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Religiosity and climate change policies

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ABSTRACT

National climate change policies vary considerably across countries. This study explores how a country's adoption of climate change policies is influenced by its population's level of religiosity. We update and extend an existing cross-country index of climate change policy stringency. The cross-country analysis suggests that countries with populations exhibiting greater religious fervor tend to adopt less stringent climate change policies. Our findings shed new light on how a cultural dimension affects contemporary policy outcomes and may help policymakers identify obstacles to climate change policies.

1. Introduction

The scientific community has established a consensus over the causes and consequences of climate change as regularly reported by the Intergovernmental Panel on Climate Change (IPCC, 2019). Stern et al. (2006) suggest that a significant ratcheting up of the global response is warranted. However, implemented climate policies are highly uneven across countries. For example, the United States has withdrawn from the Paris Agreement (UNFCCC, 2019) while the European Union (with its 28 member states) has committed to significant emission reduction targets. The contribution of this paper is to shed further light on the underlying determinants of countries' efforts to address climate change. In particular, we investigate whether differences in the degree of religiosity may help explain countries' divergent climate change policy actions.[1]

Religion is an important dimension of culture (Mokyr, 2014). The multi-disciplinary literature has explored whether religious denominations differ in their influence on scientific progress, individual attitudes to the environment, and economic outcomes, with inconclusive results.[2] Moreover, this literature has largely ignored the degree of religiosity. In particular, no attempt has been made to understand the influence of religiosity on climate change policies. We seek to fill this gap in our understanding.

Hulme (2015) reports that individuals with strong religious beliefs view environmental problems as beyond human control and tend to rely on divine intervention. Evangelical churches emphasize the sovereignty of God and the view that God controls the fate of humans and the earth (Schwadel and Johnson, 2017). Hope and Jones (2014) use focus groups to study Muslim and Christian participants' opinions about climate change, which were shaped by the importance of environmental stewardship and intergenerational justice. Both groups expressed a relatively low degree of urgency about climate change, due to their beliefs in an afterlife and divine intervention. In particular, followers of apocalyptic beliefs such as fundamentalist Christians are inclined to see environmental problems as a sign of the coming of the end of time (the Rapture is nigh). Such beliefs render the idea of short-term cost for possible long-term environmental benefits less relevant. Lieven (2012) and Chaudoin et al. (2014) argue that religious believers reject the idea of international cooperation, fearing that compromise with secular or

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[1] Religiosity here refers to the intensity of individual religious beliefs and participation in religious services.

[2] See, e.g., Anderson (1988), Inglehart (1999), La Porta et al. (1999), Barro and McCleary (2003), Guiso et al. (2006), Owen and Videras (2007), Lindberg (2010), Smith and Leiserowitz (2013), Arbuckle and Konisky (2015), Campante and Yanagizawa-Drott (2015), Morrison et al. (2015) and Ferngren (2017).

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socialist powers may endanger the divine promise of their own country.

The literature also presents some contrasting findings, which further motivates our empirical study. Smith and Leiserowitz (2013) find that American evangelicals are less likely than non-evangelicals to believe that global warming is occurring, that it is caused mainly by human activities, or have substantial adverse effects. However, a majority of evangelicals are still somewhat concerned about climate change and support a range of energy-related and climate change policy responses. Moreover, Schaefer (2016) reports that leaders of Judaism, Christianity, and Islam have publicly advocated action to mitigate the adverse effects of human-forced climate change. Naess (1990) and Whitney (1993) find that religious beliefs such as Judeo-Christian traditions are associated with pro-environmental behavior. Arbuckle and Konisky (2015) highlight the environmental stewardship teachings of Protestantism and Islam.

Religion and science have a long history of conflict. People with stringent religious beliefs distrust scientific authority. Science contradicts religious doctrines, interferes with nature, or simply plays God (Sjöberg, 2004; Ecklund et al., 2017).[3] In that sense, climate change may be seen as the most recent case of science skepticism in the United States, following previous obstructions to evolution, biotechnology and nanotechnology (Brossard et al., 2009; Scheufele et al., 2009; Evans and Feng, 2013; Bénabou et al., 2015a).

The extent of participation in religious services and the salience of religion both play important roles in shaping a person's religious belief and how she makes sense of events (Levy and Razin, 2012; Shao, 2017). Religious organizations shape such beliefs by providing certain kinds of messages and stifling others. Bénabou et al. (2015a) reason that if a theocratic regime fears that the adoption of new scientific knowledge will erase existing religious beliefs, it may hamper its dispersion. Religious organizations may influence relevant policies by organizing mass movements and publicizing messages against science.[4] On the other hand, if fit for religious purposes, these organizations may adapt doctrines to new knowledge. In sum, religious organizations and leaders may, if required, influence the policies concerning new scientific knowledge, innovation, and a wide range of political issues (Leege and Kellstedt, 2016; Jenkins et al., 2018).

Legislators' religious beliefs may impact their support for national and foreign policies, including climate change and other environmental regulations (Fastnow et al., 1999; Newman et al., 2016; Oldmixon, 2009). Newman et al. (2016) emphasize that internal forces such as religious traits are likely to influence legislators' support for environmental policies. They establish an empirical relationship between the religious affiliations of members of the U.S. House of Representatives and the roll-call voting record on environmental regulations over the last 40 years.[5]

Drawing on the overall message of the literature discussed above, we hypothesize that a country's propensity to adopt climate change policies is negatively influenced by the average strength of religiosity within the population. Greater religiosity yields lower public support for public spending on climate change mitigation, more influential anti-environment religious movements, and lower climate change policy support from religious legislators.

Our empirical work begins with updating the index originally created by Steves and Teytelboym (2013) and extending their database to include substantially more countries. Our resulting "climate change policy stringency" (CCPS) index accounts for recent international agreements and updated data for national policies. We believe this new CCPS index is a useful contribution to the literature on its own.[6]

Next, we construct a cross-country measure of religiosity, following the procedure of Bénabou et al. (2015b). Specifically, we measure the extent of religiosity by using global survey data on religious beliefs and religious participation practices from six waves of the World Values Survey (WVS) carried out over the years 1981 to 2014. The resulting religiosity index shows a high level of heterogeneity in religious beliefs and religious participation across the world.

Based on a cross-section of 75 countries, our regression results suggest that greater religiosity is associated with less stringent climate change policies, lending support to our hypothesis. This result holds even when we account for real GDP per capita, openness in the economic, social, and political dimensions (globalization index), coal production, democracy, quality of institutions, and public perception of climate change. Our finding is also robust to alternative measures of religiosity and religious affiliations, cultural differences measured through demarcation of civilizations, national impact of climate change and cost of emission reduction. The result also appears unlikely to be driven by outliers or omitted variable bias(Oster, 2019).

This study adds novel knowledge to the literature, which so far has abstracted from religiosity. The results show how religiosity, irrespective of religious affiliation, might obstruct efforts to implement climate change policies and sustainable development programs. Policymakers and communicators in governments and international organizations, as well as advocacy groups, may benefit from a further understanding of such underlying blockages. This may, in turn, improve policy designs and public communication strategies.

This paper is organized as follows. Section 2 outlines the empirical approach and describes the data, and Section 3 reports the main results. Section 4 performs some robustness checks. Section 5 concludes.

2. Empirical approach and data

2.1. Regression model

The following empirical model is used in our cross-country analysis:

$$\mathrm{CCPS}_i = \alpha + \beta\ \mathrm{Religiosity}_i + \gamma' \mathrm{CV}_i + \epsilon_i \tag{1}$$

where CCPS_i is the climate change policy stringency index in country *i*, and $\mathrm{Religiosity}_i$ is a measure of religiosity in the country *i*. CV_i is a set of control variables, which include real GDP per capita, globalization index, coal production, democracy index, quality of institutions, public perceptions on climate change, and region dummies. ϵ_i is an unobserved error term. Including all these control variables results in 75 observations.

2.2. Construction of variables and data sources

2.2.1. The Climate Change Policy Stringency (CCPS) index

To measure a country's willingness to address and collaborate on climate change, we seek to measure country-level climate change

[3] Herbig and Dunphy (1998) and Mokyr (2014), e.g., argue that highly religious countries resist innovations.

