of public salience, quantified through "most important problem" survey questions, future research should explore whether an alternative measure of public opinion might have greater association with vote choice in more recent years.

Changes in green support are found to correspond to the occurrence and severity of natural disasters in Europe, indicating voting intentions may be influenced by risk perceptions. Although, absence of effects for other environmental and economic conditions might indicate that traditional post-materialist and demand-side explanations for green party success may not necessarily apply at the aggregate level. In contrast, while media coverage can be predicted by environmental and economic conditions, as well as political events, media is not predictive of green party support. Instead, media attention can be predicted by green support, environmental protest and public salience, suggesting it is responding to changes in voting patterns rather than driving them. The findings of this Chapter confirm the importance of taking into account agenda-setting dynamics, in order to understand not only the causes of green voting, but also the consequences of such.

The ability to sustain these higher levels of environmentalism depends on political action and the costs of achieving such (cf. Downs 1972). Indeed, issue fatigue is to be expected, and a partial collapse of public salience has already occurred during the subsequent Covid-19 pandemic. Although peak levels of green support were not fully sustained in the run-up to the election, the greens were nonetheless successful in entering into government. This marks a shift in Central European relations and party dynamics. Nonetheless, in line with the findings of this Chapter, if the previous SPD-coalition period between 1998 and 2005 is anything to go by, the greens may ultimately lose public support in coming years.

Chapter 5
Conclusion

5.1 Background

Climate change is a significant geopolitical issue; both caused by, and affecting, every country across the globe. Mitigation of the issue requires drastic action by governments, 'at a scale and speed significantly faster than that represented by current trends' (IPCC 2022: 178). Yet, despite the rising threat of continued inaction on climate change, the extent to which the public believe it to be an important issue has varied dramatically over time. While many countries have reached new peak levels of concern in recent years, this is not the first time that environmental salience has peaked. For example, in Britain the public were previously most concerned about the environment in 2007. Given that policymakers are at least to some extent driven by public demand (Erikson et al. 2002), understanding public opinion on climate change is of vital importance in order to gauge societal demand and support for mitigation and adaptation, in both present and coming years (Wiertz and de Graaf 2022). This thesis sought to better comprehend these macro developments in environmental public opinion, to not only discern the patterns and driving factors of these changes, but to also investigate the potential consequences of such.

Traditional sociological theories tell us that public opinion on climate change may change over time in response to environmental conditions, in line with the "objective problems" explanation (Echavarren 2017), economic conditions, in line with post-materialism (Inglehart 1983; Inglehart 2008), or the level of attention given to the issue by media and politicians, in line with agenda-setting theory (McCombs 2004). However, these do not necessarily explain the recent heightened public interest in the environment across many countries, which also co-occurred with large-scale global protest movements including School Strikes for Climate and Extinction Rebellion. The role of environmental protest has not been well studied, and studies into any form

of protest have not usually considered the relationship between public salience and protest, instead focusing on its impact on policymaking.

In addition, as a relatively new issue with a moderate scarcity of opinion data, our understanding has thus far been restricted to small subset of countries, with research typically focusing on the US, a static point in time, or prior decades. This is particularly significant given that countries often included in opinion polling and analysis are those with some of the largest economies and some of the biggest polluters, while smaller and/or poorer countries are excluded, despite being disproportionately at risk from climate change outcomes (Klinenberg et al. 2020). This is also meaningful considering the commitments made at COP27 regarding supporting a new "loss and damage" fund for vulnerable countries.

5.2 Approach and findings

To first understand patterns of cross-national environmental opinion, Chapter Two brought together existing polls on climate concern that have been conducted in multiple countries and years, producing a dataset for 81 countries between 1998-2022. These were then used to produce country-year metrics of climate mood using a dynamic Bayesian latent variable model which adjusted for different wording of survey items and varying contextual impact of different questions, while also smoothing the estimates over time. To examine why public attention to the issue changes over time and how much this is affected by other factors, Chapter Three analysed monthly-level fluctuations in the perceived importance of the environment to the public (public salience) in Britain between 2006-2019, using time-series analysis to model this against changes in the attention given to the issue by MPs and media, occurrence of protest, as well as a variety of political events and environmental and economic indicators. In light of the success of the German green party at the 2021 federal elections, Chapter Four built upon the theoretical basis and findings of the prior Chapter and applied such to examine monthly changes in green support between 1994-2019.

The findings of Chapter Two emphasise that there is a lack of consistent polling data on climate attitudes and, for the data which is available, that there are important discrepancies between the results of climate opinion polls, both within and between survey organisations. In some countries, when comparing results *within* polling organisations, different survey questions fielded by the same organisation (for example the two Pew measures) are very closely aligned, while in other countries they produce very different outcomes and suggest different levels of climate concern. Likewise, when comparing results *between* polling organisations, in some countries the different results all tell a similar story about levels of concern and change over time making them relatively interchangeable, while in other countries they have contradictory findings. Therefore, by using a Bayesian model this produces a more comparable metric of climate consciousness by accounting for these discrepancies, thus better highlighting patterns of change within and between countries. These metrics of climate consciousness tell us that there was a decline in concern following the 2008 recession in the majority of countries. They also provide insight into the recent wave of environmental concern, with a spike in concern witnessed across many countries from around 2019. However, there is also stagnant or declining concern in many other countries, with these either not having witnessed an increase at all, or experiencing fallout from the pandemic following the increase. These findings speak to post-materialist theory and prior literature which has found economic conditions to influence public concern (Inglehart 1983; Brulle et al. 2012; Kenny 2019).

Chapter Three found that environmental protest activity in Britain can be predicted by public attention levels, but also that occurrence of protest is successful in increasing the broader public's perceived importance of environmental issues. The study also found that media coverage of environmental issues is influenced by public attention, rather than the other way around, and that public attention to environmental issues may decline after a period of increased political activity on the issue. Importantly, protest is also found to be a confounding factor when examining

the relationship between media and public salience, as media is found to predict public attention when protest is not accounted for.

As in Britain, protest is also found to be a significant predictor of public salience in Germany. That is, a surge in environmental protest is found to result in an increase in the perceived importance of the issue to the public in both contexts. Likewise, in both countries, the media is not predictive of public perceptions of the issue for the period 2006-2019, giving no evidence for media effects. While it is hard to directly compare the results of the two case studies due to different variable inclusion and measurement, this highlights important similarities in the dynamics of public opinion in two contexts.

It used to be possible to predict levels of green support based on how much attention the public was paying to environmental issues. However, that is no longer the case. Now, changes in how important the public perceives environmental issues to come after changes in support for the green party, suggesting that the recent increase in support for green parties cannot be predicted by level of public attention to the environment in the months leading up to it. The extent to which the media cover the issue does not predict levels of support for the green party over time. Instead, it appears that media coverage responds to changes in green voting. In addition, while media coverage is not predictive of public opinion when considering the entire period, it is predictive when looking at earlier years. This suggests that media does not explain the recent surge in public attention to the issue, nor voting intentions, indicating a potential weakening of media effects.

For both Britain and Germany, findings suggest that short-term exogenous factors influence media coverage but do not consistently impact aggregate public attention, nor green party support. Though in Germany there is evidence that natural disasters result in greater environmental salience, as well as increased green voting. The lack of impact of exogenous factors outside of this indicates that, while they may have an effect in some instances, they are not able to consistently predict change over time across the period, giving little support for the "objective problems" explanation. Likewise, while there is a dip in concern around the 2008 recession in both

countries, economic conditions cannot sufficiently explain changes in public opinion when considering the whole period, which is unsurprising given that economic metrics were relatively stable before and during the surge in concern that occurred from around 2018 onwards.

5.3 Contributions and implications

The investigations contained within this thesis have shed light upon the dynamics of macro environmental opinion and have important contributions and implications. By bringing together existing repeated cross-national measures of climate opinion, Chapter Two highlights significant issues with relying on a single survey measure in cross-national research as this can impact interpretations of cross-national differences and change in concern over time. This emphasises a need for more consistent polling and indicates there are issues for survey organisations to investigate in terms of the quality of their polling methods and survey partners for different countries, and their comparability with other organisations. Because of this, it may be that single-country investigations are necessary going forward, or that cross-national analyses carefully consider the extent to which the cross-national differences produced by any single survey item are indeed accurate.

The patterns of change that are outlined in Chapter Two contribute to our understanding of macro developments, including for many countries which have yet to be included in climate opinion research. The trends confirm the economic dip following the recession, the recent spike in concern in many countries, but also the lack thereof in others. They additionally highlight that following the 2019 peak, climate concern has plateaued and/or declined in many countries. These findings also confirm the negative impacts of the pandemic, with many countries witnessing declining concern and fallout from the pandemic. This has important implications as despite the general consensus regarding heightened climate concern, it is important to recognise that not all countries are showing rising concern. Though, when considering the global population as a whole, climate consciousness has been increasing over the past eight years.

For both Chapters Three and Four, a significant contribution is in identifying mechanisms of influence which are often studied in isolation, and in applying these bodies of literature which have yet to have been used to understand Green voting and environmental public salience. Application of agenda-setting theory means this research has considered the potential reciprocal effects or impacts of public salience and rising green voting, rather than these just being treated as an outcome variable. For instance, allowing these to in turn be driving news articles on the issue rather than just resulting from heightened media coverage. Relatedly, on a methodological level, by looking at public opinion at a more granular monthly level, this gives better insight into the driving factors of short-run fluctuations and change.

Previous research has not focused extensively on how effective environmental protest can be in changing public opinion, nor green voting, so this was an important question for this research. A key finding of this research is that protest is an important factor to consider, as evidenced in both British and German analyses. Future investigations into environmental opinion should therefore pay careful consideration to the potential role of protest, particularly as protest is becoming increasingly commonplace and widespread.

5.4 Limitations and future work

The analyses contained within this thesis have raised several areas for further work. As highlighted by Chapter Two, it would be beneficial to build upon the preliminary cross-national investigation and bring in future measures of climate opinion as they become available to improve our understanding of the wave of environmentalism from 2019 onwards. This would provide greater insight into whether peak levels of attention have been sustained or whether they are returning to former levels as was the case after prior peaks. Relatedly, it would be interesting to study why some countries have sustained higher levels of climate concern and why others have seen concern decline.

Chapters Three and Four used unprompted "most important problem" style measures to reflect public salience as the proportion saying the environment is one of the most important problems facing Britain and Germany respectively. Theory on climate change attitudes should still be expected to impact attention to the environment and climate change consistently ranks among the top issues associated with the environment (Eurobarometer, 2019), which indicates the majority reporting the environment as an important issue are referencing climate change. Yet, as this is not a direct measure of climate concern it would be beneficial to further explore the link between climate concern and "most important problem" measures, as well as climate concern and agenda-setting dynamics. However, as evidenced by Chapter Two, an analysis of this type would be very restricted by data availability, and it would not be possible to look at sub-annual dynamics.

In the end, while public opinion is important, to resolve the climate crisis the most significant consequence is how this translates into behaviour and political action being taken. There are reasons to believe that concern translates into pro-environmental behaviours at least in some forms, however, greater sociological research into this area is indeed necessary (cf. Wiertz and de Graaf 2022). Future research could therefore explore different measures of environmental/climate opinion, such as behavioural changes, or support for specific policy interventions. This was not possible in this research due to the limited availability of such data, but this would be useful for both cross-national aggregate analyses and country-specific cases. In addition, future research is needed on how such attitudes spread through society (*ibid.*) and particularly given that this research found that protest is important, future investigations should more carefully examine the social forces and contagion effects surrounding this, both within and between countries.

The Bayesian latent variable model employed in Chapter Two has the benefit of establishing cross-national differences and controlling for the varying contextual impact of different survey items (country-item effects). However, because of this it only factors in the results of cross-national surveys. Given the lack of available cross-national climate data, for a future methodological endeavour it would be beneficial to adjust such a model so that single-country

series could be included to calibrate the trends within countries and thus provide a more robust benchmark.

Chapter Two emphasises a need to conduct country-by-country analysis to examine the determinants of changing public opinion on climate change over time, given the problems with cross-national data coverage and consistency. Having looked at Britain and Germany as case studies in Chapter Three and Four, future research into other contexts would provide insight into to what extent these dynamics are universal or case specific. While green voting intentions have increased in recent years the phenomenon in Germany is not necessarily applicable to all European countries, with many green parties struggling to convert climate concern into votes and other countries such as the Netherlands witnessing the greens losing seats. Future research could examine how these agenda-setting dynamics play out in other contexts, and better explain why greens are successful in some countries but not all. For example, looking at how other parties have taken some issue ownership on green issues (cf. Dennison 2020b), media framing of the environment/green parties (cf. Moser and Dilling 2012; Dennison 2015), as well as the obvious opportunity structure within the political system. Relatedly, it would be beneficial to also consider voting in European Parliament and local elections, which can often differ to national voting in both individual vote choice and outcomes. Or, at a more individualistic level, the mechanisms of why green concern may not be playing into vote choice.

This research considered the "finite pool of worry" hypothesis by operationalising this with respect to economic conditions, as has often been done by prior research. Recent studies have suggested that the "finite pool of worry" no longer applies to climate beliefs, evidenced by concern remaining relatively high despite the economic impact and uncertainty surrounding the Covid-19 pandemic (Leiserowitz et al. 2020; Evensen et al. 2020). However, there is room for this to be investigated further, particularly with respect to other worries such as immigration, the rise of far-right populism, and other global concerns such as political instability and international relations. In doing so, it would be beneficial to differentiate between public salience, which is more

likely to be crowded out by other issues due to the way it is measured, and other measures of climate opinion, to test if these are indeed changing public concern.

5.5 Final remarks

The Stern Review of the economics of climate change stated in 2006 that the costs of inaction far outweigh the costs of acting (Stern 2006). This remains increasingly true, with the projected costs of inaction having increased and the costs of taking action to mitigate and adapt having decreased with technological advancements (Black 2022). Without such action, climate change's impacts will increasingly affect the lives of, and come at a cost to, the public. Climate-related disasters are estimated to have globally cost $650-billion between 2016-2018, and by 2040 damages could cost $54-trillion (IPCC 2018; Morgan Stanley 2020). While poorer countries are disproportionately affected by climate change's outcomes (Klinenberg et al. 2020), its negative impacts are not restricted to such countries. For example, in the US, the Government forecast that the fiscal risk of climate change is $2-trillion per year (Vahlsing and Yagan 2022). In the UK, climate damages are expected to increase to 3.3% of GDP by 2050 and 7.4% by 2100 (currently at 1.1% of GDP), and around £9 from property damages caused by flooding can be saved for every £1 spent on protections (NAO 2020; Rising et al. 2022). While the general public's perceived importance of the environment may vary across time, its prominence as a geopolitical issue remains increasingly significant, particularly as the severity of inaction worsens. In coming years, with recovery from the Covid-19 pandemic, whether climate concern continues to rise or falls once again remains to be seen. Nonetheless, this analysis shows that in many countries, as well as at the global level, the public recognise the importance of climate change and the environment at unprecedented levels, indicating there is demand for politicians to act.

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Appendix A: Supplementary Material for Chapter Two

I. DATA SOURCES FOR SURVEY ITEMS USED IN ANALYSIS

GlobeScan Radar - https://globescan.com/our-insights/

Gallup World Poll - Lloyd's Register Foundation World Risk Poll - https://wrp.lrfoundation.org.uk/

Pew Global Attitudes Survey - https://www.pewresearch.org/global/datasets/

Eurobarometer - https://www.gesis.org/en/eurobarometer-data-service/home

Latin American Public Opinion Project (LAPOP) - https://www.vanderbilt.edu/lapop/raw-data.php

European Investment Bank (EIB) Climate Survey - https://www.eib.org/en/surveys/climate-survey/index.htm

HSBC Climate Confidence Monitor/Index - https://globescan.wpenginepowered.com/wp-content/uploads/2017/07/Climate_Confidence_Monitor_2009_Full_Report__HSBC_GlobeScan.pdf

