Acts of God? Religiosity and Natural Disasters Across Subnational World Districts

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Abstract

Religiosity potentially affects everything from fertility and health to labor force participation and productivity. But why are some societies more religious than others? One answer is religious coping: Individuals turn to religion to deal with times of hardship. This research combines individual-level data on religiosity across the globe with spatial data on natural disaster occurrences. One main finding is that individuals become more religious if their district was recently hit by an earthquake. Even though the effect abates with time, data on children of immigrants reveals a persistent effect across generations. The results point to religious coping as the main mediating channel, as opposed to, for instance, economic insurance or selection. The findings may help explain why religiosity has not declined worldwide as the secularisation hypothesis has otherwise suggested.

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1 Introduction

83% of the world population believe in God. This covers large variation across countries from 20% in China to 100% in Algeria and Pakistan, which again covers large differences *within* countries: The share of believers in China varies from 2% in Shanghai to 60% in the Fujian province.[1] These differences in religiosity matter for various economic outcomes, such as fertility, labour force participation, education, crime, redistribution policies, health, and even such aggregate outcomes as GDP per capita growth.[2] A first order question is thus: Why are some societies more religious than others?

This study tests whether the religious coping hypothesis can contribute with an answer. The hypothesis states that individuals draw on religious beliefs and practices to understand and deal with unbearable situations.[3] Examples are seeking a closer relationship with God, praying, attempting to be less sinful, or finding a reason for the event by attributing it to an act of God. According to the religious, coping with life stressors is one of the main purposes of religion,[4] and theoretically religion can be used in coping within all major religions. Indeed, philosophers such as Karl Marx and Sigmund Freud maintained that *all* religions evolve to provide individuals with a higher power to turn to in times of hardship.[5] Religious coping may even explain why religion has not declined in many places of the world today as the secularization hypothesis otherwise suggests.[6]

To test the religious coping hypothesis, this research exploits natural disasters as exogenous variation in adverse life events.[7] Data on natural disasters are combined with a global dataset on religiosity, available for 190,000 individuals interviewed in 85 countries

[1] Source: The pooled World Values Survey and European Values Study 2004-2014.

[2] See Guiso *et al.* (2003), Scheve & Stasavage (2006), McCleary & Barro (2006), Gruber & Hungerman (2008), and Campante & Yanagizawa-Drott (2015) for empirical investigations or Iannaccone (1998), Lehrer (2004), and Kimball *et al.* (2009) for reviews.

[3] E.g., Pargament (2001), Cohen & Wills (1985), Park *et al.* (1990), Williams *et al.* (1991). The terminology "religious coping" is taken from the psychology literature, but other labels have been used. For instance, religious buffering, the religious comfort hypothesis, and psychological social insurance.

[4] Clark (1958) and Pargament (2001).

[5] Feuerbach (1957), Freud (1927), Marx (1867).

[6] According to the secularization hypothesis, societies will become less religious as they modernise. Norris & Inglehart (2011) show that while religion has declined in importance in many Western countries, it has increased in importance in other places of the world, leading to a net-increase in the number of people with traditional religious views during the past fifty years. See also Stark & Finke (2000) and Iannaccone (1998).

[7] The religious coping literature broadly agrees that religion is mainly used to cope with negative events rather than positive (e.g., Bjorck & Cohen (1993), Smith *et al.* (2000)).

(the pooled World Values Survey and European Values Study, WVS-EVS). Measures of religiosity include answers to questions such as "How important is God in your life?" and "Are you a religious person?" The WVS-EVS data has information on the subnational district of a country in which the interviews took place, which allows inclusion of country fixed effects in the econometric analysis. This means that religiosity is compared only *within* countries, not across. The main measure of natural disasters is earthquakes, as earthquakes have proven impossible to predict and since data on earthquakes is remarkably reliable.[8] Across 600-850 subnational districts of the world, the analysis documents that individuals living in districts more frequently hit by earthquakes are more religious than those living in areas with fewer earthquakes. The result is robust to adding controls for country-by-year fixed effects, various individual characteristics, and district-level geographic and economic confounders. Similar results obtain for other unpredictable major disasters such as volcanic eruptions and tsunamis. The phenomenon applies to individuals belonging to all major denominations and living on every continent. The size of the effect amounts to 70% of the well-established gender difference in religiosity.