[4] Theocratic regime refers to the governance by divine guidance, where government leaders are also the religious leaders and the state's legal system is based on religious law.

[5] Religious factors may affect economic outcomes and the balance of political power. For example, Chaney (2013) shows that in pre-modern Egypt, severe flooding by the Nile increased the political power of religious leaders. This raised the allocation of resources for the construction of religious structures. Greif (1994) provides a historical analysis of pre-modern societies, associating cultural and religious factors with contemporary institutional structures and economic development.

[6] Our CCPS index database provides data for 183 countries. However, due to the limited availability of other variables, the size of our main sample declines to 75 observations. Using the dataset of Steves and Teytelboym (2013) results in only 51 observations.

policies in the international and national dimensions. We recognize that comparing the quality and depth of climate change policies across countries presents a challenge (Steves and Teytelboym, 2013). However, we aim to update the Climate Laws, Institutions, and Measures Index (CLIMI) index of Steves and Teytelboym (2013) and expand it to include more countries. CLIMI compares countries' climate change responses in terms of their international commitments as well as national legislative, fiscal, and institutional frameworks with the potential to make a long-term impact on emission mitigation.

CLIMI uses policy inputs based on information collected for 95 countries over the period 2005–2010. CLIMI focuses on policy inputs rather than outputs such as emissions trends. In the same vein, it does not include implementation issues in terms of outcomes such as the frequency of use of climate laws in practice. It accounts for both global and domestic climate change policies. CLIMI has previously been utilized by, e.g., Obydenkova and Salahodjaev (2017) and Ang and Fredriksson (2021).

Our updated policy index denoted as the Climate Change Policy Stringency (CCPS) index, is created for a cross-section of 183 countries using available information for policy efforts over the period 1997–2015 (since the inception of the Kyoto Protocol). CCPS goes beyond CLIMI in two ways: first, international cooperation is captured by one additional measure - ratification of the Paris Agreement; second, more extensive and up-to-date data are included for both the national and international domains.

In particular, CCPS measures the strength of the following four main policy domains (see Table A1 in Appendix A): (1) international cooperation and policy (overall weight in CCPS = 0.10); (2) domestic institutions, and national climate change mitigation policy (weight = 0.40); (3) sectoral policies (weight = 0.40); and (4) cross-sectoral policies (weight = 0.10). These four policy areas, in turn, include 14 underlying variables: the speed of Kyoto Protocol ratification; the speed of Paris Agreement ratification; development of Clean Development mechanism (CDM) or Joint Implementation (JI) projects; national climate change laws; emission reduction commitments pre- and post-2020; institutional engagement (such as at the ministerial level) in climate change; mitigation and regulation policies for energy efficiency and/or renewable energy in buildings; policies in the transport sector; policies in agriculture; policies in forestry; policies specific to industries; and cross-sectoral fiscal or regulatory measures such as carbon taxes.

Following the methodology used by Steves and Teytelboym (2013), the policy stringency scores are assigned on a 3-point scale in most categories: 0 = institution or policy does not exist; 0.5 = significant mitigation measures have been taken, or an institution is established, but not at the best practice level; 1 = worldwide best practice.[7,8] Ratification of the Kyoto Protocol and Paris Agreement is scored on a linear scale of zero to one, depending on how quickly they are ratified.[9] The participation in CDM or JI projects (or both) is a binary measure. The final index is the weighted average of the 14 variables in these policy domains.

The data sources used are comprehensive. First, publicly available information such as the public registries and national communications to the United Nations Framework Conventions on Climate Change (UNFCCC) are used. As parties to the UNFCCC, countries are obligated to submit national communications, which provide an incentive to report policy efforts, and reduce misreporting, intentional omissions, or exaggerations. Several other global (IEA databases, e.g.) and national public domains were used (see notes section, Table A1 in Appendix A for details).

The resulting CCPS index varies continuously between zero and one, where higher values correspond to more stringent climate change policies. Fig. 1 shows the spatial distribution of the CCPS among the 75 countries utilized in our estimations. In our sample, the United Kingdom has the most stringent climate change policies (CCPS = 0.86) whereas Qatar (CCPS = 0.08) has the least stringent policies. Table A3 in Appendix A provides a list of countries included in our sample. For the 75 countries in our sample, the correlation coefficient between CCPS and CLIMI equals 0.84. Moreover, CCPS and the policy component of the climate change cooperation index (C3–I) by Bernauer and Böhmelt (2013) exhibit a correlation coefficient of 0.62.[10] CCPS and the environmental policy stringency index (EPS) by Botta and Koźluk (2014) have a correlation coefficient of 0.54.[11,12]

Carbon taxes and emission trading schemes are commonly used price instruments for curbing climate change. In response to global commitments under the UNFCCC to address climate change, some countries have implemented carbon taxes or emission trading schemes (ETS). Based on the data from The World Bank (2021), the correlation coefficient between CCPS and carbon tax rates equals 0.52, and between CCPS and ETS permit prices the coefficient equals 0.70 (1997–2015 time period).

Similar to CLIMI, CCPS captures policies adopted to mitigate climate change. It should be noted that CCPS is not able to adequately capture the level of implementation, and readers should keep this in mind in the interpretation of the results. However, we believe that our measure reflects a considerable degree of actual policy implementation. For example, the existence of an institution dedicated to climate change is significantly more likely to be associated with the implementation of a stringent climate change policy than if no such institution is in place. Moreover, in our view, the vast majority of profit-maximizing firms around the world are likely to pollute up to the maximum allowed by the law, i.e., sector regulations are binding in practice.

In addition, our baseline model controls for the quality of institutions since it may influence the actual (but hard to measure precisely) implementation of environmental policies (Ang and Fredriksson, 2021). In any case, CCPS has the advantage of utilizing the latest available data, is relatively easy to interpret, is highly correlated with other climate

[7] If no information related to policy measures is available from any of the data sources considered, a 0 score is assigned. The underlying assumption is that if a country has a climate change policy in place, it will communicate this to the UNFCCC, include it in its national plan documents, or showcase it in some other public domain.

[8] As an example, for "dedicated climate change institution", a score of 0 is assigned if there is no dedicated institution, 0.5 if a government committee exists, and 1 if an autonomous agency exists. Similarly, for the "energy efficiency and renewable energy" policy measures, a score of 0 is assigned if no policy exists, 0.5 if a set of policies promoting renewable energy or energy efficiency exists, and 1 if there is a comprehensive law or policy aiming for renewable sources in electricity production or energy efficiency, with effective implementation and enforcement instruments. See Steves and Teytelboym (2013) for further details on the scoring method.

[9] We compute the ratification time lags by considering the length of time between the ratification starting year of such international commitments and the actual year of the country's ratification. We then normalize it so that all scores vary between zero and one. For instance, among the countries that have ratified the Kyoto Protocol in our baseline sample of 75 countries, the lowest score is 0.35 (Iraq and Turkey, both ratified in 2009) and the highest score is 1 (El Salvador, who first ratified in 1998). The US receives a zero score as it never ratified the Protocol.

[10] C3—I captures the overall performance of countries in terms of their political behavior (output) and emissions (outcome).

[11] EPS measures the stringency of 14 environmental policy instruments (such as renewable energy trading schemes, CO_2 tax, feed-in tariff) in OECD countries, but does not include contributions to international agreements.

[12] The Spearman's correlations equal 0.81 (between CCPS and CLIMI), 0.59 (between CCPS and C3—I), and 0.64 (between CCPS and EPS).