II. SURVEY COMPARISONS

Figure A1: Eurobarometer very serious problem vs most serious problem

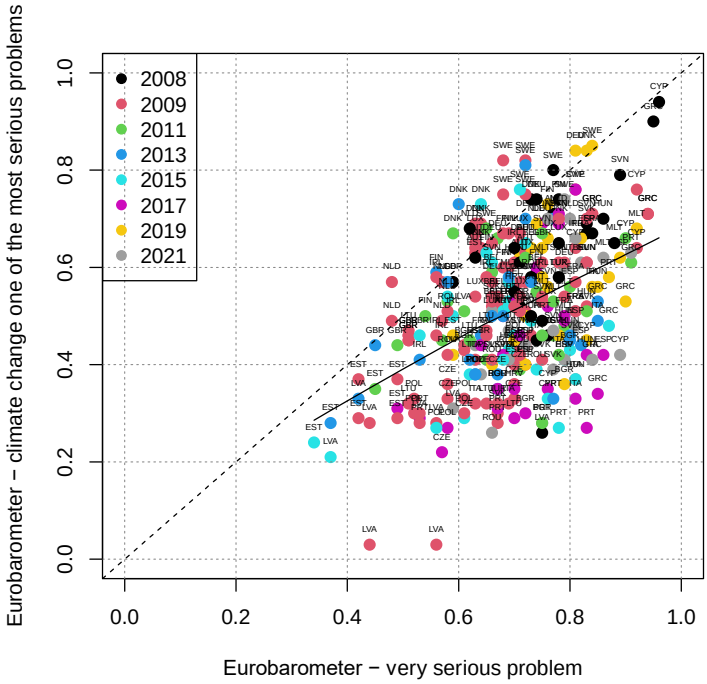
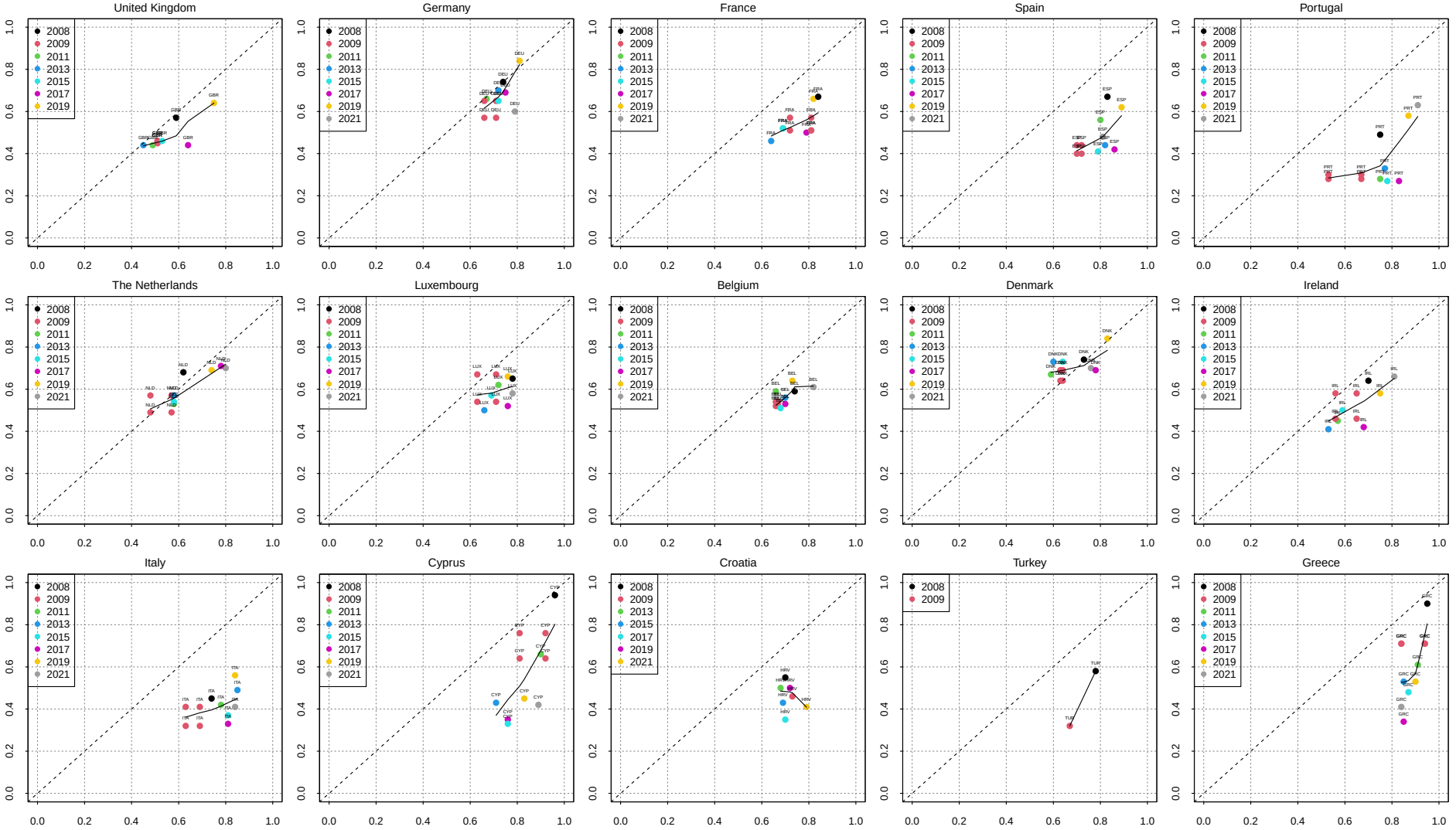
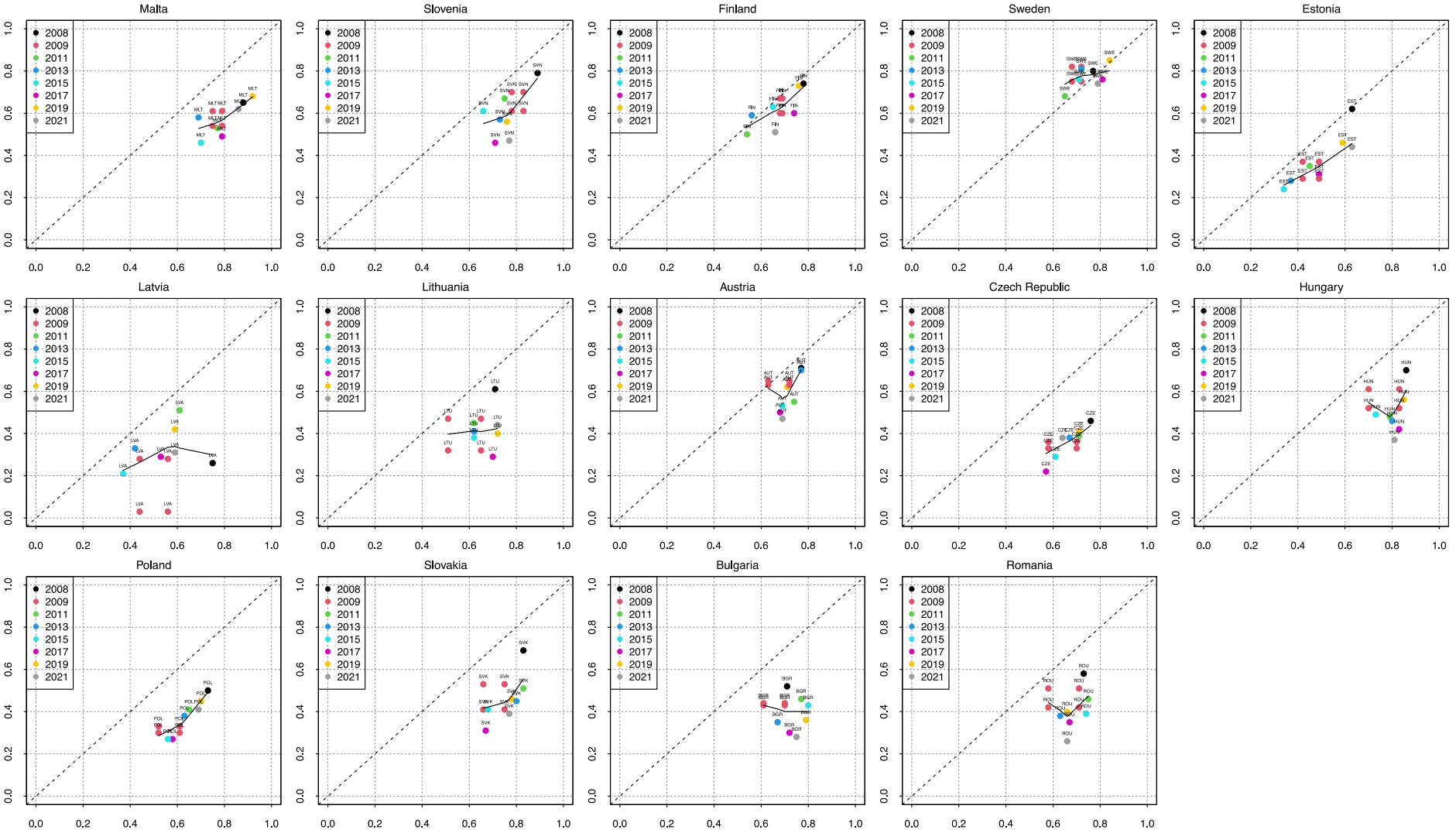


Figure A2 highlights how the relationship between the Eurobarometer "very serious problem" and "most serious problem" variables differs depending on the country they are fielded in. For example, countries such as Germany, the UK, Denmark, Finland, and the Netherlands have quite good alignment between the two measures. In such cases, changes in the proportion ranking climate change as one of the most important problems is a relatively good indicator of changes in the perceived seriousness of the problem. Other countries such as Poland, the Czech Republic and France have a linear relationship, albeit one that leans far more pro-climate on the "very serious" measure, which indicates the proportion choosing climate change as one of the most serious problems underestimates the general levels of perceived seriousness of the issue. This might show that while people believe climate change is a serious issue, they do not emphasise it's seriousness, or importance, above other political issues. Greece and Cyprus show far greater variation in reporting climate change as one of the most serious problems, than saying it is very serious. By contrast, for Bulgaria and Lithuania the LOWESS curve is almost flat, suggesting the reported importance of climate change is not at all an accurate reflection of the perceived seriousness of the issue.

Figure A2: Eurobarometer measures of climate opinion – very serious vs most serious problems, by country



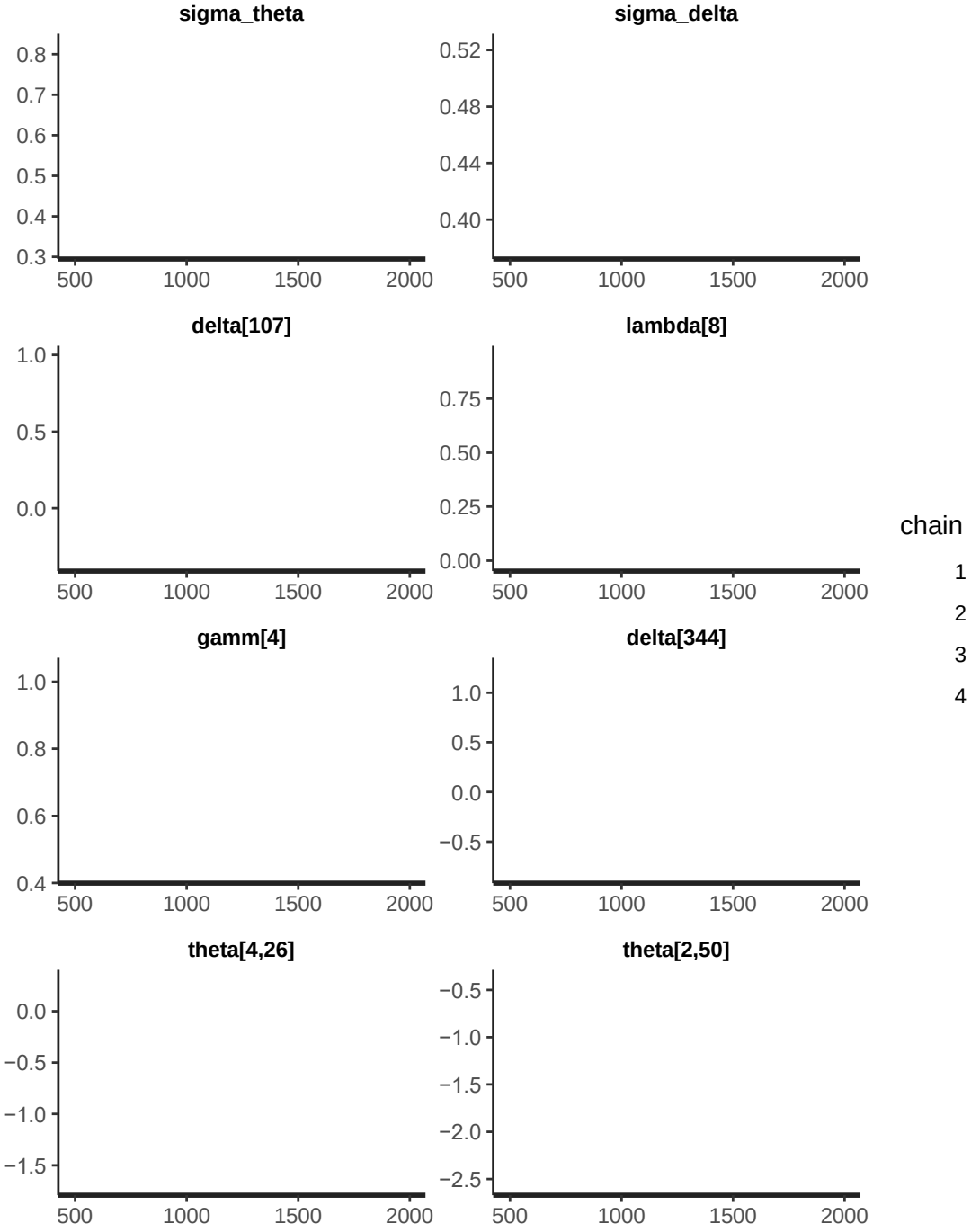
X-axis = Eurobarometer – very serious problem, Y-axis = Eurobarometer - climate change one of the most serious problems



X-axis = Eurobarometer – very serious problem, Y-axis = Eurobarometer - climate change one of the most serious problems

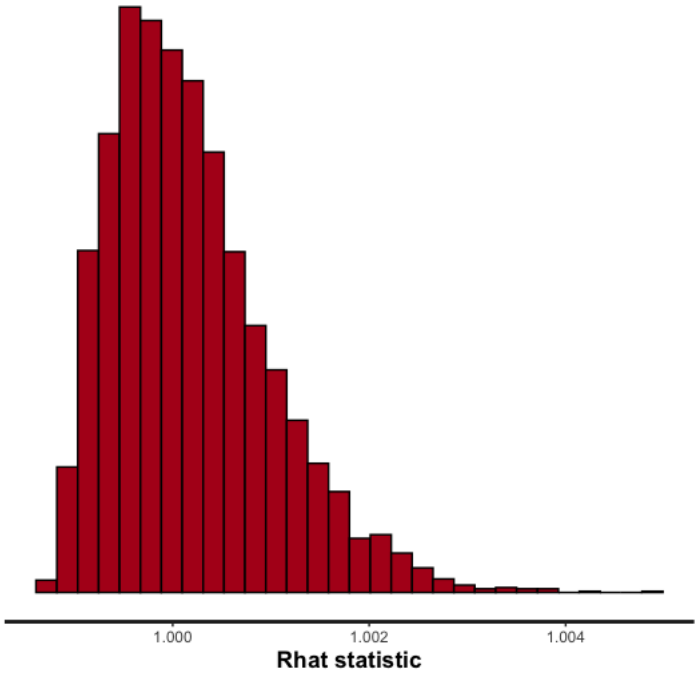
III. MODEL DIAGNOSTICS

Figure A3: Trace plot of selected parameters



The above trace plot suggests that the model has converged. For each parameter that is plotted, the four chains used to estimate the model have mixed and there is no evidence of clear trends.

Figure A4: R-hat plot



The above plot again indicates all chains have convergence and mixed well, with all R-hat statistics close to 1. Values above 1.05 would suggest a convergence issue.

Figure A5: Distribution of log posterior and mean metropolis acceptance

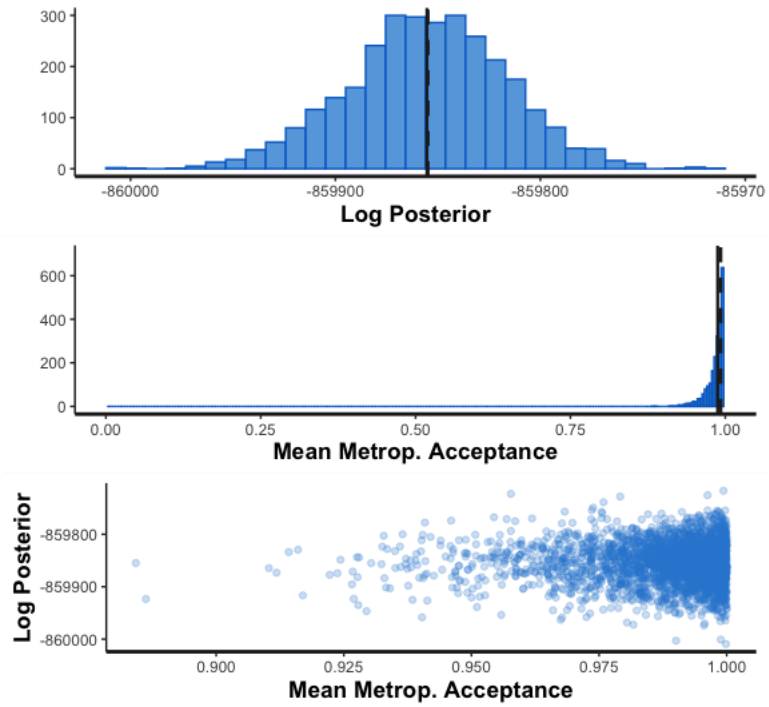


Figure A6: Distributions of log posterior and mean metropolis acceptance at each of the sampled step sizes (one per chain)

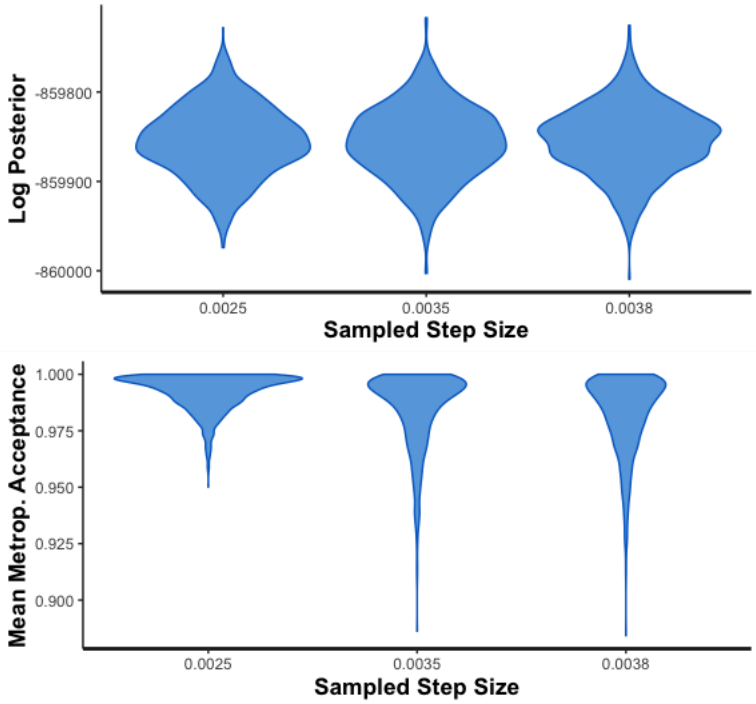


Figure A7: Histogram of treedepth and violin plots showing distributions of log posterior and mean metropolis acceptance for each value of treedepth

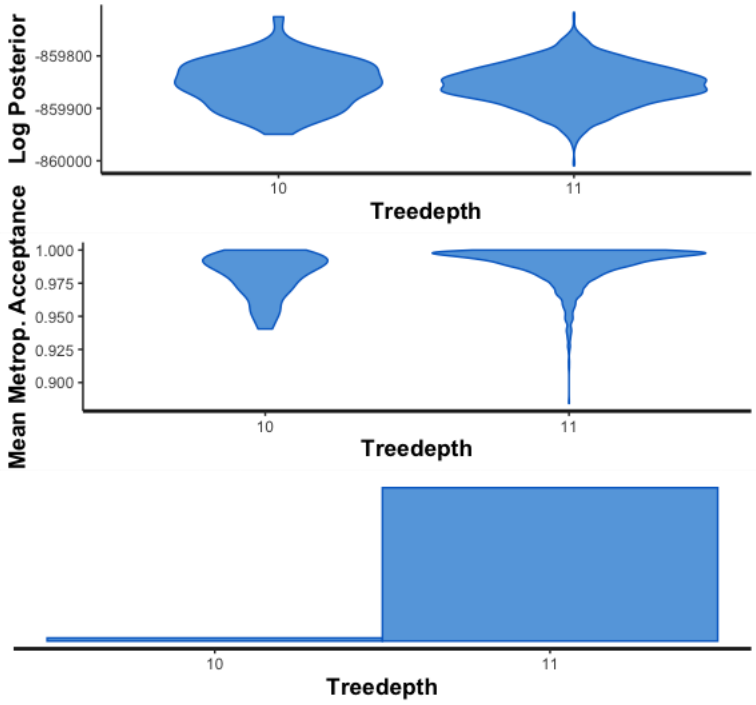
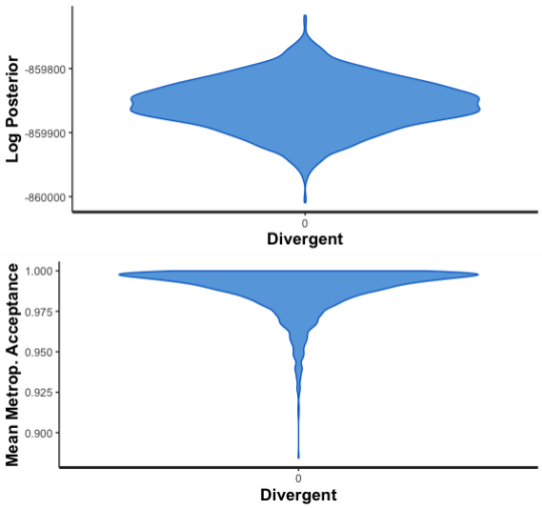


Figure A8: Violin plots showing distributions of log posterior and mean metropolis acceptance for divergent/non-divergent transitions



The above plots show that iterations encountered no divergent (divergent = 1) transitions, with those that did not divergence (divergent = 0) exhibiting typical distributions.