A central concern is that important district-level factors are left out of the analysis, biasing the results. To address this, the time-dimension of the data is exploited to construct a panel where district-level religiosity is followed over time. The analysis reveals that district-level religiosity increases in response to recent earthquakes. The result is robust to adding country-by-year fixed effects, individual level controls, and rather comforting, future earthquakes have no impact on current levels of religiosity. Consistent with a literature on dynamic effects of various shocks on cultural values, the short-term spike in religiosity after an earthquake abates with time. That earthquakes can still, in the modern world, instigate intensified believing is illustrated by a Gallup survey conducted in the aftermath of the great 1993 Mississippi River floods, which asked Americans whether the recent floods were an indication of God's judgement upon the sinful ways of the Americans. 18 % answered in the affirmative (Steinberg (2006)).

To investigate whether a persistent residual impact remains, the last part of the analysis combines data on children of immigrants in Europe with earthquake risk in their parents' country of origin. Children of immigrants with parents from countries with high

[8] Fisker (2012). Other types of disasters such as wars, economic crises, and epidemic diseases are endogenous to various factors and thus unsuitable as natural experiments.

earthquake risk are more religious than those from low earthquake risk areas, independent of actual earthquake risk and level of religiosity in their current country of residence. It seems that living in high-earthquake risk areas instigates a culture of religiosity that is passed on to future generations like many other cultural values.

The analysis proceeds to investigate the mechanism through which earthquakes influence religiosity. This is done by validating the results against insights from the religious coping literature and alternative explanations. It turns out that the uncovered results are consistent with a psychological mechanism and not with other explanations involving direct economic loss, migration/selection, or a special culture evolving in high-risk areas.

The paper is structured as follows. The literature on religious coping is reviewed in more detail in Section 2, where the contributions of the current paper are emphasized and testable predictions are formed. The empirical link between long-term earthquake risk and religiosity is investigated in Section 3. The short-term response to actual earthquakes is investigated in Section 4. Section 5 investigates persistence across immigrants. Thereafter, the results are validated against the religious coping literature and alternative explanations in Section 6. Section 7 concludes.

2 Related literature

2.1 Religious coping

Existing empirical evidence on religious coping shows that individuals hit by various adverse life events, such as cancer, heart problems, death in close family, alcoholism, divorce, or injury are more religious than others.[9] In addition, prayer is often chosen by various hospitalised patients as a coping strategy above seeking information, going to the doctor, or taking prescription drugs (Conway (1985)). This literature faces the major challenge that being hit by adverse life events is most likely correlated with unobserved individual characteristics (such as lifestyle), which in turn may matter for the individual's inclination to be religious.[10] The current study exploits exogenous shocks to adverse life events to address this challenge.

[9]See e.g., Ano & Vasconcelles (2005) and Pargament (2001) for reviews.

[10]Psychologists have also argued that an endogeneity problem exists, see e.g. Norenzayan & Hansen (2006).

Norenzayan & Hansen (2006) addressed the endogeneity concern in a controlled experiment of 28 undergraduate students from the University of Michigan. They primed half of the students with thoughts of death by having them answer questions such as "What will happen to you when you die?" and the other half with neutral thoughts with questions such as "What is your favourite dish?" After the experiment, the students primed with thoughts of death were more likely to reveal beliefs in God and to rank themselves as more religious. While solving the endogeneity issue, the study's external validity is challenged by the very small sample. Indeed, much of the remaining literature faces the additional challenge of small samples that mainly encompass Westerners. Yet, the theory is that religious coping is not something peculiar to Christianity. For instance, Pargament (2001) notes that (p3) "*While different religions envision different solutions to problems, every religion offers a way to come to terms with tragedy, suffering, and the most significant issues in life.*" The dataset in the current study encompasses the globe at large, and thus this assertion can be tested.