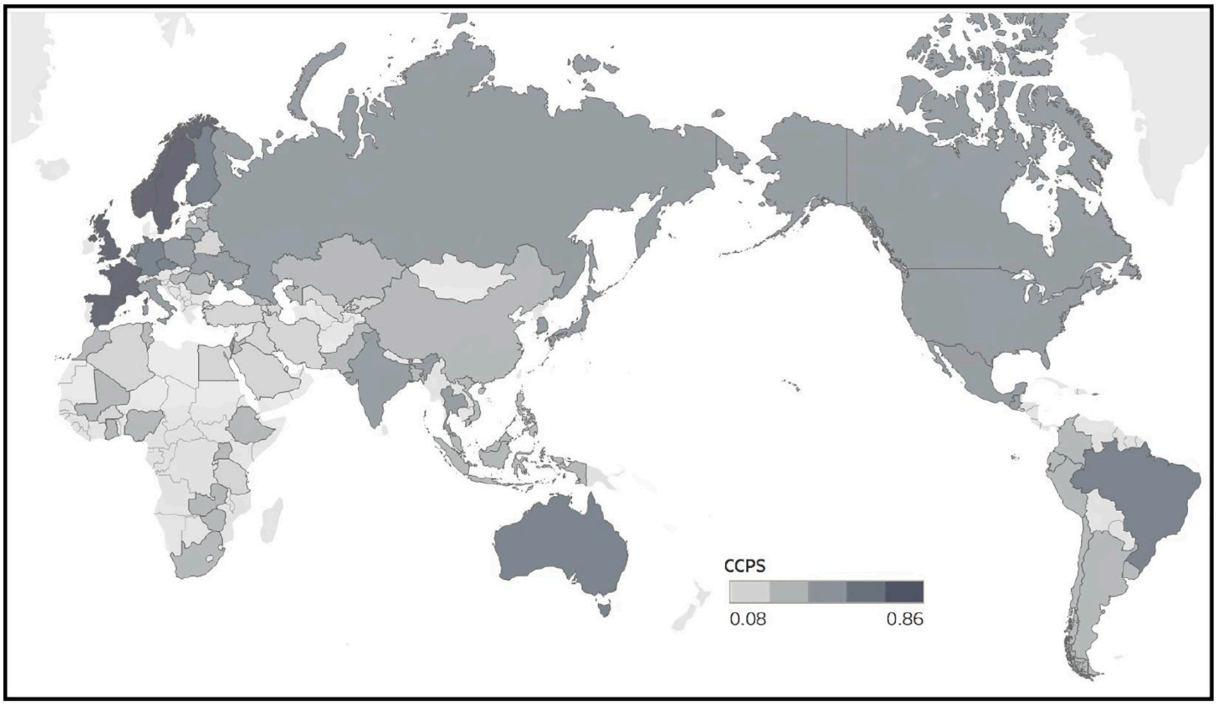

Fig. 1. Spatial distribution of CCPS.
Notes: The figure shows the distribution of Climate Change Policy Stringency (CCPS) across 75 countries used in our estimations. Higher values, represented by darker areas, correspond to the adoption of more stringent climate change policies.

change policy indices used by the literature, has extensive global coverage, is neutral to political economy distortions, and does not mix policy choice with emission outcomes.

2.2.2. Measuring the extent of religiosity

To measure religiosity, we follow Bénabou et al. (2015b) and focus on five important aspects of individual religious orientation: (i) one considers oneself as a religious person; (ii) belief in God; (iii) importance of God; (iv) religious participation; and (v) importance of religion. Data are taken from the World Value Survey (WVS).[13] Restricting the sample to a single survey wave limits the sample size. We, therefore, use the pooled WVS data averaged over all available waves spanning approximately three decades (1981–2014).[14] Every WVS wave retains a certain number of countries surveyed in the preceding waves, while several new countries are added (see Table A2 in Appendix A for a list of countries included in each wave). By using the pooled data approach, we can combine countries that are represented in different waves and include multiple observations for a single country (see Table A3 in Appendix A for the sample countries).

We generate five measures of religiosity at the country-level by following the procedure described in Table 1. That is, our religiosity measures are based on the proportion of people who consider themselves a religious person, who believe in God, who say that religion is very important in their lives, who attend religious services regularly (once a week or more), and who say that God is important in their lives. These five measures of religiosity are strongly correlated (see Fig. 2).

Table 1
Religiosity measures.

Measure	Construction method
Religious person	The questionnaire asks, “Independently of whether you attend religious services or not, would you say you are: a religious person, not a religious person, or a convinced atheist?” We take the percentage of respondents who consider themselves a religious person.
Belief in God	The questionnaire asks, “Do you believe in God?” We take the percentage of respondents who say “yes”.
Importance of God	The questionnaire asks, “How important is God in your life?” Respondents are asked to rate on a scale of 1 (not at all important) to 10 (very important). We take the percentage of respondents who provide a rating from 6 to 10.
Religious participation	The questionnaire asks, “How often do you attend religious services?” Respondents are asked to select on an eight-point scale from “never, practically never” to “more than once a week”. We take the percentage of respondents who say, “once a week” or “more than once a week”.
Importance of religion	The questionnaire asks, “How important is religion in your life”. The respondents are asked to rate on a four-point scale from “not at all important” to “very important”. We take the percentage of respondents who say, “rather important” or “very important”.

Source: Pooled WVS Dataset (1981–2014).

The principal component analysis shows that these measures may represent a common dimension (the first principal component captures 86% of the total variation) and form a consistent scale of overall religiosity (Cronbach's alpha = 0.94).[15] We construct an overall index using an aggregated average of all five religiosity measures.[16] The resulting

[13] We note that WVS is biased towards monotheism.

[14] The number of countries for which religiosity data are available in each WVS wave is indicated in parenthesis: wave 1: 1981–84 (8 countries); wave 2: 1989–93 (18); wave 3: 1994–98 (54); wave 4: 1999–2004 (40); wave 5: 2005–2009 (58); wave 6: 2010–2014 (60). After including control variables, the number of observations declines. Using pooled WVS data is the standard approach in the literature to maximize the number of observations (e.g., Norris and Inglehart (2011) and Bénabou et al. (2015b), among others).

[15] The high Cronbach's alpha test score suggests that all religiosity measures are very closely related as a group, providing the basis for constructing an overall summary measure of religiosity.

[16] Some survey questions were not asked in a few countries. For these countries, the religiosity index is constructed using the remaining measures. For instance, question related to belief in God was not asked in Ethiopia. Thus, the religiosity index for Ethiopia is constructed using the remaining four religiosity measures.

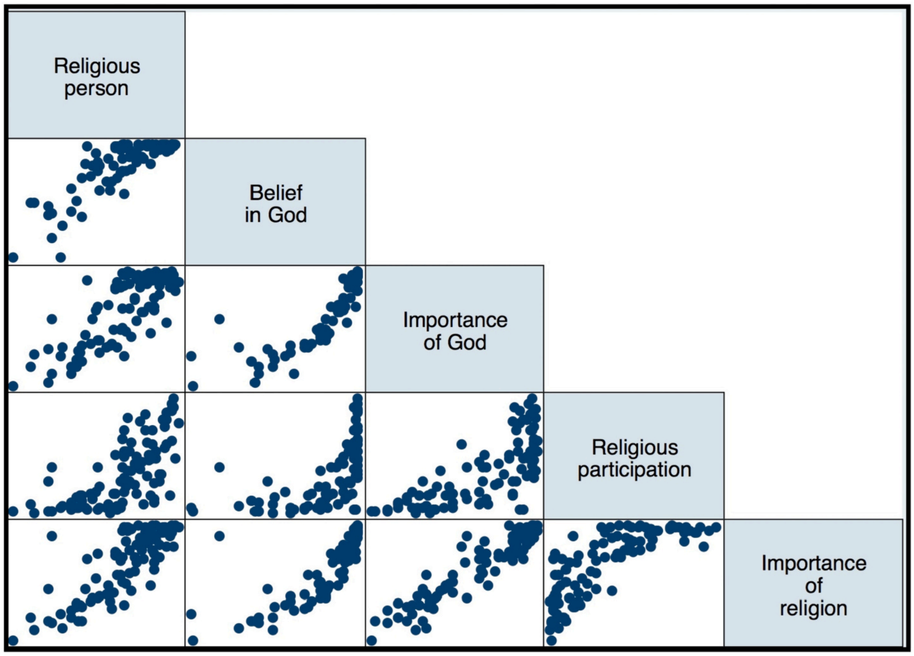

Fig. 2. Correlation of religiosity measures.

religiosity index varies between zero and one, where higher values represent greater religiosity.