Table A1: Item analysis

Item	Intercept	Slope
Pew – major threat	0.61	0.74
GlobeScan – very serious	0.60	0.69
Pew – serious problem	0.61	0.68
GlobeScan – serious	0.90	0.68
Gallup – serious threat	0.50	0.68
Eurobarometer – serious problem	0.74	0.66
Gallup – gw serious threat	0.55	0.61
LAPOP – serious problem	0.67	0.60
LAPOP – average	0.83	0.59

Table A1 shows the item parameters, adjusted for standardisation of theta. The item intercepts adjust the underlying latent opinion by the characteristics of survey items – effectively item bias effects. The item slopes reflect factor loadings/discrimination parameters and allow for variance across items in the observed vs latent trait relationship (covariance of item effects). The item-country intercepts account for varying item bias across countries. The top ten highest and lowest item-country parameters are shown in Table A2 below.

Table A2: Largest item-country parameters

Item-Country	Parameter	Item-Country	Parameter
Gallup – gw serious threat – Bulgaria	-1.23	Gallup – serious threat – Cyprus	1.23
Gallup – serious threat – Denmark	-1.19	Pew – serious problem – Mexico	1.01
Gallup – serious threat – Romania	-1.16	Gallup – gw serious threat – China	1.00
LAPOP – average – Bolivia	-0.96	Gallup – gw serious threat – Israel	0.93
Pew – serious problem – Chile	-0.95	Gallup – serious threat – Tunisia	0.86
Gallup – gw serious threat – Brazil	-0.91	Pew – serious problem – Bulgaria	0.86
Pew – major threat – Indonesia	-0.90	Pew – serious problem – Ukraine	0.74
Pew – major threat – Canada	-0.90	Pew – major threat – China	0.74
Gallup – gw serious threat – Greece	-0.88	Pew – serious problem - Indonesia	0.71
Eurobarometer – serious problem – Germany	-0.80	LAPOP – serious problem - Paraguay	0.69

Table A3: Correlations between survey items and final theta estimates

Item	Correlation with theta
Globescan - very serious	0.93
GlobeScan - serious	0.74
Pew - serious problem	0.87
Pew - major threat	0.91
Gallup - serious threat	0.88
Gallup - gw serious threat	0.72
LAPOP serious problem	0.80
Eurobarometer - serious problem	0.83

Table A3 shows correlations between the final theta estimate and individual survey items for each country-year overall. As in Table A1, this highlights how the different items are related to the underlying latent trait and they extent to which they are contributing.

IV. CLIMATE CONSCIOUSNESS ESTIMATES

Table A4: Mean climate consciousness across 2007-2022, by country

	Country	Mean theta	s.d		Country	Mean theta	s.d
1	Greece	1.61	0.49	**42**	Bulgaria	-0.04	0.29
2	Costa Rica	1.40	0.34	**43**	Morocco	-0.07	0.39
3	Chile	1.39	0.69	**44**	Tanzania	-0.09	0.26
4	Ecuador	1.33	0.63	**45**	Slovakia	-0.11	0.47
5	Colombia	1.25	0.40	**46**	Belgium	-0.12	0.45
6	Brazil	1.25	0.54	**47**	Thailand	-0.13	0.33
7	Peru	1.02	0.53	**48**	Germany	-0.16	0.42
8	Guatemala	0.96	0.50	**49**	South Africa	-0.16	0.30
9	Panama	0.92	0.27	**50**	Lebanon	-0.16	0.69
10	Uruguay	0.89	0.24	**51**	Ireland	-0.22	0.65
11	Portugal	0.82	0.85	**52**	Bangladesh	-0.25	0.41
12	Mexico	0.74	0.59	**53**	Australia	-0.28	0.37
13	South Korea	0.69	0.44	**54**	Canada	-0.28	0.38
14	Nicaragua	0.68	0.47	**55**	United Kingdom	-0.28	0.39
15	Singapore	0.67	0.42	**56**	India	-0.41	0.65
16	Argentina	0.65	0.24	**57**	Sweden	-0.43	0.50
17	Cyprus	0.63	0.78	**58**	Indonesia	-0.44	0.29
18	Spain	0.63	0.57	**59**	Senegal	-0.45	0.23
19	Venezuela	0.62	0.47	**60**	Ukraine	-0.52	0.48
20	Bolivia	0.62	0.30	**61**	Poland	-0.53	0.47
21	Romania	0.58	0.24	**62**	Malaysia	-0.56	0.15
22	El Salvador	0.54	0.41	**63**	Tunisia	-0.57	0.38
23	Honduras	0.53	0.30	**64**	Ghana	-0.71	0.33
24	Paraguay	0.47	0.35	**65**	Nigeria	-0.78	0.54
25	Philippines	0.45	0.49	**66**	United States	-0.79	0.42
26	Dominican Republic	0.41	0.34	**67**	Czech Republic	-0.81	0.39
27	Hungary	0.34	0.40	**68**	Russia	-0.86	0.25
28	Turkey	0.30	0.76	**69**	Denmark	-0.87	0.64
29	Italy	0.26	0.63	**70**	Israel	-0.90	0.43
30	Vietnam	0.26	0.18	**71**	Lithuania	-0.91	0.34
31	Austria	0.25	0.25	**72**	The Netherlands	-0.93	0.78
32	Burkina Faso	0.21	0.42	**73**	Saudi Arabia	-0.95	0.25
33	France	0.19	0.54	**74**	Palestine	-0.98	0.50
34	Hong Kong	0.18	0.39	**75**	Jordan	-1.02	0.39
35	Japan	0.18	0.54	**76**	Finland	-1.03	0.52
36	Uganda	0.17	0.50	**77**	Latvia	-1.12	0.69
37	Croatia	0.10	0.32	**78**	China	-1.17	0.50
38	Kenya	0.08	0.42	**79**	Pakistan	-1.38	0.44
39	Luxembourg	0.06	0.42	**80**	Egypt	-1.44	0.35
40	Slovenia	0.04	0.56	**81**	Estonia	-1.51	0.69
41	Malta	0.01	0.71				
	Global (unweighted)	**0.00**	**0.86**		**Global (weighted)**	**-0.36**	0.19

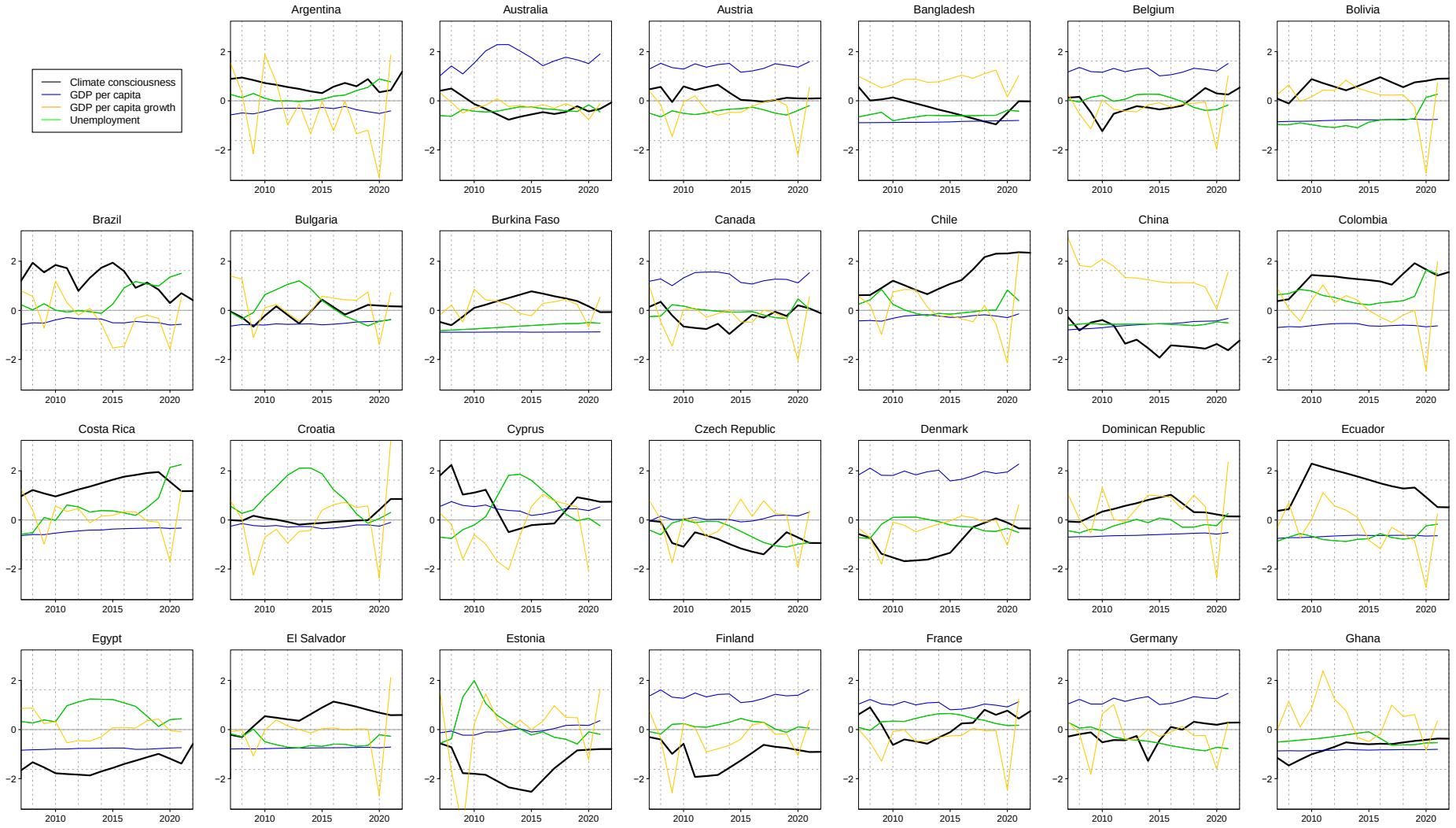
Countries are ordered by decreasing mean climate consciousness. S.d = standard deviation.

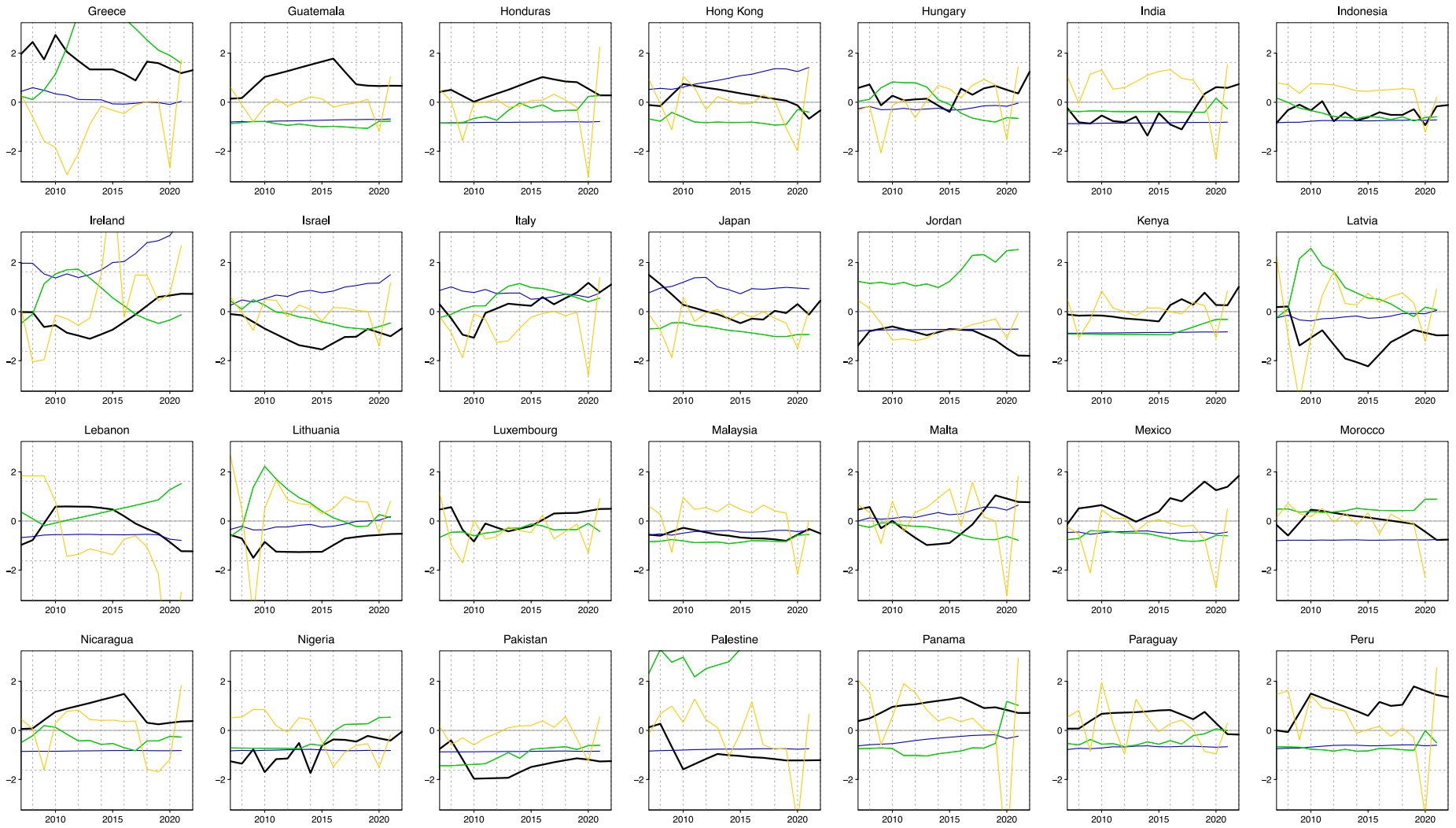
Table A5: Estimates of climate consciousness for 2022

	Country	Theta		Country	Theta
1	Chile	2.34	**42**	Slovenia	0.16
2	Mexico	1.84	**43**	Bulgaria	0.15
3	Portugal	1.79	**44**	United Kingdom	0.14
4	Colombia	1.56	**45**	Dominican Republic	0.14
5	Peru	1.36	**46**	South Africa	0.14
6	Greece	1.30	**47**	Austria	0.10
7	Hungary	1.24	**48**	Poland	0.09
8	Argentina	1.18	**49**	Singapore	0.03
9	Costa Rica	1.18	**50**	Bangladesh	-0.03
10	Italy	1.10	**51**	Nigeria	-0.06
11	Kenya	1.01	**52**	Australia	-0.07
12	Philippines	1.01	**53**	Burkina Faso	-0.07
13	Spain	0.91	**54**	Indonesia	-0.11
14	Bolivia	0.90	**55**	Canada	-0.12
15	Croatia	0.85	**56**	Paraguay	-0.17
16	Malta	0.77	**57**	Hong Kong	-0.33
17	France	0.74	**58**	Denmark	-0.35
18	Cyprus	0.74	**59**	Thailand	-0.35
19	India	0.73	**60**	Ghana	-0.37
20	Ireland	0.72	**61**	Ukraine	-0.37
21	Panama	0.71	**62**	Senegal	-0.39
22	Venezuela	0.68	**63**	United States	-0.40
23	Guatemala	0.67	**64**	Tanzania	-0.51
24	El Salvador	0.59	**65**	Malaysia	-0.51
25	Belgium	0.53	**66**	Lithuania	-0.52
26	Turkey	0.53	**67**	Tunisia	-0.56
27	South Korea	0.52	**68**	Egypt	-0.59
28	Ecuador	0.51	**69**	Israel	-0.68
29	Luxembourg	0.49	**70**	Morocco	-0.76
30	Romania	0.46	**71**	Estonia	-0.79
31	Japan	0.45	**72**	Saudi Arabia	-0.80
32	Uruguay	0.44	**73**	Finland	-0.91
33	Uganda	0.43	**74**	Czech Republic	-0.94
34	Brazil	0.42	**75**	Latvia	-0.96
35	Vietnam	0.39	**76**	Russia	-0.98
36	Nicaragua	0.38	**77**	Palestine	-1.21
37	Slovakia	0.29	**78**	China	-1.23
38	Germany	0.29	**79**	Lebanon	-1.24
39	The Netherlands	0.28	**80**	Pakistan	-1.25
40	Honduras	0.28	**81**	Jordan	-1.80
41	Sweden	0.18			
	Global (unweighted)	**0.18**		**Global (weighted)**	**-0.05**

Note, these estimates do not reflect the extent of uncertainty, and 2022 estimates are highly reliant on the results of GlobeScan and Pew as this is the only data available for this year.

Figure A9: Estimates of climate consciousness vs economic indicators, 2007-2021

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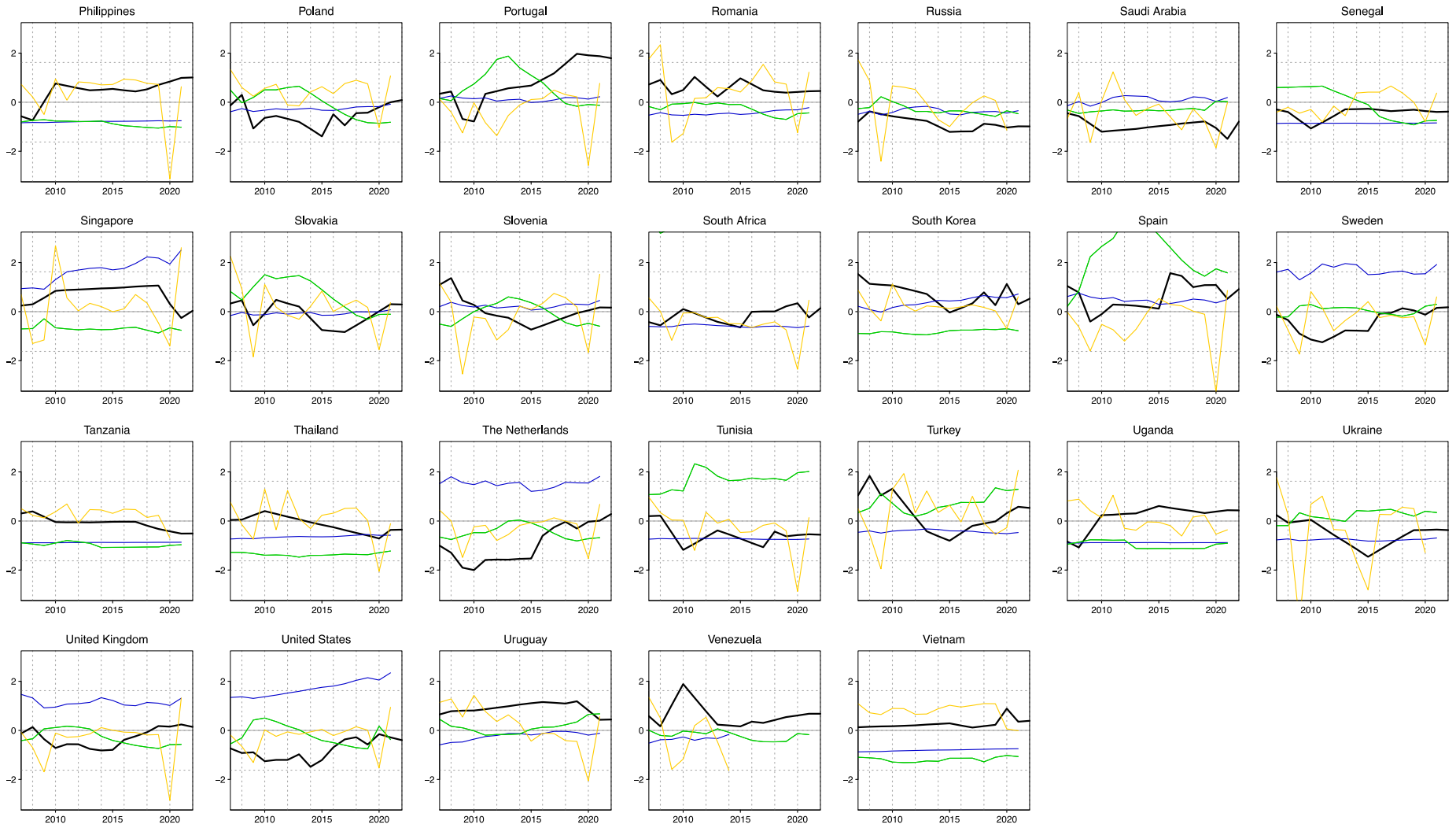
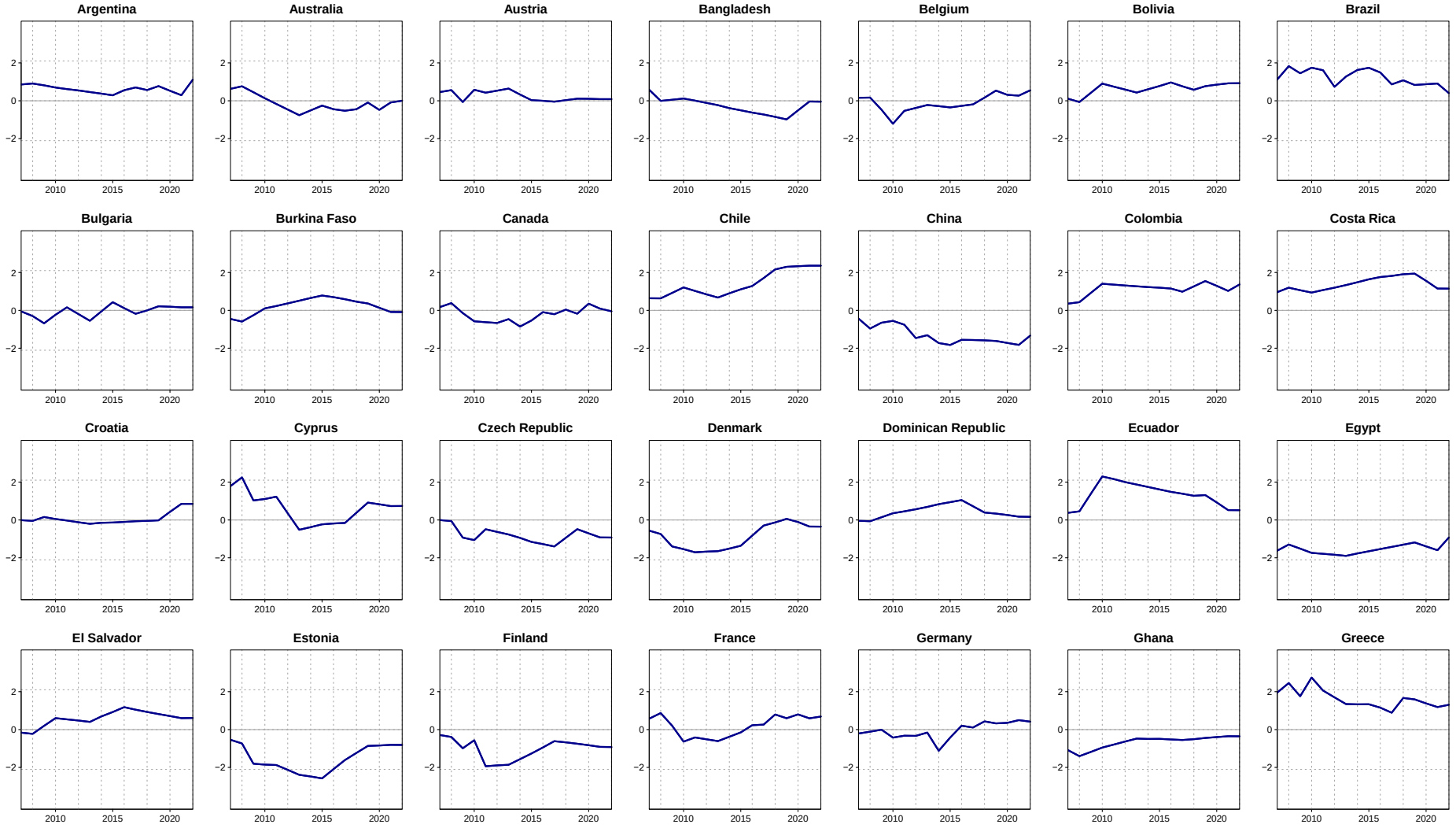
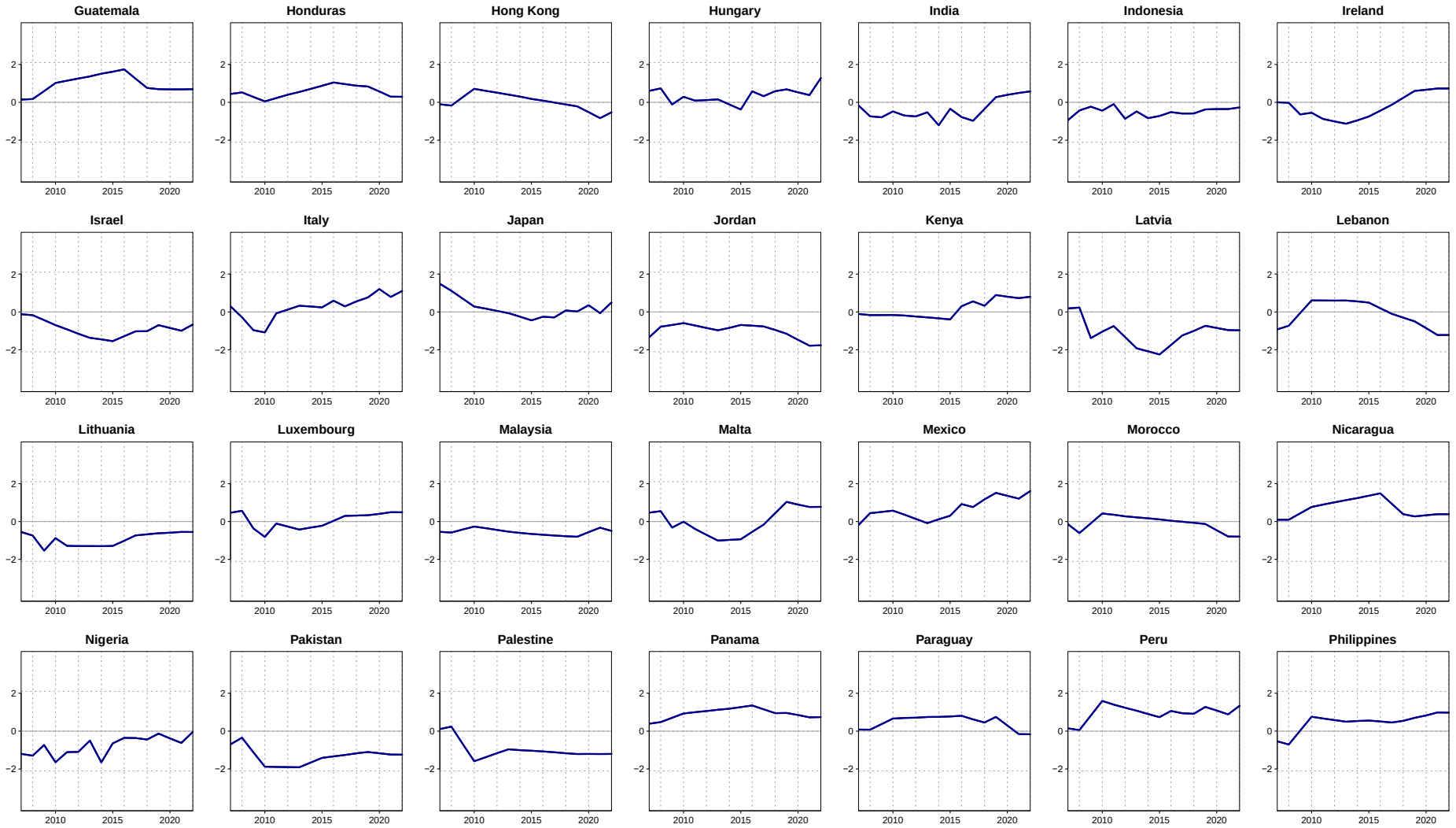


Macro-economic indicators are normalised to have mean of zero and standard deviation of one to facilitate plotting them against latent estimates. Note, this graph does not account for uncertainty in the estimates and only shows the mean estimate for each country. Economic measures come from World Bank – World Development Indicators.

Figure A10: Estimates of climate consciousness when excluding GlobeScan's "somewhat" serious measure, 2007-2022

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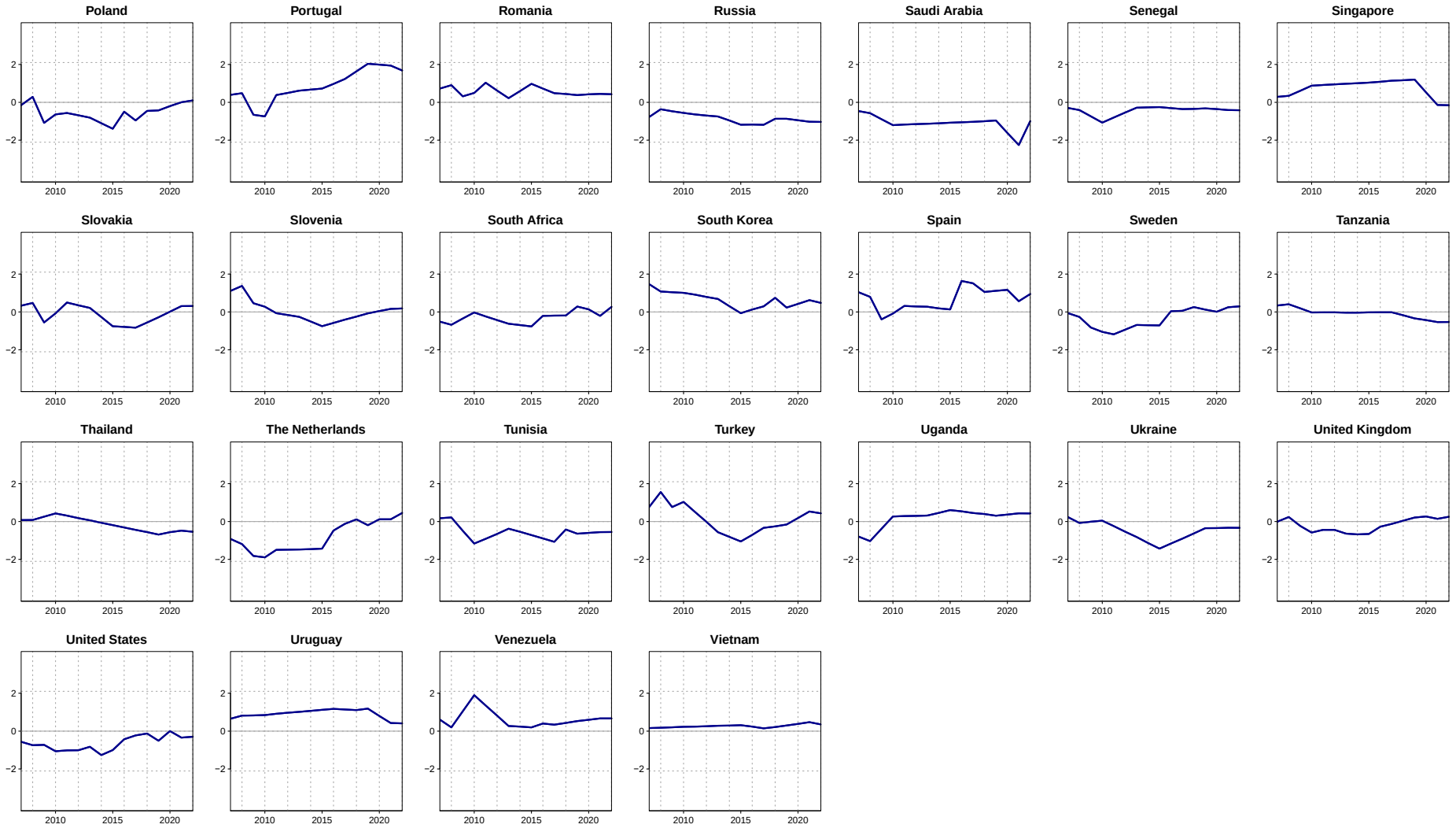
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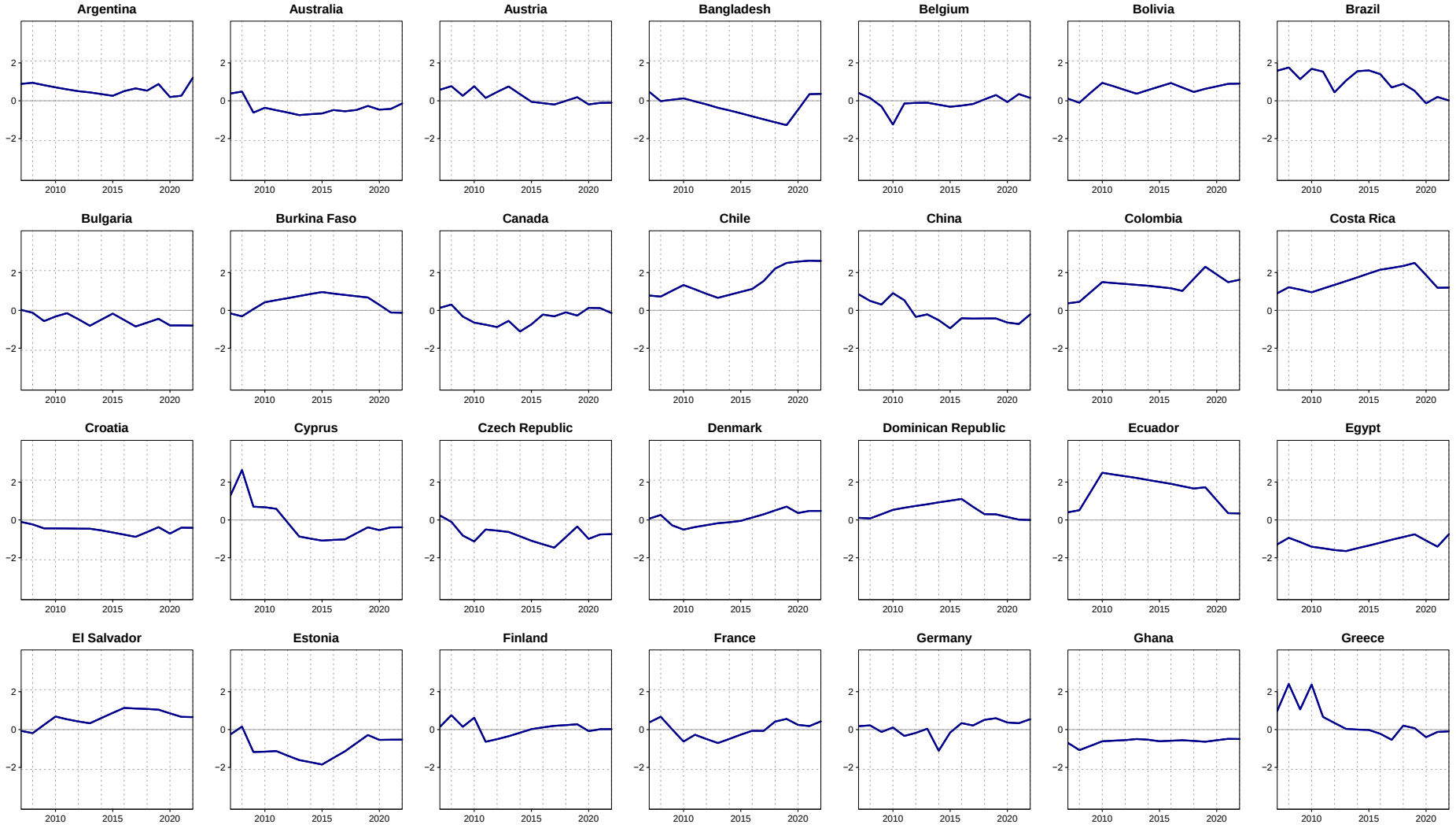
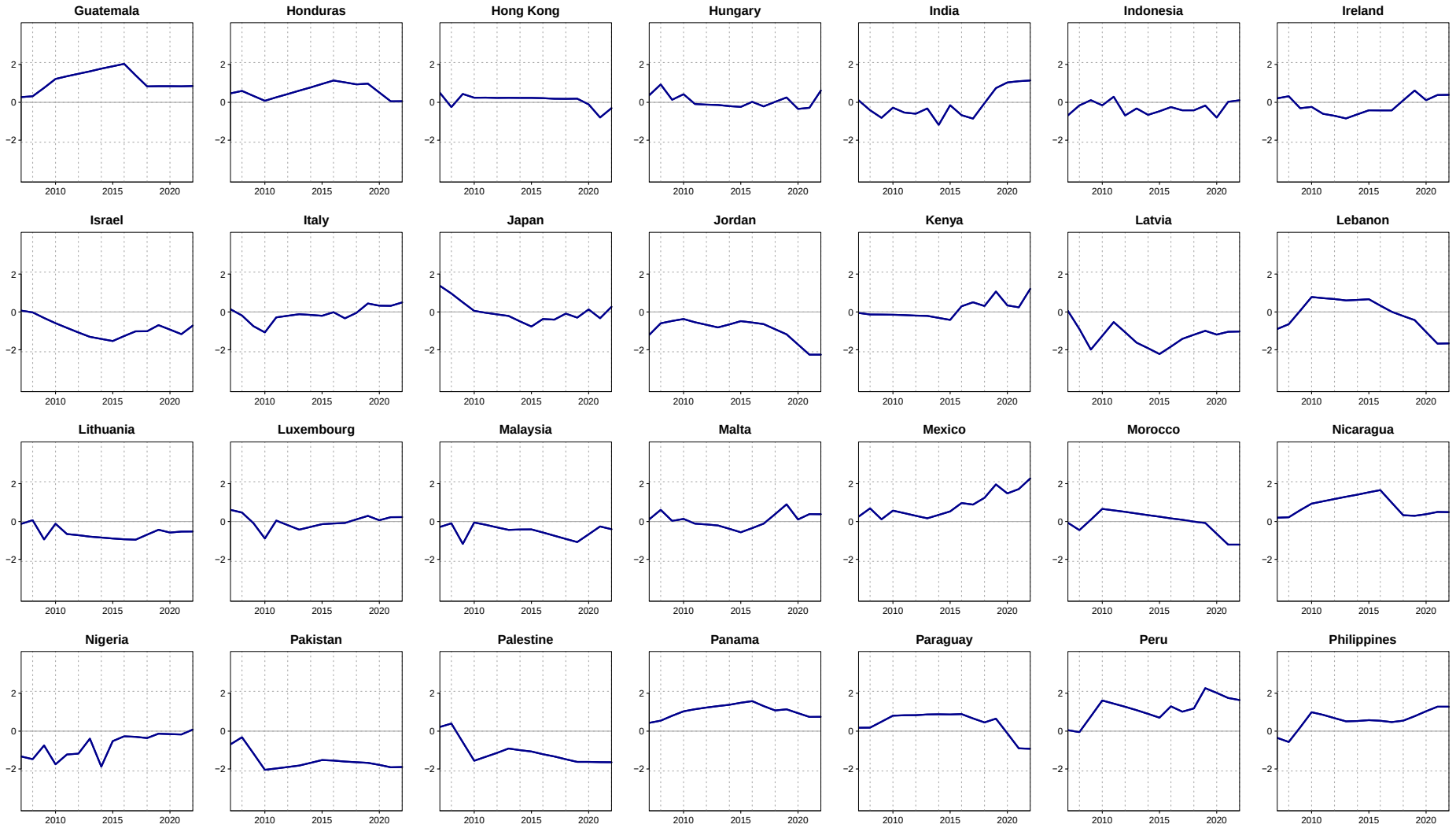
Figure A11: Climate consciousness estimates when including all variables in model, 2007-2022