Fig. 3 shows the global variation in the strength of religious faiths. China emerges as the least religious country in our sample of 75 countries (religiosity index score = 0.16), while Qatar is the most religious (religiosity index score = 0.97). Countries such as Germany, Netherlands, Norway, the United Kingdom, Sweden exhibit low religiosity, while the United States has a higher religiosity score (0.73).

The degree of religiosity has not changed extensively in most of these countries over the sample period. For instance, Argentina's (included in all WVS waves) religiosity index takes values in the range of 0.62–0.73 during the six waves. In this case, measuring a country's strength of religiosity by averaging over different survey waves appears to be a useful approach. Nonetheless, in the next section, we check the robustness of this approach.

2.2.3. *Control variables*

We control for economic, political, institutional, and public perception influences that help determine climate change policies (see, e.g., Ang and Fredriksson, 2021).[17] First, we include real GDP per capita (constant 2011 international dollars using PPP rates; The World Bank, 2019a, 2021) since income is related to the demand for environmental quality and the state capacity to design and adopt advanced policies. Second, the overall globalization index of Gygli et al. (2019) is used to measure openness in the economic (trade and economic globalization), social and political dimensions. Third, domestic coal production captures political pressures and is computed as production (thousand tons) per capita. Sherwood (2011) discusses the negative relationship between climate change acceptance and coal production.[18] Coal production data come from BP (2020), Enerdata (2019), and EIA (2020), and population data are from The World Bank, 2019.

Fourth, we include a democracy index (denoted as democracy) to capture some political influences. Our democracy index comes from the Polity IV data set (Marshall et al., 2017). Fifth, we include the quality of institutions (denoted as institutions) by taking the average of political stability and control of corruption from Kaufmann and Kraay (2018). Sixth, we control for the public perception of climate change using a worldwide survey on climate change opinions conducted during 2007–2008 by GALLUP (2019). Our public opinion measure is the fraction of the population who view global warming as a serious personal threat. Finally, we include region dummies based on the classification of the World Bank. Table 2 reports their descriptive statistics.

3. Main results

Table 3 reports the regression results for Eq. (1). All specifications include region dummies. Column (1) reports the ordinary least square estimates without control variables. Real GDP per capita (log), globalization index, coal production, democracy index, and the quality of institutions are included in column (2). Column (3) adds public perceptions of climate change.

We find a negative and significant association between religiosity and the stringency of climate change policies in all three columns. Specifically, a complete change in status from being non-religious to fully religious, conditioning on other effects, is associated with a reduction in climate change stringency by about 0.29 index points. The standardized estimates in columns (2) and (3) indicate that one standard deviation increase in the religiosity index is associated with about one-third standard deviations reduction in the CCPS index - a difference that roughly reflects the disparity in CCPS between Switzerland and Mexico. The results are more or less consistent when the individual religiosity measures are used, as shown in Table A4 in Appendix A. Fig. 4 shows the partial regression plot using the estimates reported in column (3) of Table 3. Overall, the estimates reported in this section lend some support to our hypothesis.

4. Robustness checks

In this section, we discuss the robustness and sensitivity of our main findings to (i) unavailable religiosity data; (ii) alternative measures of religiosity; and (iii) religious affiliations and civilizations. Each of these robustness checks is discussed in detail in the following sub-sections.

[17] Following the latest wave of the WVS data, all control variables are measured by taking the average over the years 2010–2014.

[18] CO_2 emissions per capita and UNFCCC Annex 1 membership are potentially endogenous and therefore not included.

Fig. 3. Global variations in religiosity.
Source: Pooled WVS data (1981–2014).
Notes: The religiosity index varies between zero and one. Higher values (represented by darker areas) indicate greater religiosity.

Table 2
Descriptive statistics.

Variable	Mean	Std. Dev.	Min.	Max.
Climate Change Policy Stringency index (CCPS)	0.36	0.17	0.08	0.86
Religiosity index	0.69	0.21	0.16	0.97
Real GDP per capita (log)	9.46	1.02	7.13	11.73
Globalization	68.44	12.46	41.82	89.74
Coal production per capita	0.001	0.002	0.00	0.02
Democracy	4.50	6.02	−10	10
Institutions	−0.09	0.92	−1.82	1.78
Climate change perceptions	0.50	0.18	0.18	0.80

Notes: The description of the data is given in the text. The sample size is 75.

Table 3
Religiosity and the stringency of climate change policies.

Dependent variable = CCPS	(1)	(2)	(3)
	Basic specification	Adding economic, political, and institutional controls	Main specification (Baseline model)
Religiosity index	−0.45*** (−3.24)	−0.29*** (−3.20)	−0.29*** (−3.16)
Real GDP per capita (log)		0.02 (0.79)	0.02 (0.78)
Globalization		0.01** (2.49)	0.01** (2.44)
Coal production per capita		1.24 (0.55)	1.33 (0.56)
Democracy		0.01*** (3.79)	0.01*** (3.44)
Institutions		−0.01 (−0.34)	−0.01 (−0.37)
Climate change perceptions			0.06 (0.59)
Standardized coefficient of religiosity index	−0.54***	−0.34***	−0.34***
Region dummy	Yes	Yes	Yes
R^2	0.38	0.67	0.68
No. of observations	75	75	75

Notes: The religiosity index measures the overall strength of religiosity and varies continuously from zero to one. The region dummy variables are East Asia and Pacific, Europe and Central Asia, Latin America and the Caribbean, the Middle East and North Africa, North America, South Asia, and Sub-Saharan Africa. Robust standard errors are used. t-statistics are reported in parentheses. *, ** and *** indicate significance at the 10%, 5% and 1% levels, respectively. The intercept estimates are not shown.

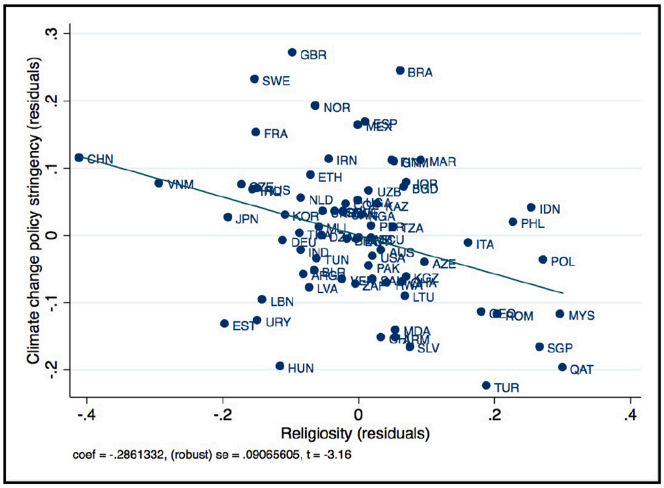

Fig. 4. Religiosity and the stringency of climate change policies.
Notes: The figure shows the effect of religiosity on CCPS, after partialling out the influence of the control variables used in column (3), Table 3.

4.1. Missing religiosity values

Survey questions related to some of the religiosity measures (mainly "Belief in God" and "Religious participation") were not asked in some countries (about 15% of our sample countries). This is a potential concern. For instance, the question related to "Belief in God" was not asked in Ethiopia. In our baseline approach, the religiosity index for such countries is constructed by using all other available religiosity measures (four, in the case of Ethiopia). While this is a pragmatic approach in a cross-sectional analysis where we seek to retain the largest possible number of observations, the resulting religiosity index is likely to be imprecise for those countries that lack information on some religiosity measures.

We re-estimate our main model to include missing religiosity values by using a stochastic multiple imputation algorithm. This approach is an improved version of deterministic imputations (see Little (1992) and Little and Rubin (2019) for theoretical details). In deterministic imputation, a regression model is estimated to predict the observed values of a variable on the basis of other variables that have complete and incomplete information. Missing values are then imputed by using fitted values from the regression model. Stochastic multiple imputations extend the procedure in two ways: first, a residual term is added to the predicted values to manage the lost variability. Second, instead of using one missing value, missing values are drawn multiple times from the distribution and each of these datasets is analyzed separately. Regression results are then consolidated by using the average values of separate regression coefficients (Enders, 2010).

Table 4 reports the regression estimates based on the imputed values. Columns (1) to (5) report the results for the individual measures of religiosity whereas column (6) shows the results for the overall religiosity index. In all but one case (column (4)), the results are consistent with the main findings reported in Table 3.