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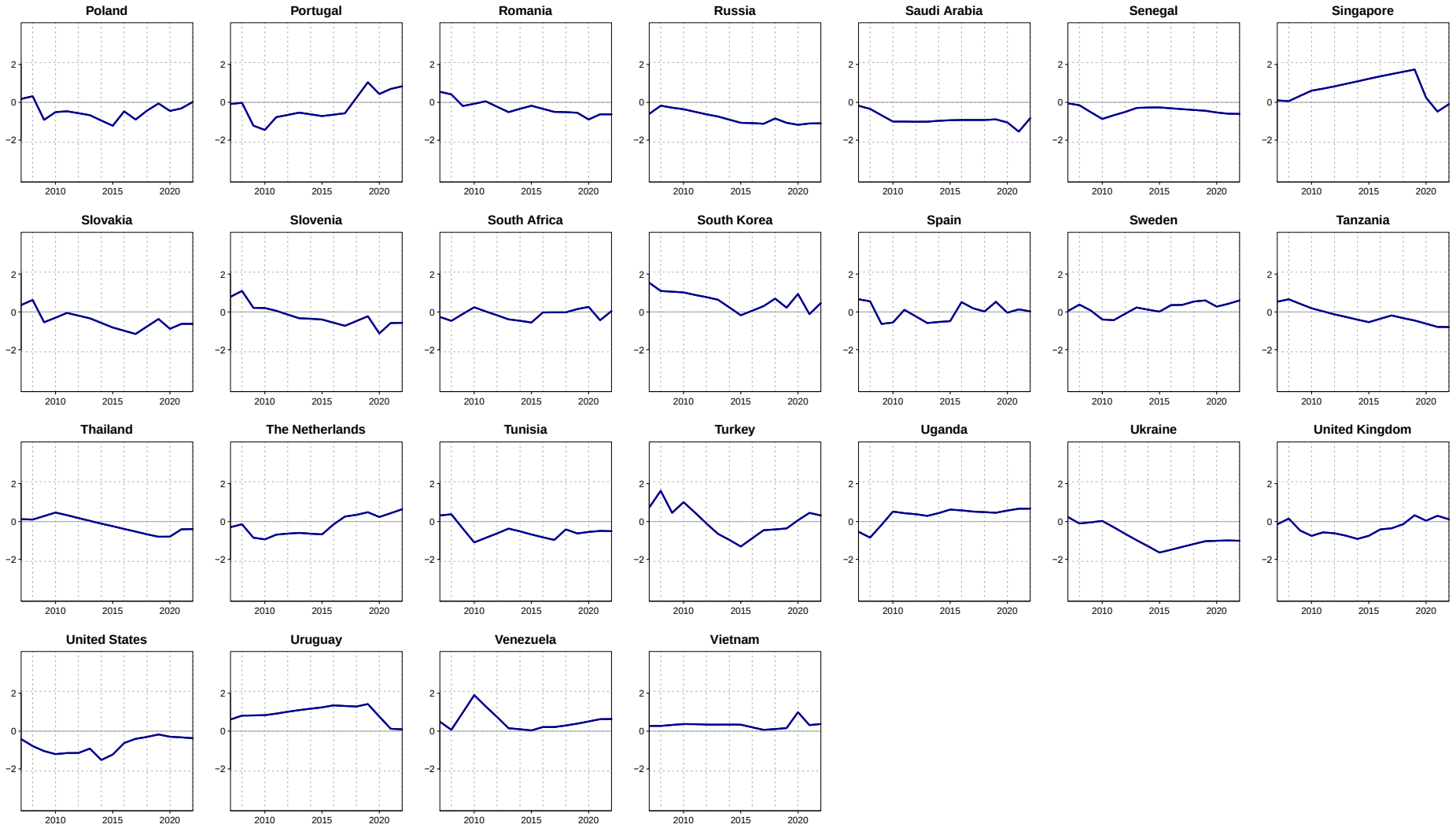
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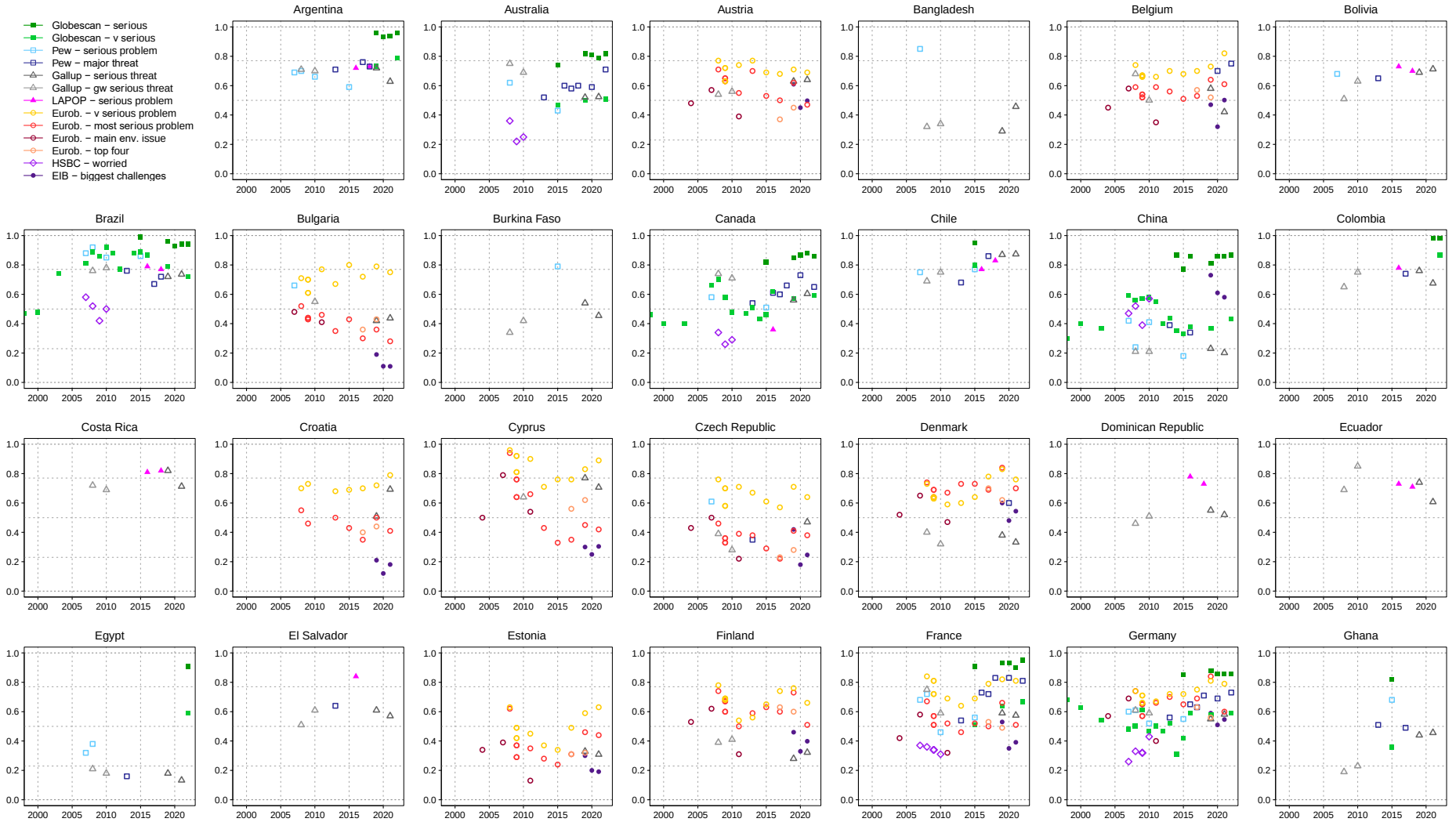
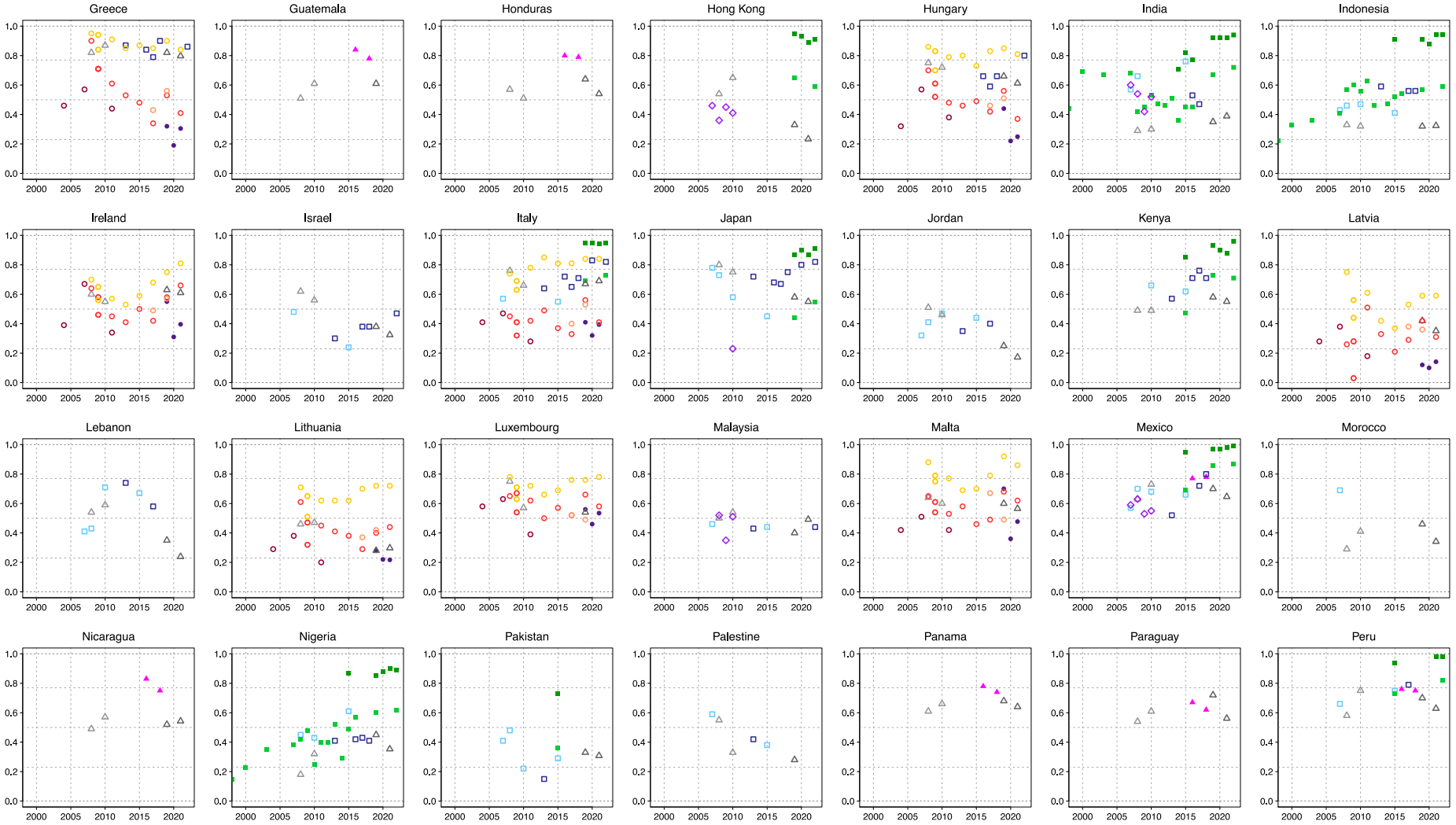
Tanzania
Thailand
The Netherlands
Tunisia
Turkey
Uganda
Ukraine
United Kingdom
United States
Uruguay
Venezuela
Vietnam
2
0
−2
2010
2015
2020

Figure A12: Trends in all climate polls shown in Table 2.1, 1998-2022

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Honduras
Hong Kong
Hungary
India
Indonesia
Ireland
Israel
Italy
Japan
Jordan
Kenya
Latvia
Lebanon
Lithuania
Luxembourg
Malaysia
Malta
Mexico
Morocco
Nicaragua
Nigeria
Pakistan
Palestine
Panama
Paraguay
Peru
0.0
0.2
0.4
0.6
0.8
1.0
2000
2005
2010
2015
2020