4.2. Alternative sample and measures of religiosity

In this section, we investigate whether our religiosity measure, constructed by averaging data over multiple waves of the WVS survey, leads to a biased estimate of the coefficient of interest. We undertake several strategies to check the reliability of this method of constructing the religiosity measure.

First, we construct the religiosity index for each country by using the data from each available wave separately and check their correlations. The results in Table 5 indicate that all religiosity indices (constructed from different waves) are highly correlated. They are also highly correlated with the overall religiosity index created using the pooled data, which is our baseline measure. This suggests that our results are unlikely to be subject to aggregation bias, providing some credence to the use of our overall religiosity index.

Second, we check the robustness of our main findings by using wave-specific religiosity indices. A sharp decline in the number of observations for several waves becomes a hurdle for this exercise, however. For instance, estimating the eq. (1) by using the data for wave 2 results in only 16 observations. We, therefore, use the most recent wave (number 6, for 2010–2014) to construct a wave-specific religiosity index which includes the largest number of countries. The estimates using this alternative religiosity measure are reported in column (1), Table 6. While the wave 6 survey provides data for 60 countries, column (1) has only 49 observations due to the unavailability of data for other variables. The results are consistent with our main findings.

Third, for each country, we use only the latest WVS wave for which data on religiosity is available. That is, if no religiosity measure is available for wave 6, we use wave 5, then wave 4, and so on. Reassuringly, the results reported in column (2) are also in line with our earlier results. Fourth, we construct an alternative religiosity measure following Inglehart et al. (2003). This index measures six important aspects of people's religious orientation: (i) importance of God; (ii) comfort and strength from God; (iii) belief in God; (iv) being a religious person; (v) belief in life after death; and (vi) religious participation. Note that our religiosity index excludes items (ii) and (v) but includes "importance of religion". We construct the religiosity index of Inglehart et al. (2003) using the pooled WVS data. Column (3) in Table 6 reports the results, which are very similar to our baseline estimates.

A final potential concern is the treatment of survey responses for

Table 4
Results based on imputed values of religiosity.

Dependent variable = CCPS	(1)	(2)	(3)	(4)	(5)	(6)
Religious person	−0.24** (−2.64)					
Belief in God		−0.24*** (−3.34)				
Importance of God			−0.29*** (−3.28)			
Religious participation				−0.07 (−0.71)		
Importance of religion					−0.21*** (−2.99)	
Religiosity index						−0.27*** (−2.98)
Baseline controls	Yes	Yes	Yes	Yes	Yes	Yes
Region dummy	Yes	Yes	Yes	Yes	Yes	Yes
R^2	0.67	0.67	0.68	0.63	0.67	0.67
No. of observations	75	75	75	75	75	75

Notes: The reported results are estimated with the imputed value of unavailable religiosity measures. Imputations are repeated ten times; thus, ten sets of imputed values are generated. The importance of God is used to impute the value of missing measures. Multiple imputation regression is reported for other measures in columns (1) to (5). In constructing the religiosity index in column (6), the unavailable religiosity measures are replaced with an average of their ten different imputed values. Baseline controls include real GDP per capita (log), globalization index, coal production, democracy index, quality of institutions, and public perceptions on climate change.

Table 5
Correlation among religiosity indices.

	Wave 1	Wave 2	Wave 3	Wave 4	Wave 5	Wave 6	Pooled data
Religiosity index: Wave 1	1.00						
Religiosity index: Wave 2	0.93**	1.00					
Religiosity index: Wave 3	0.91***	0.91***	1.00				
Religiosity index: Wave 4	0.97***	0.98***	0.97***	1.00			
Religiosity index: Wave 5	0.93***	0.91***	0.89***	0.93***	1.00		
Religiosity index: Wave 6	0.96***	0.90***	0.92***	0.90***	0.94***	1.00	
Religiosity index: pooled data	0.93***	0.96***	0.97***	0.98***	0.97***	0.96***	1.00

Notes: *, ** and *** indicate significance at the 10%, 5% and 1% level, respectively.

Table 6
Alternative samples and measures of religiosity.

Dependent variable = CCPS	(1)	(2)	(3)	(4)
Religiosity index: wave 6	−0.26** (−2.66)			
Religiosity index: the most recent wave		−0.26*** (−2.94)		
Religiosity index: Inglehart			−0.29*** (−3.26)	
Religiosity index: an alternative approach				−0.31*** (−3.35)
Baseline controls	Yes	Yes	Yes	Yes
Region dummy	Yes	Yes	Yes	Yes
R^2	0.66	0.67	0.68	0.68
No. of observations	49	75	75	75

Notes: Baseline controls include real GDP per capita (log), globalization index, coal production, democracy index, quality of institutions, and public perception of climate change. Robust standard errors are used. t-statistics are reported in parentheses. *, ** and *** indicate significance at the 10%, 5% and 1% levels. The intercept estimates are not shown.

some religiosity measures. To check the sensitivity of our findings, we construct an alternative religiosity index without trimming the response scale. All five religiosity sub-measures use their complete response scales. We normalize three variables (importance of God, religious participation, and importance of religion) so that all measures now vary between zero and one.

We generate country-level averages using the average of all waves, and an overall index is constructed using the average of the five religiosity measures. The resulting religiosity index varies between zero and one, where higher values represent greater religiosity. The results reported in column (4) are, again, consistent with our main findings. In sum, irrespective of which alternative measure of religiosity is used, the association of religiosity with the stringency of climate change policy remains robust, and the coefficient size and significance level are stable.

4.3. *Religious affiliations and civilizations*

In this section, we begin by performing robustness checks for the impact of religious affiliations. We re-estimate Eq. (1) by controlling for the composition of the population with different religious affiliations. We investigate both the contemporary and historical effects.

PEW (2012) reports the population fractions adhering to different religions as of 2010. Following Barro and McCleary (2003), we use six categories and calculate the fraction out of the total number of individuals with religious affiliations in each category, including Christian, Muslim, Hindu, Buddhist, Jewish, Folk and Other religions (such as African traditional religions, Chinese Folk religions, Native American religions, the Baha'i faith, Shintoism).

To measure the historical religious adherence, religious affiliations in the year 1900 is computed using data from Barro and McCleary (2003). We again calculate the fractions out of the total number of religious followers: Christians, Muslims, Hindu, Eastern religions (including Buddhist), Jewish, and Other religions. For the analysis using either contemporary or historical data, Christians is the omitted group.

Moreover, following the Huntington (1993) civilization thesis, we account for the shared history of religion, languages, and culture. Civilization is considered to be the highest form of cultural grouping and the broadest level of cultural identity. It is defined by various key elements such as language, history, customs, and most importantly, religion. Huntington (1993) argues for civilization being the most deterministic aspect of future global affairs. He suggests that people belonging to different civilizations have different views on significant issues such as the relationships between God and man, the citizen and the state, as well as about rights and responsibilities, liberty, and authority. The civilization to which a country belongs, and the prominent influence of language, history, and religion may thus impact climate change policies.

We classify our sample under the following group of civilizations using dummy variables: Western, Latin American, the Orthodox, the Eastern world, the Muslim world, Sub-Saharan Africa, and Others (including countries with unique and mixed civilizations). Finally, to control for the impact of civilizations, we include these civilization classifications as dummy variables (Other civilizations is the omitted group).

Columns (1) to (3) in Table 7 report the results that include these additional covariates. Columns (1) controls for contemporary religious adherence whereas column (2) controls for historical religious adherence. Our main result remains robust in both cases. The religious affiliations do not show any significant correlation in columns (1) and (2). Religiosity appears to matter for climate change policies, not religious affiliation. For completeness, we additionally check for interaction effects, reported in Table A5 in Appendix A. Only the interaction effect of eastern religions is negative and weakly significant, while the association between CCPS and religiosity is still statistically highly significant.

Column (3) reports the estimates with controls for civilizations. Religiosity remains negative and significant. Finally, to check that our findings are not driven by individual civilizations, we sequentially omit countries that belong to (i) the Muslim civilization; (ii) the Orthodox civilization; and (iii) the Western world, in columns (4)–(6), respectively. While the sample size declines, the estimates of religiosity remain robust in all three subsamples. The coefficient size declines somewhat in column (6), suggesting that the association between religiosity and CCPS may be stronger in the Western world countries.

4.4. *National climate change impacts and cost of emission reduction*

The stringency of climate change policies is likely to be influenced by the impact of climate change on a country and the cost associated with emission reduction. To address this concern, we control for the national

Table 7
Sensitivity to religious affiliations and civilizations.

Dependent Variable = CCPS	(1) Adding contemporary religious adherence	(2) Adding historical religious adherence	(3) Controlling for different civilizations	(4) Excluding the Muslim world	(5) Excluding the Orthodox civilization	(6) Excluding the Western world
Religiosity index	−0.37** (−2.61)	−0.36*** (−2.67)	−0.21** (−2.54)	−0.28** (−2.22)	−0.28*** (−3.12)	−0.16** (−2.60)
Contemporary Religious adherence						
Muslim fraction	0.02 (0.41)					
Hindu fraction	−0.11 (−1.19)					
Buddhist fraction	−0.15 (−1.53)					
Jewish fraction	0.05 (0.66)					
Folk and Other religions fraction	−0.11 (−0.68)					
Historical Religious adherence						
Muslim fraction		0.02 (0.28)				
Hindu fraction		−0.10 (−0.86)				
Eastern religion fraction		−0.12 (−1.27)				
Jewish fraction		−0.53 (−0.58)				
Other religions fraction		−0.00 (−0.05)				
Impact of different civilizations						
Western			0.10* (1.86)			
Latin American			−0.05 (−1.10)			
The Orthodox			−0.12*** (−3.51)			
The Eastern world			−0.02 (−0.66)			
The Muslim world			−0.08*** (−3.11)			
Sub-Saharan Africa			−0.06 (−1.44)			
Baseline controls	Yes	Yes	Yes	Yes	Yes	Yes
Region dummy	Yes	Yes	No	Yes	Yes	Yes
R^2	0.69	0.69	0.74	0.67	0.73	0.58
No. of observations	75	75	75	55	65	60

Notes: Baseline controls include real GDP per capita (log), globalization index, coal production, democracy index, quality of institutions, and public perception of climate change. Robust standard errors are used. t-statistics are reported in parentheses. *, ** and *** indicate significance at the 10%, 5% and 1% levels. The intercept estimates are not shown.

Table 8
Sensitivity to climate change impacts and abatement cost.

Dependent Variable = CCPS	(1) Adding a measure of climate change impact	(2) Adding a measure of abatement cost
Religiosity index	−0.28*** (−2.78)	−0.24** (−2.19)
Climate change impacts	0.01 (0.39)	
Abatement cost		0.22 (0.90)
Baseline controls	Yes	Yes
Region dummy	Yes	Yes
R^2	0.68	0.69
No. of observations	75	53

Note: Baseline controls include real GDP per capita (log), globalization index, coal production, democracy index, quality of institutions, and public perception of climate change. To measure national climate change impact, the social cost of carbon computed by Tol (2019) is used. The base case with an SSP2 scenario, a pure rate of time preference of 1%, and a rate of risk aversion of 1 is used. See Tol (2019) for further details on this. Abatement costs (Hof et al., 2017) are computed as a share of national GDP, used costs are for unconditional nationally determined contributions under no emission trading and SSP2 scenario. See Hof et al. (2017) for further details on this. Robust standard errors are used. t-statistics are reported in parentheses. *, ** and *** indicate significance at the 10%, 5% and 1% levels. The intercept estimates are not shown.

social cost of carbon using the measure of Tol (2019). We also include the estimated annual abatement costs associated with the intended nationally determined contributions (NDCs) of emission reduction using the measure of Hof et al. (2017).

Column (1) in Table 8 controls for the national climate change impact and column (2) controls for the national abatement cost. None of the added covariates show any significant correlation. However, with a reduced sample size, the religiosity index coefficient size declines slightly in column (2). Importantly, the association between religiosity and the stringency of climate change policy remains robust.

4.5. *Omitted unobservable variables*

We have interpreted the above results as indicative of a robust association, not a causal relationship because of the possibility of omitted variable bias. However, by using Oster (2019) method for analyzing the omitted variable bias, we can provide evidence in favor of a causal relationship. This approach extends Altonji et al. (2005), where the premise is that the degree of selection on the observable variables is informative about the selection on the unobserved factors. If observable covariates come from a random subset of all relevant variables, then it is assumed that the selection on observables covariates is the same as the selection on unobservable variables.

Thus, the coefficient movement caused by the insertion of observable

Table 9
Robustness to omitted variable bias.

Dependent variable = CCPS	(1) Baseline effect β^0 [R^0]	(2) Controlled effect $\tilde{\beta}$ [$\tilde{R}$]	(3) Bias adjusted effect	(4) Identified set [$\tilde{\beta}$, $\beta^*(R_{max}, 1)$]	(5) Exclude zero?	(6) Within confidence interval?	(7) δ for $\beta = 0$ given R_{max}
Panel I: Controlled effect as in Eq. (1), $R_{max} = 0.88$							
Religiosity index	−0.44***[0.38]	−0.29*** [0.68]	−0.15	[−0.29, −0.15]	Yes	Yes	1.72
Panel II: Controlled effect as in Eq. (1) contemporary religious adherence, $R_{max} = 0.89$							
Religiosity index	−0.44***[0.38]	−0.37**[0.69]	−0.06	[−0.37, −0.06]	Yes	Yes	1.05
Panel III: Controlled effect as in Eq. (1) historical religious adherence, $R_{max} = 0.89$							
Religiosity index	−0.44***[0.38]	−0.36***[0.69]	−0.12	[−0.36, −0.12]	Yes	Yes	1.16
Panel IV: Controlled effect as in Eq. (1) climate change impacts, $R_{max} = 0.88$							
Religiosity index	−0.44***[0.38]	−0.28***[0.68]	−0.11	[−0.28, −0.11]	Yes	Yes	1.42
Panel V: Controlled effect as in Eq. (1) abatement cost, $R_{max} = 0.89$							
Religiosity index	−0.44***[0.38]	−0.24***[0.69]	−0.20	[−0.24, −0.20]	Yes	Yes	2.91

Notes: This table shows the results of the omitted variable analysis using the method of Oster (2019). Columns (1) and (2) report the baseline and controlled effects, respectively. Baseline effects are without controls. The full set of controls in Eq. (1) include real GDP per capita, globalization index, coal production, democracy index, quality of institutions, and public perception of climate change. All regressions include region dummies. Panel I considers only the baseline controls, whereas Panel II and Panel III add the religious adherence variables of Table 7. Panel IV and Panel V add the climate change impacts and abatement cost from Table 8. Column 3 reports the bias-adjusted effect for R_{max} stated in the top row of each panel and unity proportionality selection (see Appendix B). Note that due to rounding of R^2 values up to two decimal places in Tables 3 and 7, R_{max} values reported here might not match exactly to 1.3* R^2. The identified set shown in column (4) is bounded below by $\tilde{\beta}$ and above by β^*.Column (7) shows the value of δ which yields $\beta = 0$. *, ** and *** indicate significance at the 10%, 5% and 1% levels, respectively.

covariates in the regression equation can be used to determine an estimate of selection on unobservables. In other words, it signifies the strength of the likely bias arising from unobservable variables: the extent of selection on unobservables as compared to the selection of observables required to explain away the estimated effect with all covariates included.

Oster (2019) extends this approach by considering both the movement of coefficients and R^2 values in the regression equation after including a full set of controls. The objective is to compute the bounding values for the treatment effect and ultimately the size of the omitted variable bias. Oster (2019) suggests calculating the bias-adjusted coefficient (β^*) on the basis of estimated parameters ($\tilde{\beta}$, β^0, $\tilde{R}$, R^0),degree of proportionality-δ (that shows how strongly unobservable variables are related to the main explanatory variable in comparison to the observable variables) and R_{max} (an assumption about the R^2 values that considers both observed and unobserved variables) (see Appendix B for more details).