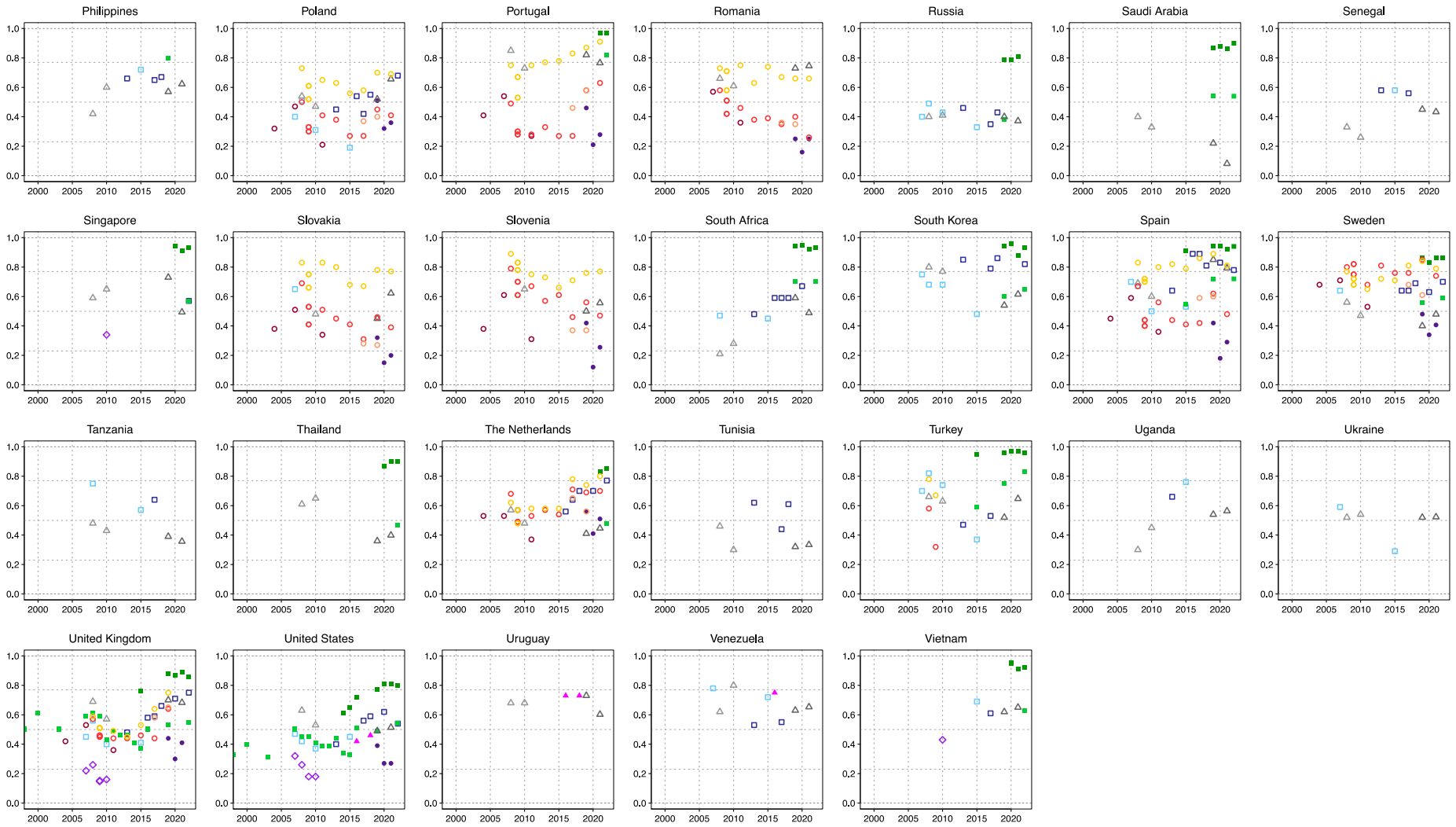
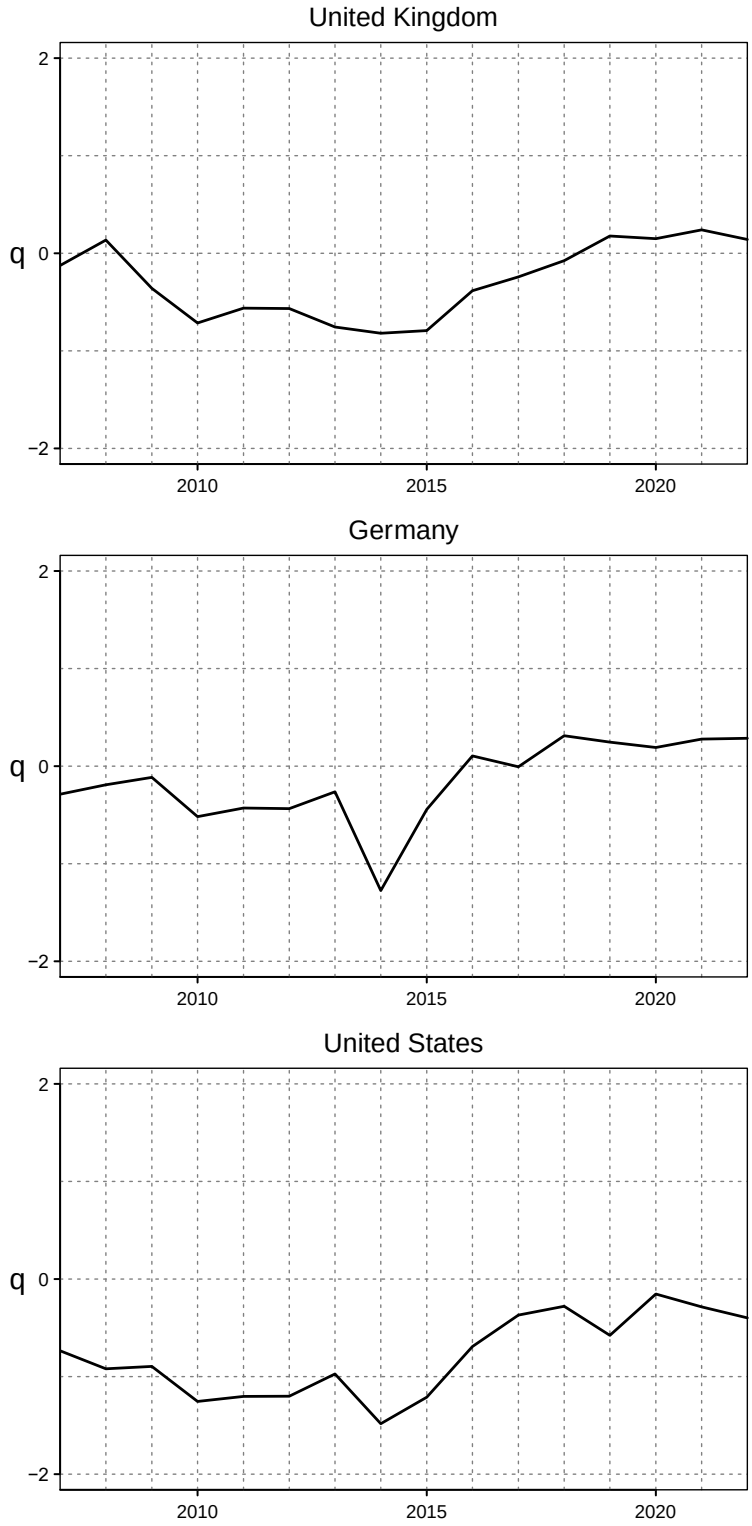

Philippines
Poland
Portugal
Romania
Russia
Saudi Arabia
Senegal
Singapore
Slovakia
Slovenia
South Africa
South Korea
Spain
Sweden
Tanzania
Thailand
The Netherlands
Tunisia
Turkey
Uganda
Ukraine
United Kingdom
United States
Uruguay
Venezuela
Vietnam
0.0
0.2
0.4
0.6
0.8
1.0
2000
2005
2010
2015
2020

Table A6: Item analysis for model including all variables

Item	Intercept	Slope
EIB – biggest challenges	0.38	0.86
Eurobarometer – main env. issue	0.44	0.85
Pew – major threat	0.63	0.77
Eurobarometer – most serious problem	0.55	0.68
GlobeScan – serious	0.90	0.67
GlobeScan – very serious	0.60	0.66
Pew – serious problem	0.60	0.66
Eurobarometer – serious problem	0.74	0.66
HSBC - worry	0.36	0.64
Gallup – gw serious threat	0.53	0.61
Gallup – serious threat	0.52	0.60
LAPOP – serious problem	0.67	0.59
LAPOP – average	0.83	0.58
Eurobarometer – cc top four	0.49	0.55

Figure A13: Estimates of climate consciousness for the UK, Germany and the US from main model, 2007-2022



Appendix B: Supplementary Material for Chapter Three

Figure B1: Changes in reporting by newspaper platform, 2006-2020

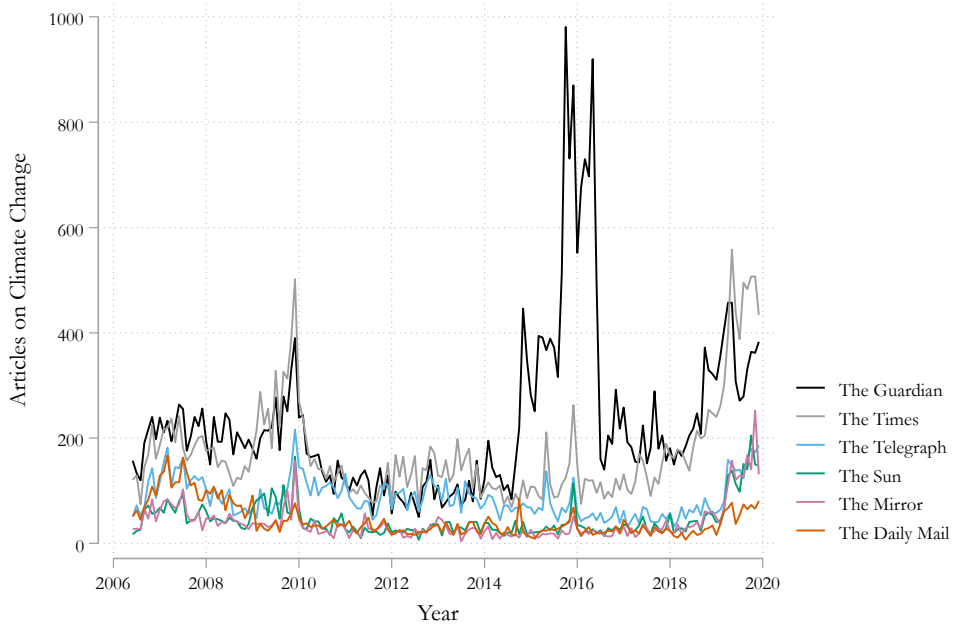


Table B1: Granger-causal relationships in 2006-2017 model

	Public	**Media**	**MPs**	**Protest**
Endogenous				
Public Salience	220.95***	–	–	–
Media Attention	–	110.06***	9.17*	16.80***
MPs' Attention	–	–	–	–
Protest Participant-Days	–	10.12*	–	–
Exogenous				
Temperature Anomaly	–	–	–	
Domestic Disaster	–	5.37*	–	
European Disaster	–	6.92**	–	
CO2	–	9.02*	–	
UNCCC	–	23.46***	–	
EU Summits	–	–	–	
G7/G8 Meetings	–	–	–	
GDP Growth	–	–	–	
Campaign	–	–		
Recess			32.66***	

*Figures show chi2 value. Only significant figures shown. Significance level: *0.05, **0.01, ***0.001. Endogenous lags = 3. - indicates variable included in model but not significant.*

Table B2: Granger-causal relationships in protest arrests model, 2006-2019

	Public	**Media**	**MPs**	**Protest**
Endogenous				
Public Salience	302.97***	9.97*	8.25*	–
Media Attention	–	183.18***	17.96***	8.51*
MPs' Attention	13.89**	10.29*	–	–
Protest Arrests	–	14.54**	–	–
Exogenous				
Temperature Anomaly	–	–	–	
Domestic Disaster	–	5.27*	–	
European Disaster	–	4.65*	–	
CO2	–	7.52*	–	
UNCCC	–	24.91***	–	
EU Summits	–	–	–	
G7/G8 Meetings	–	–	–	
GDP Growth	–	–	–	
Campaign	–	–		
Recess			22.92***	

*Figures show chi2 value. Only significant figures shown. Significance level: *0.05, **0.01, ***0.001.*

Endogenous lags = 3. - indicates variable included in model but not significant.

Table B3: Granger-causal relations in model excluding protest activity variables, 2006-2019

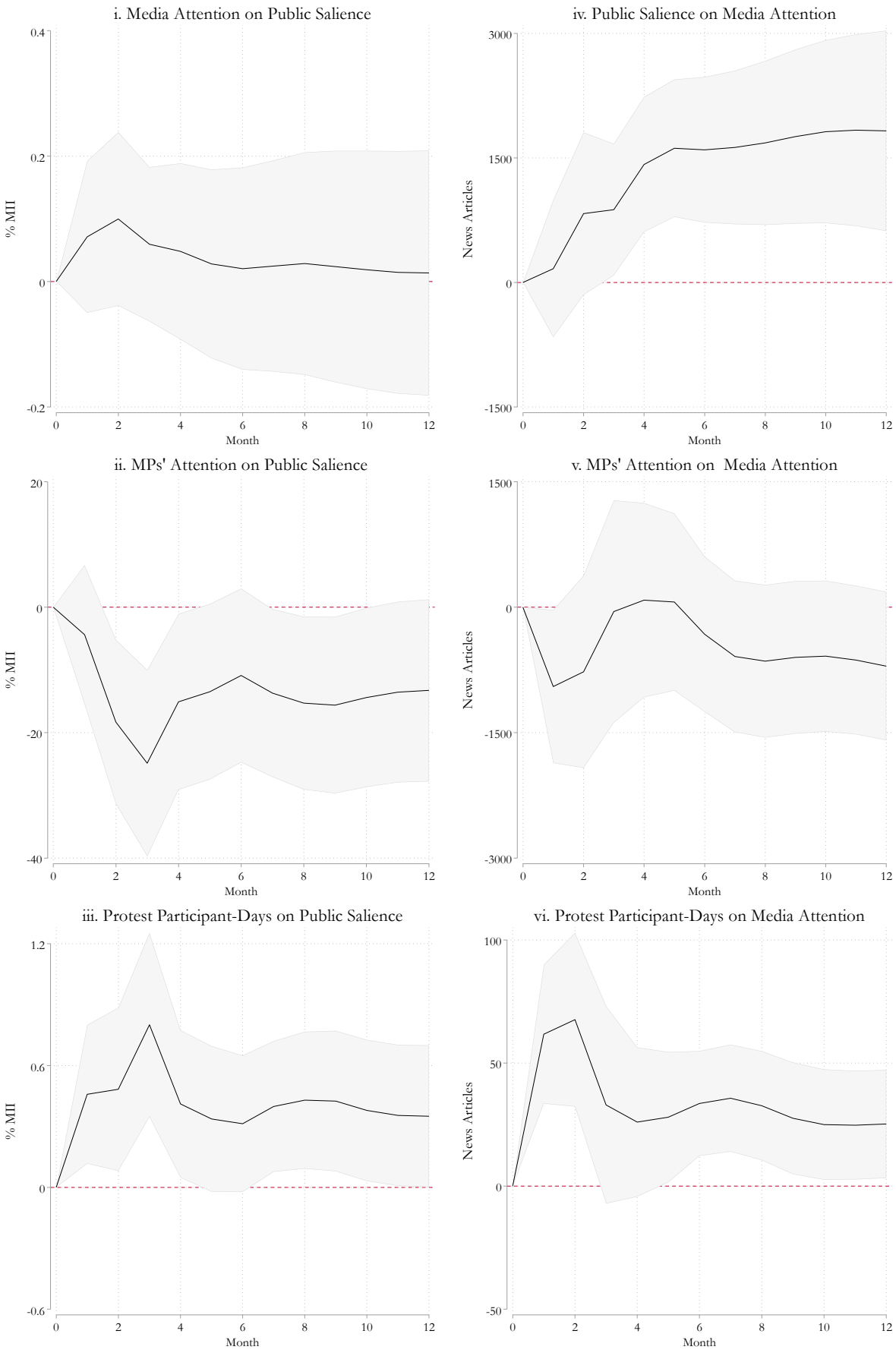
	Public	**Media**	**MPs**
Endogenous			
Public Salience	338.86***	9.25*	–
Media Attention	9.15*	179.65***	24.79***
MPs' Attention	11.69**	–	–
Exogenous			
Temperature Anomaly	–	–	–
Domestic Disaster	–	–	–
European Disaster	–	3.87*	–
CO2	–	–	–
UNCCC	–	18.93***	–
EU Summits	–	–	–
G7/G8 Meetings	–	–	–
GDP Growth	–	–	–
Campaign	–	–	
Recess			22.00***

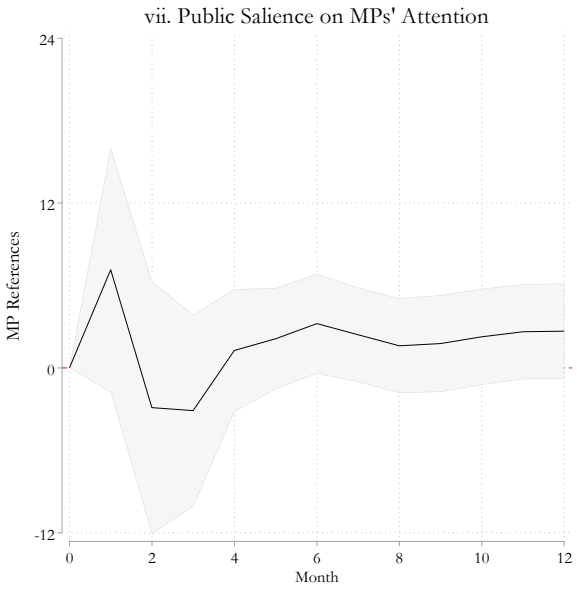
Figures show chi2 value. Only significant figures shown.

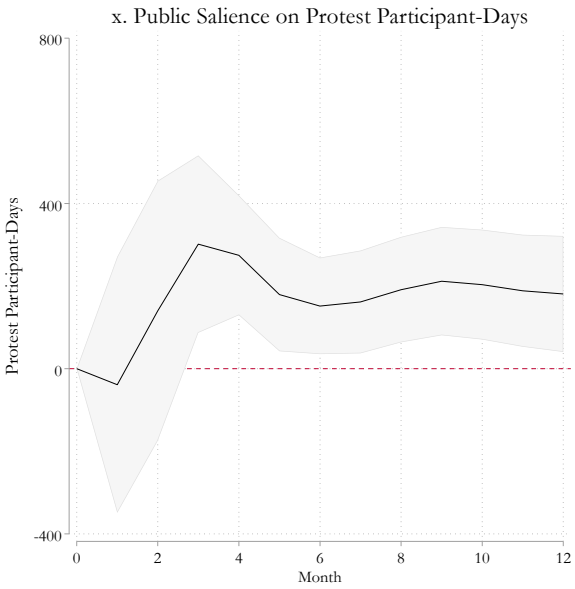
*Significance level: *0.05, **0.01, ***0.001.*

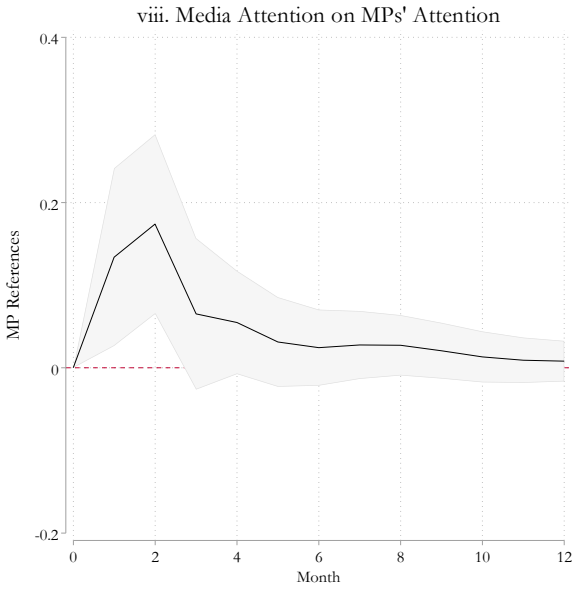
Endogenous lags = 3. - indicates variable included in model but not significant.

Figure B2: All IRFs from 2006-2019 model




vii. Public Salience on MPs' Attention
MP References
24
12
0
-12
0
2
4
6
8
10
12
Month


x. Public Salience on Protest Participant-Days
Protest Participant-Days
800
400
0
-400
0
2
4
6
8
10
12
Month


viii. Media Attention on MPs' Attention
MP References
0.4
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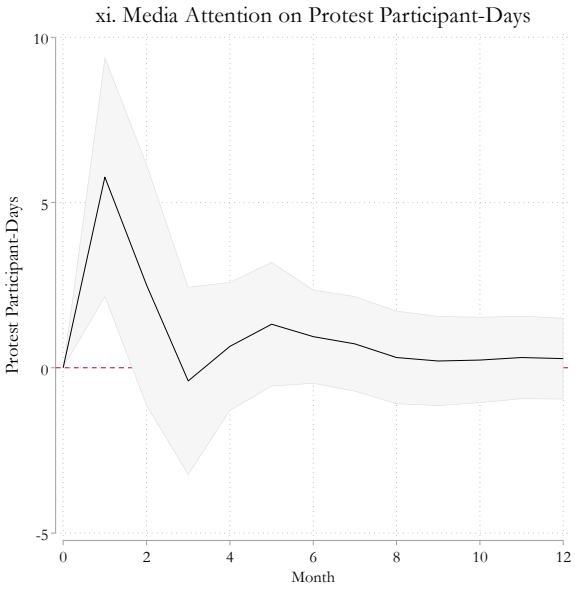
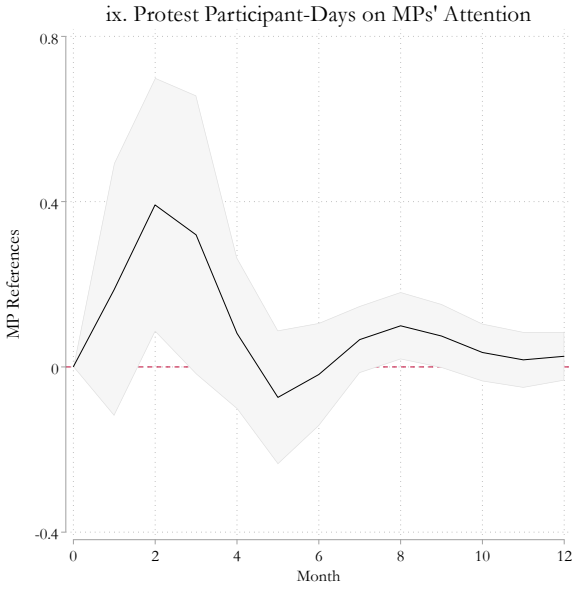
0
-0.2
0
2
4
6
8
10
12
Month


xi. Media Attention on Protest Participant-Days
Protest Participant-Days
10
5
0
-5
0
2
4
6
8
10
12
Month


ix. Protest Participant-Days on MPs' Attention
MP References
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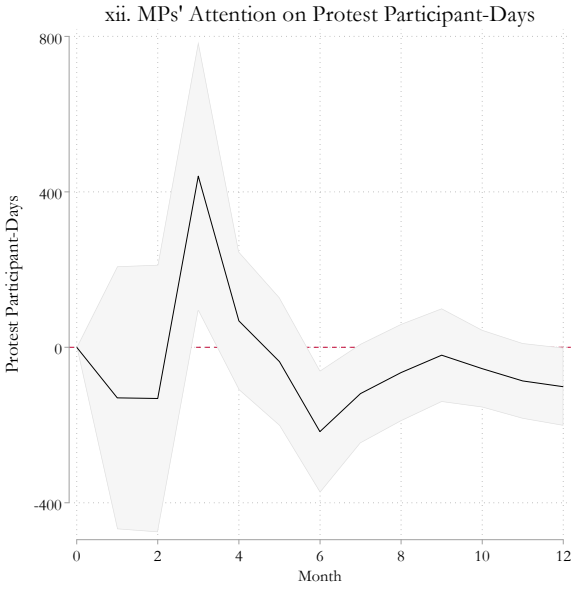
0.4
0
-0.4
0
2
4
6
8
10
12
Month


xii. MPs' Attention on Protest Participant-Days
Protest Participant-Days
800
400
0
-400
0
2
4
6
8
10
12
Month

N.

Appendix C: Supplementary Material for Chapter Four

Table C1: Topic coding

Topic	Sub-Topic	German responses included in topic	Translation
Environment	Environment (15)	Umwelt (allgemein) + speziell (Luftverschmutzung, chem. Verschmutzung von Flüssen, Tempolimit, Tieffflieger, Fluglärm) (1986-1988), Umweltschutz (1989-06/1994,08/1994-05/1995,07-12/1995,1996-2004,02-10/2006), Umweltschutz/Ozon (07/1994), Umweltschutz/Ölplattform Brent Spar (06/1995), Umweltschutz/Atomtransport (2005), Umweltschutz/Hochwasser/Flut (14/2006-02/2007), Umweltschutz/Klima/Klimawandel (06/2007-2010), Erneuerbare Energien (2008-2010), Umweltschutz/Klima/Klimawandel/ern euerbare Energien (02-13/2012), Umweltschutz/Klima/Klimawandel/ern euerbare Energien/Energiewende (17-50/2012), Umweltschutz/Klimawandel (2013-2015, 2018, 02-06/2019), Umweltschutz/ Klimawandel/ Klimagipfel (2016-2017), Umweltschutz/ Klimawandel/ Schutz von Insekten (08-15/2019), Umweltschutz/ Klimawandel/ Artenschutz (19-50/2019)	Environment (general) + special (air pollution, chem. River pollution, speed limit, low-flying aircraft, aircraft noise) (1986-1988), environmental protection (1989-06 / 1994.08 / 1994-05 / 1995.07-12/1995, 1996-2004,02-10 / 2006), environmental protection / ozone (07/1994), environmental protection / Brent Spar oil platform (06/1995), environmental protection / atom transport (2005), environmental protection / flood / flood (14 / 2006-02 / 2007), environment / climate / climate change (06 / 2007-2010), renewable energy (2008-2010), environment / climate / climate change / renewable energy (02-13 / 2012), environment / climate / climate change / renewable energy / energy revolution (17-50 / 2012), environment / climate change (2013-2015, 2018, 02-06 / 2019), environment / climate change / climate summit (2016-2017), environmental / climate change / protection from insects (08-15 / 2019) ,

			environmental / climate change / biodiversity (19-50 / 2019)
	Renewable energy (123)	Energiewende/erneuerbare Energie (2013-2018, 02-39 /2019), Energiewende/ Erneuerbare Energien/ CO2-Steuer/ Kohleausstieg (42-50/2019)	energy revolution / renewable energy (2013-2018, 02-39 / 2019), energy policy / renewable energy / CO2 tax / carbon exit (42-50 / 2019)
Nuclear	Nuclear dispute (107)	Iran/Atomstreit (17-39/2006), Atomstreit: Iran/Nordkorea (41/2006-2007), Nordkorea/Krise (36-49/2017-2019)	Iran / nuclear (17-39 / 2006), nuclear dispute: Iran / North Korea (41 / 2006-2007), North Korea / Crisis (36-49 / 2017-2019)
	Nuclear (16)	Kernkraftwerke, Atomenergie, Strahlenbelastung, Tschernobyl, Energieprobleme, Atommüll (1986-1988), Kernenergie (04-12/1995,1996-1998), Kernenergie, Atomtransporte (1999-2004), Atomkraftwerke/Atomtransport (2006-2010), Atomkraftwerke/Atomtransport/Japan (2011), Atomkraftwerke/Atomtransport/Atomunfall Japan/Atompolitik (02-13/2012), Atomkraftwerke/Atomtransport/Atompolitik (17-50/2012), Atompolitik/Atomkraftwerke/Endlagerung (2013-2019)	nuclear power plants, atomic energy, radiation exposure, Chernobyl, energy problems, nuclear waste (1986-1988), nuclear energy (04-12 / 1995.1996-1998), nuclear energy, nuclear transport (1999-2004), nuclear power plants / nuclear transport (2006-2010), nuclear power plants / atom transport / Japan (2011), nuclear power plants / nuclear transport / nuclear accident Japan / nuclear policy (02-13 / 2012), nuclear power plants / nuclear transport / nuclear policy (17-50 / 2012), nuclear policy / nuclear power stations / disposal (2013-2019)

MEDIA SEARCH TERMS:

"umwelt" OR "umweltschutz" OR "umweltschäden" OR "umweltbewusst" OR "ozon" OR "luftverschmutzung" OR "verschmutzung" OR "saurer regen" OR "lärmbelästigung" OR "wasserverschmutzung" OR "erneuerbare energien" OR "energiewende" OR "kohleausstieg" OR "artenschutz" OR "artensterben" OR "biodiversität" OR "recycling" OR "abholzung" OR "Ökosystem*" OR "klimawandel" OR "globale erwärmung" OR "treibhauseffekt" OR "klimakatastrophe" OR "klimaschutz" OR "klimaklise" OR "klimaeffekt" OR "klimaerwärmung" OR

"klimatrend" OR "klimavariabilität" OR "erderwärmung" OR "globale Kühlung" OR "globale temperatur*" OR "klimanotstand" OR "kernkraftwerke" OR "atomenergie" OR "kernenergie" OR "strahlenbelastung" OR "energieprobleme" OR "atommüll" OR "atomkraftwerke" OR "atomtransport" OR "atompolitik"

Figure C1: Perceptions of Green Party Leader (below 6 = negative), 1994-2019

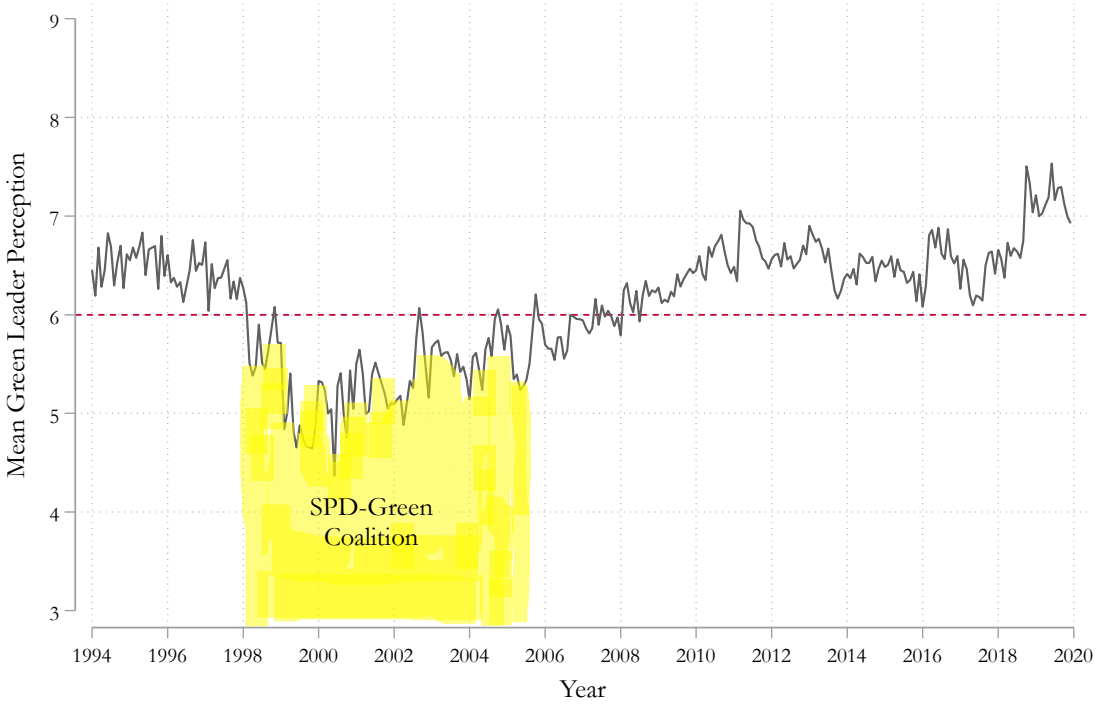
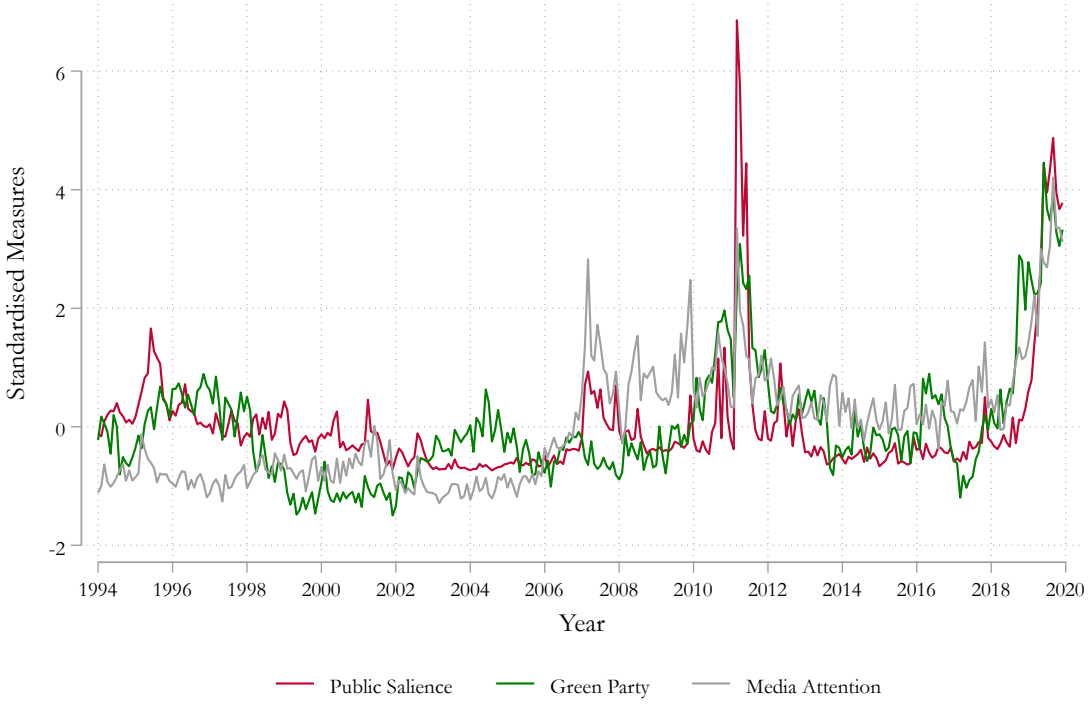


Fig. C2 compares public measures against the number of media articles on the environment over time. This graph suggests that the recent rise in green party support occurred prior to any change in media coverage. In plotting these, it is worth highlighting particular exogenous events which can be linked with spikes in attention, many of which fit patterns of prior studies. The spike in attention in public salience and media coverage in 2006 can be linked with Al Gore's *An Inconvenient Truth*, and the subsequent award of a Nobel Peace Prize to Al Gore and the IPCC in 2007. However, these do not appear to be associated with changes in support for the green party. The Fukushima disaster occurred in March 2011, and this is when public salience was at its greatest across the whole period of study.

Figure C2: Measures of public green support vs. media coverage, 1994-2019



The inaugural Conference of the Parties (COP), which involves the meeting of countries in the United Nations framework, occurred in Berlin between March/April 1995. Since then, a number of other climate change conferences (UNCCCs) have occurred in Germany, including COP5 in October/November 1999, COP6 in July 2001, COP23 in November 2017 and a meeting of the subsidiary bodies in June 2019. Although, it is not immediately obvious that these can be linked with changes in party support or public opinion. The spikes in media attention in 2009 and 2010 can be linked with the Copenhagen Summit and COP16 respectively, as previously highlighted by Grundmann and Scott (2012), although again, not with green party support. Other UNCCCs have resulted in the Kyoto Protocol in 1997, and the Paris Agreement in 2015, although these appear to have mobilised minimal attention changes. A number of G8/G7 meetings have also occurred in Germany in June of 1999, 2007 and 2015, yet once again these are not clearly linked with spikes in attention or changes in green party support. Regardless, these might be expected to have lesser influence as, unlike UNCCCs which solely focus on climate change, they cover a variety of topics.

Greens in Regional Government Coalitions

Figure C3: Number of green regional coalitions, 1994-2019

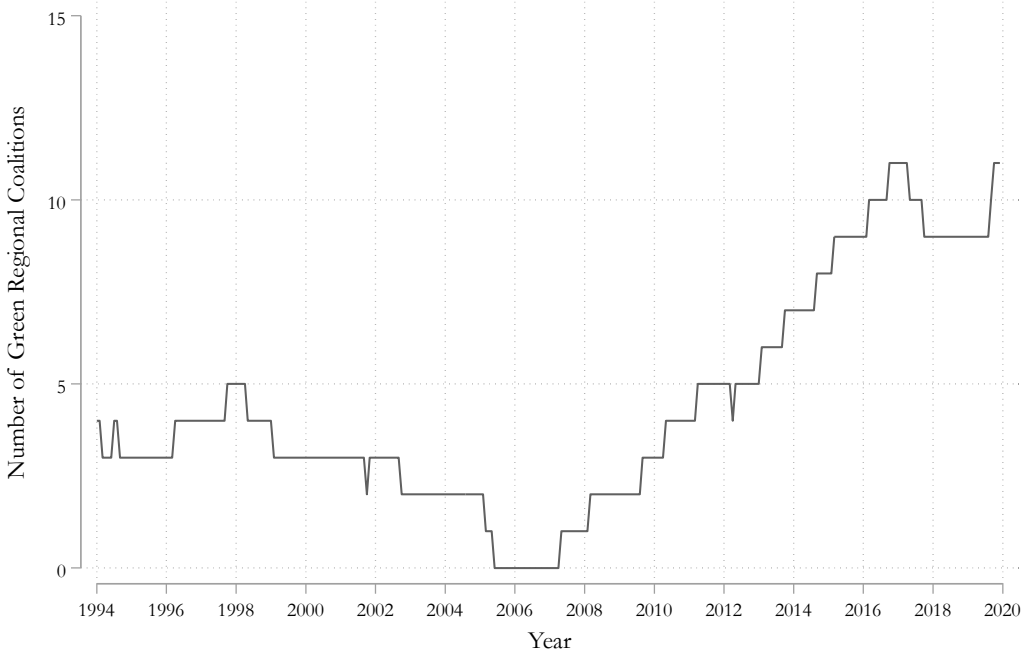
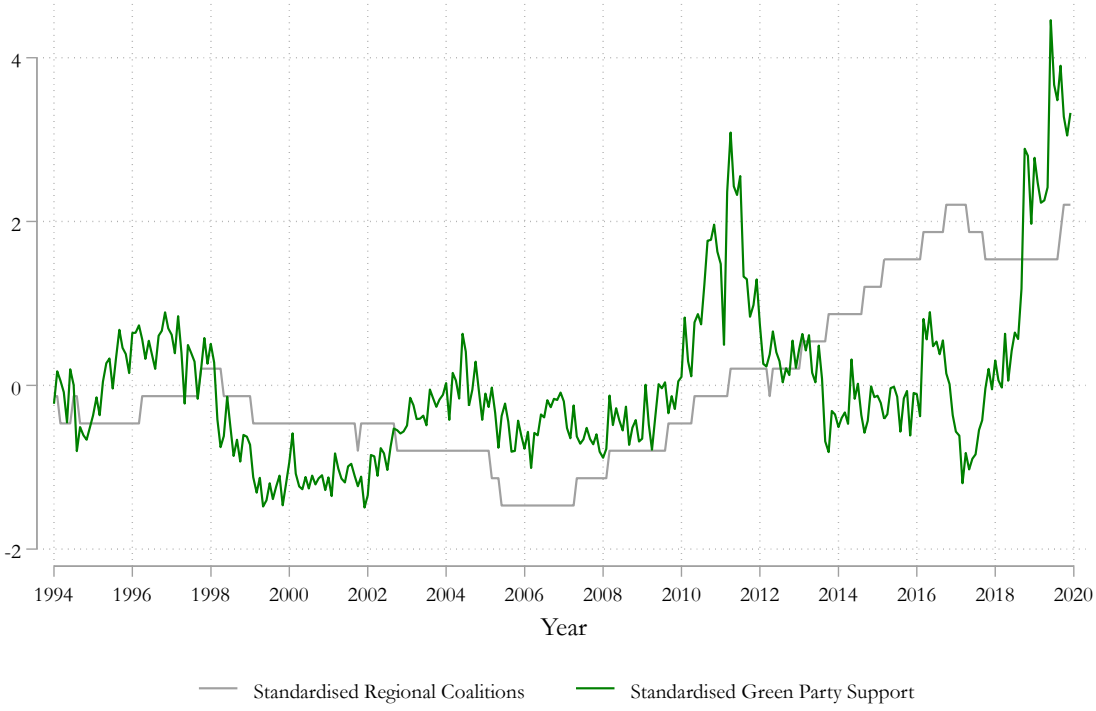


Figure C4: Greens in regional government vs support for the green party, 1994-2019



The following tables present Granger-causality results when modelling endogenous variables in stationary and level form, with the value of green party support reflecting monthly change as opposed to the absolute level.