The results are reported in Table 9. We report baseline and controlled effects. Baseline effects are without controls. For controlled effects, five sets of full controls are considered: (i) the covariates included in Eq. (1) i.e. baseline controls; (ii) the baseline controls plus contemporary religious adherence; (iii) the baseline controls plus historical religious adherence[19]; (iv) the baseline controls plus climate change impacts; (v) the baseline controls plus abatement cost. The findings confirm the robustness to omitted variable bias in two ways. First, we find that the bias-adjusted coefficient is distant from zero, is within the confidence interval of the estimated controlled effect, and the identified set (bounded below by $\tilde{\beta}$ and above by β^*) excludes zero. Second, in all reported cases, the value of δ which produces $\beta = 0$ is greater than the cut-off value of 1.

The results suggest that omitted variables would have to be 1.05 to 2.91 times more important than the full set of control variables in order to completely eliminate the effect of religiosity. It appears unlikely that our estimates are entirely driven, or severely biased, by unobserved confounders. While in the earlier part of the paper we could interpret the results only as associations, the results in this section, based on Oster (2019), provide some evidence that the estimated negative association at least partially reflects a causal effect.

5. Conclusion

This study contributes to an improved understanding of the cultural aspect of cooperation and contribution to addressing the climate change problem by focusing on the role of religiosity. We develop and test the hypothesis that a country's ability to adopt more stringent climate change policies is negatively related to its national level of religiosity. This hypothesis receives rather robust support from our cross-country regression estimates.

Our study sheds light on how religiosity, irrespective of religious affiliation, might obstruct efforts to implement climate change policies and sustainable development programs. Our findings suggest that policymakers and international organizations will need to design strategies to overcome this barrier to effectively address climate change.

Credit author statement

The contributions of the authors are as follows:

Swati Sharma worked on the conceptualization of the topic, developed the methodology, conducted data curation, did data analysis using statistical tools and software, compiled the results and wrote the original draft of the manuscript, and worked on subsequent revisions of the paper.

James Ang helped in conceptualization of the topic, finalization of the methodology, review, and revision of the manuscript.

Per Fredriksson contributed to the writing, final editing, review and revision of the manuscript.

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[19] Our model does not include region dummies when civilization dummies are included (column (3), Table 7). Thus, in order to use consistent controls (as in Panels I, II, and III), we do not consider controlled effects with civilization dummies.

Appendix A

Table A1
CCPS construction

Policy domain	Weights	Measure	Score	Sub-weights
(1) International cooperation	0.10	Kyoto ratification	0 to 1	0.25
		Paris Agreement ratification	0 to 1	0.25
		Development of Joint implementation (JI) or Clean Development projects (CDM) projects	0 or 1	0.50
(2) Domestic institutions and national climate change mitigation policy	0.40	National climate change legislation	0, 0.5, 1	0.25
		Nationally taken and internationally declared GHG emission reduction targets: pre-2020	0, 0.5, 1	0.25
		Nationally taken and internationally declared GHG emission reduction targets: post-2020	0, 0.5, 1	0.25
		Dedicated climate change institution	0, 0.5, 1	0.25
(3) Sectoral policies	0.40	Energy efficiency and renewable energy	0, 0.5, 1	0.30
		Transport	0, 0.5, 1	0.13
		Buildings	0, 0.5, 1	0.07
		Agriculture	0, 0.5, 1	0.13
		Forestry	0, 0.5, 1	0.17
		Industry	0, 0.5, 1	0.20
(4) Cross-sectoral policies	0.10	Cross-sectoral policy measures	0, 0.5, 1	1.0

Notes: Half of the weight is assigned to international cooperation, national institutes, and nation-wide policies, and the other half is assigned to sectoral and cross-sectoral policies. Under the sectoral policies, different sectors are assigned weights as per their contribution to global emissions as reported by IPCC (2007) (see Steves and Teytelboym (2013) for further details). The databases used as sources are International Energy Agency (IEA) and International Renewable Energy Agency (IRENA) joint database for global renewable energy, IEA's energy efficiency database, IEA's policy database for buildings, transport, and other sectors, the national communication repository of the United Nations Framework Convention on Climate Change (UNFCCC), Climate Action Tracker (CAT), the climate change laws database of Grantham Research Institute on Climate change and the Environment, and UNEP DTU CDM/JI Pipeline Analysis and Database, and relevant webpages of national ministries and policy documents.

Table A2
Global coverage in the WVS survey

Countries	Wave 1	Wave 2	Wave 3	Wave 4	Wave 5	Wave 6
Albania			Yes	Yes		
Algeria				Yes		Yes
Andorra					Yes	
Argentina	Yes	Yes	Yes	Yes	Yes	Yes
Armenia			Yes			Yes
Australia	Yes		Yes		Yes	Yes
Azerbaijan			Yes			Yes
Bahrain						Yes
Bangladesh			Yes	Yes		
Belarus		Yes	Yes			Yes
Bosnia			Yes	Yes		
Brazil		Yes			Yes	Yes
Bulgaria			Yes		Yes	
Burkina Faso					Yes	
Canada				Yes	Yes	
Chile		Yes	Yes	Yes	Yes	Yes
China		Yes	Yes	Yes	Yes	Yes
Colombia			Yes		Yes	Yes
Croatia			Yes			
Cyprus					Yes	Yes
Czech Republic		Yes	Yes			
Dominical Republic			Yes			
Ecuador						Yes
El Salvador			Yes			
Egypt				Yes	Yes	Yes
Estonia			Yes			Yes
Ethiopia					Yes	
Finland	Yes		Yes		Yes	
France					Yes	
Georgia			Yes		Yes	Yes
Germany			Yes		Yes	Yes

(*continued on next page*)

Table A2 (*continued*)

Countries	Wave 1	Wave 2	Wave 3	Wave 4	Wave 5	Wave 6
Ghana					Yes	Yes
Great Britain			Yes		Yes	
Guatemala					Yes	
Hong Kong					Yes	Yes
Hungary	Yes		Yes		Yes	
India		Yes	Yes	Yes	Yes	Yes
Indonesia				Yes	Yes	
Iran				Yes	Yes	
Iraq				Yes	Yes	Yes
Israel				Yes		
Italy					Yes	
Japan	Yes	Yes	Yes	Yes	Yes	Yes
Jordan				Yes	Yes	Yes
Kazakhstan						Yes
Kuwait						Yes
Kyrgyzstan				Yes		Yes
Latvia			Yes			
Lebanon						Yes
Libya						Yes
Lithuania			Yes			
Macedonia			Yes	Yes		
Malaysia					Yes	Yes
Mali					Yes	
Mexico	Yes	Yes	Yes	Yes	Yes	Yes
Moldova			Yes	Yes	Yes	
Morocco				Yes	Yes	Yes
Montenegro			Yes	Yes		
Netherlands					Yes	Yes
New Zealand			Yes		Yes	Yes
Nigeria		Yes	Yes	Yes		Yes
Norway			Yes		Yes	
Pakistan			Yes	Yes		Yes
Palestine						Yes
Peru			Yes	Yes	Yes	Yes
Philippines			Yes	Yes		Yes
Poland		Yes	Yes		Yes	Yes
Puerto Rico			Yes	Yes		
Qatar						Yes
Romania			Yes		Yes	Yes
Russia		Yes	Yes		Yes	Yes
Rwanda					Yes	Yes
Saudi Arabia				Yes		
Serbia			Yes	Yes	Yes	
Singapore				Yes		Yes
Slovakia		Yes	Yes			
Slovenia			Yes		Yes	Yes
South Africa	Yes	Yes	Yes	Yes	Yes	Yes
South Korea	Yes	Yes	Yes	Yes	Yes	Yes
Spain		Yes	Yes	Yes	Yes	Yes
Sweden			Yes		Yes	Yes
Switzerland		Yes	Yes		Yes	
Tanzania				Yes		
Taiwan			Yes		Yes	Yes
Thailand					Yes	Yes
Trinidad and Tobago					Yes	Yes
Tunisia						Yes
Turkey		Yes	Yes	Yes	Yes	Yes
Uganda				Yes		
Ukraine			Yes		Yes	Yes
United States			Yes	Yes	Yes	Yes
Uruguay			Yes		Yes	Yes
Uzbekistan						Yes
Venezuela			Yes	Yes		
Vietnam				Yes	Yes	
Yemen						Yes
Zambia					Yes	
Zimbabwe				Yes		Yes

Table A3
Countries included in the baseline model

Algeria, Argentina, Armenia, Australia, Azerbaijan, Bangladesh, Belarus, Brazil, Burkina Faso, Canada, Chile, China, Colombia, Czech Republic, Ecuador, Egypt, El Salvador, Estonia, Ethiopia, Finland, France, Georgia, Germany, Ghana, Guatemala, Hungary, India, Indonesia, Iran, Iraq, Israel, Italy, Japan, Jordan, Kazakhstan, Korea, Rep., Kyrgyzstan, Latvia, Lebanon, Lithuania, Malaysia, Mali, Mexico, Moldova, Morocco, Netherlands, Nigeria, Norway, Pakistan, Peru, Philippines, Poland, Qatar, Romania, Russia, Rwanda, Saudi Arabia, Singapore, South Africa, Spain, Sweden, Tanzania, Thailand, Tunisia, Turkey, Uganda, Ukraine, the United Kingdom, the United States, Uruguay, Uzbekistan, Venezuela, Vietnam, Zambia, Zimbabwe

Table A4
Distinct measures of religiosity and stringency of climate change policies

Dependent variable = CCPS	(1)	(2)	(3)	(4)	(5)
	Religious person	Belief in God	Importance of God	Religious participation	Importance of religion
Religious person	−0.24** (−2.60)				
Belief in God		−0.19** (−2.67)			
Importance of God			−0.29*** (−3.28)		
Religious participation				0.004 (0.05)	
Importance of religion					−0.21*** (−2.91)
Religiosity index					
Real GDP per capita (log)	0.01 (0.53)	0.04 (1.56)	0.02 (0.88)	0.04 (1.32)	0.02 (0.80)
Globalization	0.01** (2.47)	0.00 (1.45)	0.01** (2.08)	0.01** (2.29)	0.01** (2.37)
Coal production per capita	2.55 (1.10)	3.12 (1.16)	1.14 (0.45)	1.04 (0.34)	0.04 (0.02)
Democracy	0.01*** (3.34)	0.01*** (3.02)	0.01*** (3.18)	0.01* (1.81)	0.01*** (3.24)
Institutions	−0.00 (−0.16)	0.02 (0.62)	−0.01 (−0.44)	0.02 (0.61)	−0.01 (−0.48)
Climate change perceptions	0.05 (0.53)	−0.03 (−0.24)	0.07 (0.71)	0.06 (0.58)	0.07 (0.69)
Standardized coefficient of interest	−0.28**	−0.24***	−0.36***	0.01	−0.31**
Region dummy	Yes	Yes	Yes	Yes	Yes
R^2	0.67	0.65	0.68	0.64	0.67
No. of observations	74	64	75	73	74

Notes: The region dummy variables are East Asia and Pacific, Europe and Central Asia, Latin America and the Caribbean, the Middle East and North Africa, North America, South Asia, and Sub-Saharan Africa. The sample is the set of observations for which data are available for CCPS, measures of religiosity, and all control variables. Robust standard errors are used. t-statistics are reported in parentheses. *, ** and *** indicate significance at the 10%, 5% and 1% levels. The intercept estimates are not shown.

Table A5
Sensitivity to religious affiliation interactions

Dependent Variable = CCPS	(1)	(2)
	Interaction effects for contemporary religious adherence	Interaction effects for historical religious adherence
Religiosity index	−0.32*** (−3.07)	−0.32*** (−2.86)
Religiosity index* Muslim fraction	0.03 (0.43)	
Religiosity index* Hindu fraction	−0.15 (−1.04)	
Religiosity index* Buddhist fraction	−0.31 (−1.67)	
Religiosity index* Jewish fraction	0.06 (0.61)	
Religiosity index* Folk and Other religions fraction	−0.36 (−1.84)	
Religiosity index* Muslim fraction		0.04 (0.40)
Religiosity index* Hindu fraction		−0.07 (−0.37)
Religiosity index* Eastern religion fraction		−0.28* (−1.84)
Religiosity index* Jewish fraction		−0.22 (−0.23)
Religiosity index* Other religions fraction		0.04 (0.33)
Baseline controls	Yes	Yes
Region dummy	Yes	Yes
R^2	0.69	0.69
No. of observations	75	75

Notes: Baseline controls include real GDP per capita, globalization index, coal production, democracy index, quality of institutions, and public perception of climate change. The fractions of religious adherence are not included individually to address multicollinearity problems. Robust standard errors are used. t-statistics are reported in parentheses. *, ** and *** indicate significance at the 10%, 5% and 1% levels. The intercept estimates are not shown.

Appendix B

Additional details for section 4.1.4: Our regression model can be summarized by using the illustrative model used by Oster (2019). We assume that the model which determines the stringency of climate change policies is: $CCPS_i = \beta\ Religiosity_i + W_1 + W_2 + \epsilon$, where the vector W_1 is the linear combination of observed controls multiplied by their coefficients (i.e., $W_1 = \psi\omega^0$, ω^0 is the vector of observed control), W2 is the unobserved index and ϵ is the random error term. It is assumed that W_1 is orthogonal to W_2 so that $Cov(W_1, W_2) = 0$, and the proportional selection assumption can be expressed as $\delta \frac{Cov(W_1,X)}{Var\ (W_1)} = \frac{Cov(W_2,X)}{Var\ (W_2)}$. δ is the degree of proportionality that shows how strongly unobservable variables are related to the main explanatory variable in comparison to the observable variables. Unit degree of proportionality (δ =1) would indicate the equal importance of observable and unobservable variables (i.e., equal correlation with main explanatory variable). R^2 obtained from the regression model mentioned above is R_{max}. R_{max} is an assumption about the R^2 value that considers both observed and unobserved variables. Since it depends on unobservables, it cannot be estimated and is defined as a theoretical population value.

Finally, as the coefficient of interest is not identifiable in the case of omitted variables, Oster (2019) suggests calculating the bias-adjusted coefficient (β^*) on the basis of estimated parameters ($\beta^{\sim}$, β^0, $R^{\sim}$, R^0),degree of proportionality (δ) and R_{max}. β^0 is the point estimate resulting from the regression of dependent variable on the explanatory variable with no additional controls and $R^0$is the respective R^2 value. $\beta^{\sim}$ is the main coefficient in the regression equation with additional control variables, $R^{\sim}$ is the respective R^2 value. Thus, β^*, the bias-adjusted coefficient is defined as:

$$\beta^* \approx \beta^{\sim} - \delta\left[\beta^0 - \beta^{\sim}\right]\frac{R_{max} - R^{\sim}}{R^{\sim} - R^0}$$

To calculate the bias-adjusted effects of religiosity, we need to assume the δ and R_{max} values.

Considering that the observed control variables in our study are carefully selected as potential determinants of the outcome variable (CCPS), it is less likely that unobservable variables will have a stronger effect on outcome variables than the observed variables (i.e.,$\delta > 1$). We thus make a unity proportionality selection ($\delta = 1$), i.e., the observed variables are as important as the unobserved variables. This is in line with the appropriate cut-off suggested by Oster (2019) and Altonji et al. (2005).

Given that R_{max} is bound between $R^{\sim}$ and 1, choosing R_{max}=1 is a possibility. Nonetheless, in most empirical settings, it is nearly impossible to achieve this maximum possible value of R^2, even with full set of observable and unobservable variables (e.g. due to idiosyncratic variations). We thus choose another reasonable bound suggested by Oster (2019), R_{max}=1.3 $R^{\sim}$. Oster (2019) notes that R_{max}=1.3 $R^{\sim}$ indicates a bound where the observable variables explain more than the unobservables. It is also important to highlight that R^2 values are particularly high in our study. We have around $R^{\sim}$=0.66, compared to many studies that use individual-level data, such as R_{max}= 0.169 in one of the empirical problems discussed in Oster (2019). Using the chosen R_{max} bound and proportionality selection, we first develop a set of bounds for β,and then we compute the value of δ which will cause $\beta = 0$.

Appendix C. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.eneco.2021.105414.

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