Table C2: Granger-causality results – level variables, 1994-2019

	Party	**Public**	**Media**	**Protest**
Endogenous				
Green Party	678.22***	14.95º	23.46**	42.76***
Public Salience	–	169.55***	22.28**	41.27***
Media Attention	–	13.70º	701.81***	–
Protest Participants	35.68***	76.94***	28.98***	128.18***
Exogenous				
Temperature Anomaly	–	–	6.12*	
Domestic Disaster	–	–	–	
European Disaster	4.18*	3.28º	–	
International Disaster	4.70º	8.17*	–	
D.CO2	–	–	2.79º	
UNCCC	–	6.32*	32.00***	
EU Summits	–	–	–	
G7/G8 Meetings	–	–	–	
IPCC	–	–	–	
D.Unemployment	–	–	6.75º	
Green Government	8.14**	6.38*	4.33*	
Election	5.39º	–	9.27**	

Period 1994:1 - 2019:12. Observations = 303. Endogenous lags = 8.
*Figures show chi2 value. Significance level: º0.1, *0.05, **0.01, ***0.001.*
Dash indicates variable included in model but not significant.

Table C3: Granger-causality results – level variables, 1994-2017

	Party	**Public**	**Media**	**Protest**
Endogenous				
Green Party	501.02***	17.14*	17.57*	14.50°
Public Salience	19.85*	237.08***	29.14***	72.88***
Media Attention	–	17.38*	692.07***	–
Protest Participants	24.75**	105.28***	23.60**	143.34***
Exogenous				
Temperature Anomaly	–	–	–	
Domestic Disaster	–	–	–	
European Disaster	5.75*	5.25*	–	
International Disaster	–	–	–	
D.CO2	–	–	–	
UNCCC	–	6.27*	31.01***	
EU Summits	–	2.98°	3.07°	
G7/G8 Meetings	–	–	–	
IPCC	–	–	–	
D.Unemployment	–	–	9.35*	
Green Government	10.43**	8.25**	6.30*	
Election	4.66°	–	10.11**	

Period 1994:1 - 2017:12. Observations = 280. Endogenous lags = 8.
*Figures show chi2 value. Significance level: °0.1, *0.05, **0.01, ***0.001.*
Dash indicates variable included in model but not significant.

Table C4: Granger-causality results - differenced variables (monthly change), 1994-2019

	Party	**Public**	**Media**	**Protest**
Endogenous				
Green Party	40.78***	15.45*	22.57**	34.63***
Public Salience	–	176.74***	20.31**	38.72***
Media Attention	–	12.29º	52.76***	–
Protest Participants	22.56**	82.39***	29.27***	146.46***
Exogenous				
Temperature Anomaly	–	–	–	
Domestic Disaster	–	–	–	
European Disaster	3.46º	2.88º	–	
International Disaster	5.23º	7.57*	–	
D.CO2	–	–	–	
UNCCC	–	6.65*	34.08***	
EU Summits	–	–	–	
G7/G8 Meetings	–	–	–	
IPCC	–	–	–	
D.Unemployment	–	–	–	
Green Government	–	–	–	
Election	–	–	9.63**	

Period 1994:1 - 2019:12. Observations = 303. Endogenous lags = 7.

*Figures show chi2 value. Significance level: º0.1, *0.05, **0.01, ***0.001.*

Dash indicates variable included in model but not significant.

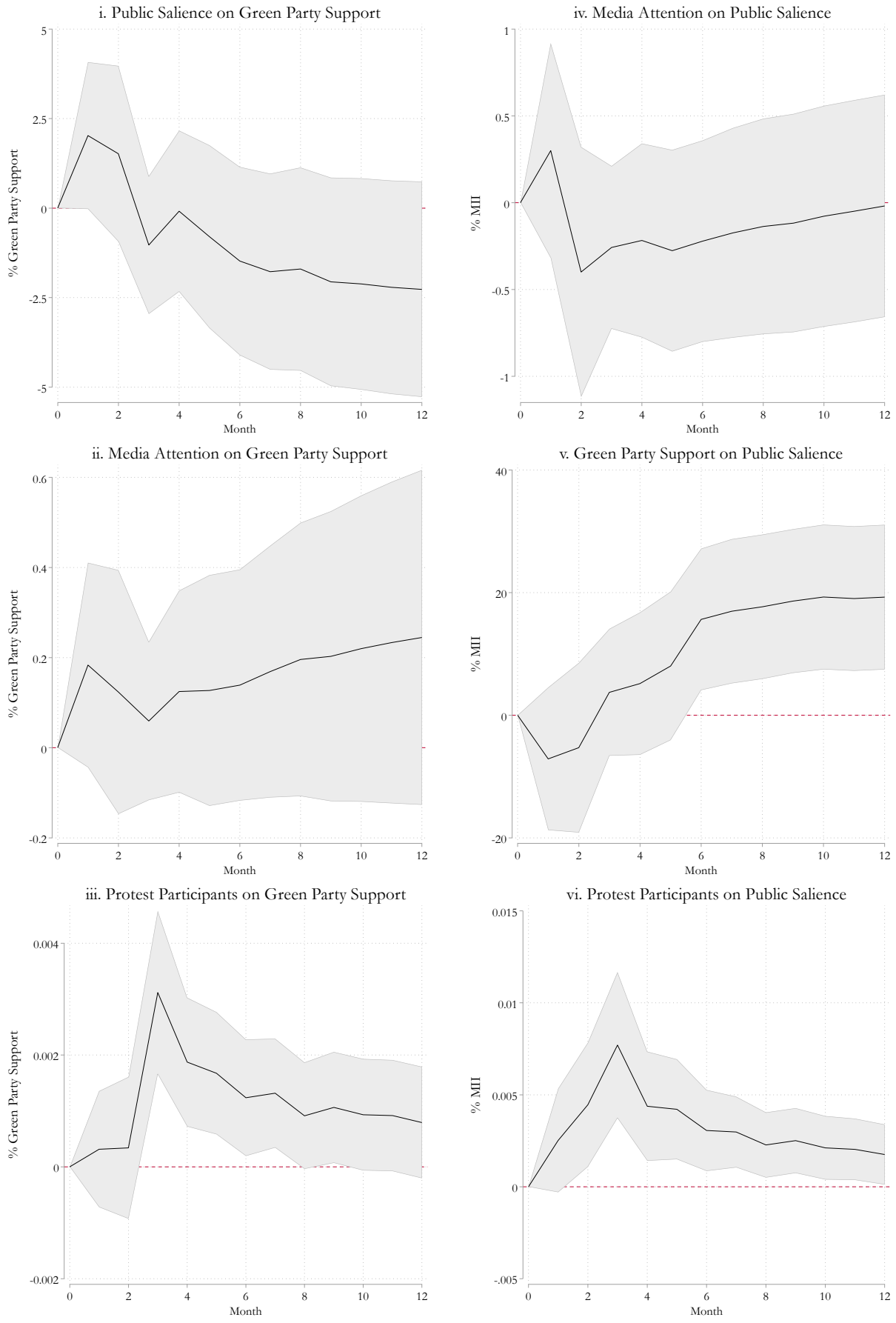
Table C5: Granger-causality results - differenced variables (monthly change), 1994-2017

	Party	Public	Media	Protest
Endogenous				
Green Party	50.14***	13.30°	17.09*	–
Public Salience	–	231.65***	22.01**	65.44***
Media Attention	–	17.68*	71.10***	–
Protest Participants	–	94.19*	16.89*	157.62***
Exogenous				
Temperature Anomaly	–	–	–	
Domestic Disaster	–	–	2.71°	
European Disaster	3.64°	4.14*	–	
International Disaster	4.95°	–	–	
D.CO2	–	–	–	
UNCCC	–	7.15*	33.89***	
EU Summits	–	4.07*	–	
G7/G8 Meetings	–	–	–	
IPCC	–	–	–	
D.Unemployment	–	–	–	
Green Government	–	–	–	
Election	–	–	10.29**	

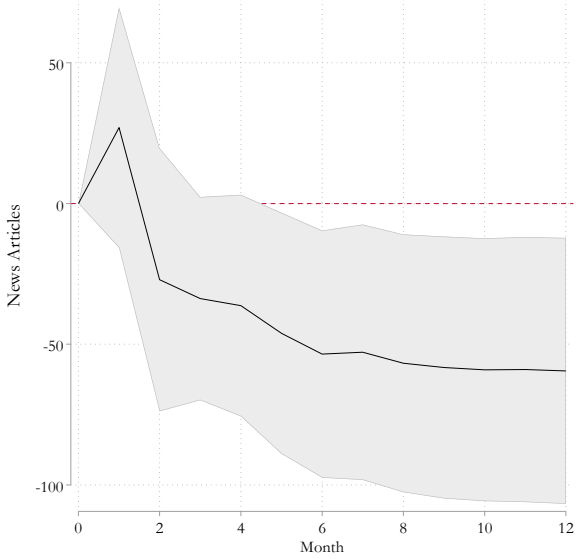
Period 1994:1 - 2017:12. Observations = 280. Endogenous lags = 7.
*Figures show chi2 value. Significance level: °0.1, *0.05, **0.01, ***0.001.*
Dash indicates variable included in model but not significant.

The impulse response functions (IRFs) in Figure C5 visualise relations between variables in terms of their moving average representation, highlighting the effect magnitude over time by showing the effect of a shock in one variable on a response variable over consecutive months. They tell us, for example, what happens to green party support following a sharp increase in protest activity or media coverage in the month prior. IRFs were calculated using a Bernanke-Sims decomposition which restricts the effects of innovations such that a shock in each variable can affect its own model residual contemporaneously but others' after one.

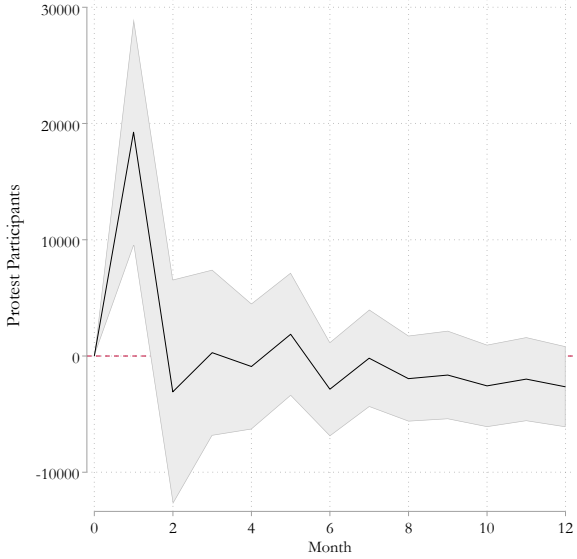
Figure C5: Impulse response functions for 1994-2019 model



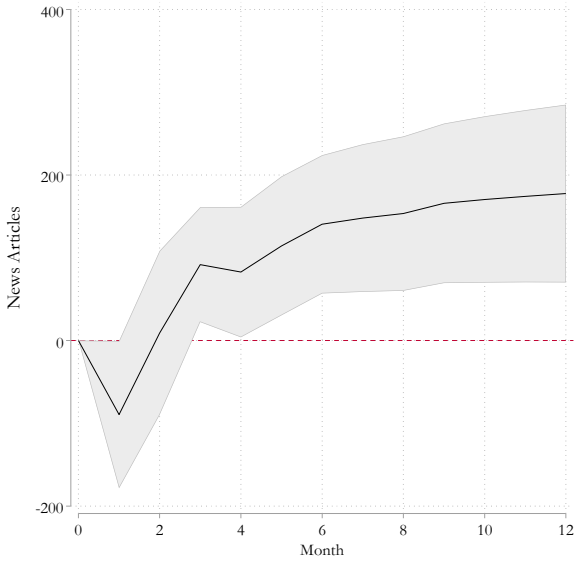
vii. Public Salience on Media Attention



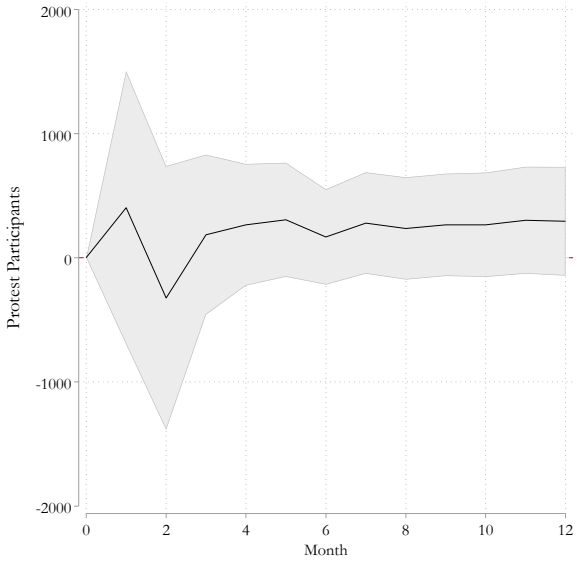
x. Public Salience on Protest Participants



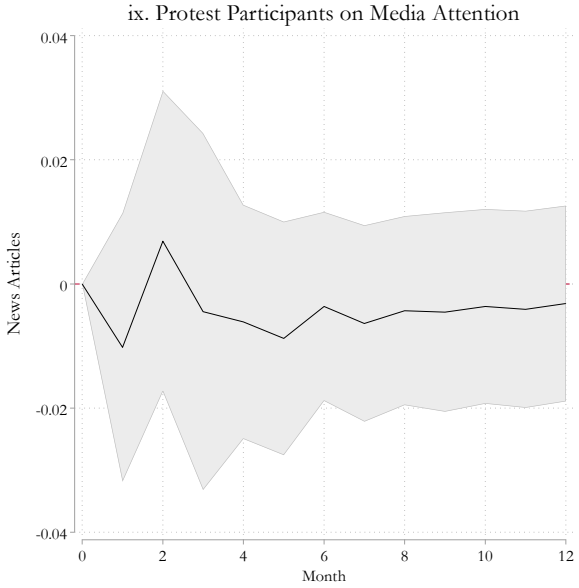
viii. Green Party Support on Media Attention



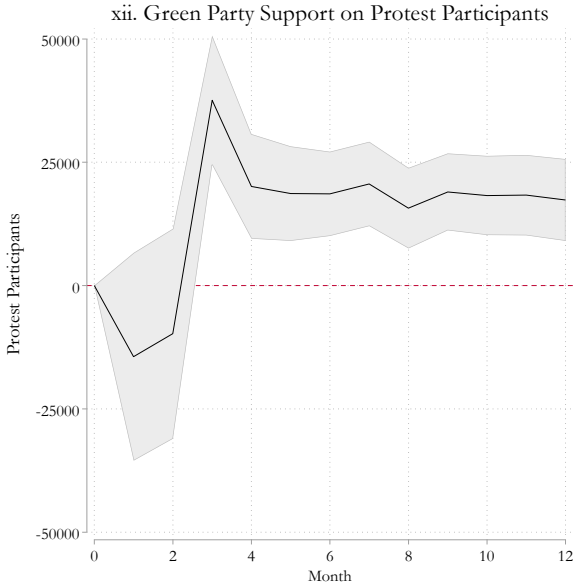
xi. Media Attention on Protest Participants



ix. Protest Participants on Media Attention



xii. Green Party Support on Protest Participants



Comparing the results of Britain and Germany

Table C6 and C7 show the results of running the German analysis for 2006-2019, which is the period covered by the case study of Britain in Chapter Three. As in the British model in Chapter Two, for 2006-2019 it is possible to run the German model using three lags of the endogenous variables without this producing any issues with autocorrelation. The results of doing so are shown in Table C6. As the main model in Chapter Three includes nine lags for 1994-2019, this is also run for the period 2006-2019 for comparison, with the results shown in Table C7.

Table C6: Granger-causality results – level results, 3 lags, 2006-2019

	Party	**Public**	**Media**	**Protest**
Endogenous				
Green Party	442.85***	9.82*	20.35***	34.53***
Public Salience	12.07**	29.46***	7.42º	13.00**
Media Attention	–	17.38*	106.22***	–
Protest Participants	14.85**	11.46**	–	8.18*
Exogenous				
Temperature Anomaly	–	6.09*	4.85º	
Domestic Disaster	–	–	–	
European Disaster	4.40*	–	–	
International Disaster	6.61*	14.39***	–	
D.CO2	2.88º	–	2.86º	
UNCCC	–	6.38*	23.81***	
EU Summits	–	–	–	
G7/G8 Meetings	–	–	–	
IPCC	–	–	–	
D.Unemployment	–	–	–	
Election	–	–	14.86***	

Period 2006:1 - 2019:12. Observations = 167. Endogenous lags = 3.
*Figures show chi2 value. Significance level: º0.1, *0.05, **0.01, ***0.001.*
Dash indicates variable included in model but not significant.

Table C7: Granger-causality results – lag augmented results, 8(9) lags, 2006-2019

	Party	**Public**	**Media**	**Protest**
Endogenous				
Green Party	396.60***	13.82º	18.57*	46.62***
Public Salience	–	57.11***	–	38.77***
Media Attention	–	–	120.68***	–
Protest Participants	25.62**	66.67***	21.75**	94.87***
Exogenous				
Temperature Anomaly	–	6.09*	5.46º	
Domestic Disaster	–	–	–	
European Disaster	4.83*	–	–	
International Disaster	–	11.03**	–	
D.CO2	–	–	–	
UNCCC	–	6.62*	26.60***	
EU Summits	–	–	–	
G7/G8 Meetings	–	–	–	
IPCC	–	–	–	
D.Unemployment	–	–	–	
Election	5.87º	–	22.32***	

Period 2006:1 - 2019:12. Observations = 167. Endogenous lags = 9.
*Figures show chi2 value. Significance level: º0.1, *0.05, **0.01, ***0.001.*
Dash indicates variable included in model but not significant.