This study is not the first to relate natural disasters to religiosity. Indeed, the belief that natural disasters carried a deeper message from God was the rule rather than the exception before the Enlightenment (e.g., Hall (1990), Van De Wetering (1982)). Later, the famous 1755 Lisbon earthquake has been compared to the Holocaust as a catastrophe that transformed European culture and philosophy.[11] Penick (1981) documents more systematically that US states hit by massive earthquakes in 1811 and 1812 saw church membership increase by 50% in the following year, compared to an increase of only 1% in remaining states. More recently, Sibley & Bulbulia (2012) found that religious conversion rates increased more in the Christchurch region after the large earthquake in 2011, compared to the remaining four regions of New Zealand. While not investigating religion directly, Belloc *et al.* (2016) document an impact of earthquakes on autocracy across Medieval Italian city states and interpret the finding as caused by religious coping.

While these studies interpret the mechanism as a psychological one, this is not investigated vis-a-vis alternative explanations. Other researchers have attempted to pin down

[11] See review by Ray (2004). In addition to being one of the deadliest earthquakes ever, it struck on an important church holiday and destroyed many important churches in Lisbon, but spared the red light district. Accordingly, many thinkers associate the earthquake with the *decline* in religiosity across Europe afterwards. According to religious coping theory, shocks can both instigate leaving God and embracing him. Empirics show that the latter is the most common reaction (e.g., Pargament (2001)).

the mechanism by asking victims directly. For instance, Schuster *et al.* (2001) found that 90% of the surveyed Americans reported that they coped with their distress after the September 11 attack in 2001 by turning to their religion. Likewise, Smith *et al.* (2000) found that many of the victims of the 1993 Mississippi River floods reported that religious stories, the fellowship of church members, and strength from God helped them endure and survive the flood. Arguably, these are rather specific events and individuals' own account of their intensions may be inaccurate. Thus, further analysis is needed to identify the mechanism.

The current analysis attempts instead to reveal the mechanism by testing predictions from the literature on religious coping against predictions from alternative explanations. First, unforeseeable life events are more likely to instigate religious coping compared to more foreseeable events.[12] On the contrary, foreseeable events, such as an approaching feared exam or a devastating storm, are more likely to ignite problem-focused coping. This type of coping strategy attempts to alter the source of the stress, for instance by studying harder or getting the car ready to leave.[13] On the other hand, religious coping is an example of emotion-focused coping, which aims at reducing or managing the emotional distress arising from a situation. In the present analysis, major geophysical and meteorological disasters are grouped in terms of predictability. For instance, meteorologists have a much easier time predicting storms than seismologists have in predicting earthquakes.[14] Earthquakes are further grouped into more or less surprising ones, where the latter are those hitting areas frequently hit in general. Consistent with the religious coping literature, surprising disasters increase religiosity more than less surprising ones for equal amount of damage.

[12]E.g., Norris & Inglehart (2011), Sosis (2008), Park *et al.* (1990). Skinner (1948) found that this reaction to unpredictability extends into the animal world. He found that pigeons subjected to an unpredictable feeding schedule were more likely to develop inexplicable behaviour, compared to the birds not subject to unpredictability. Since Skinner's pioneering work, various studies have documented how children and adults in analogous unpredictable experimental conditions quickly generate novel superstitious practices (e.g., Ono (1987)). This concept is termed the uncertainty hypothesis.

[13]See also Mattlin *et al.* (1990) on how practical everyday problems are less likely to trigger religious coping compared to large bad events.

[14]The US Geological Survey (USGS) notes that earthquakes cannot be predicted (https://www2.usgs.gov/faq/categories/9830/3278). See also this post about our ability to forecast storms and their paths, as opposed to our inability to forecast earthquakes: https://www.tripwire.com/state-of-security/risk-based-security-for-executives/risk-management/hurricanes-earthquakes-prediction-vs-forecasting-in-information-security/

Another finding in the literature on religious coping, exploited to investigate the mechanism, is that intrinsic religiosity is used to cope with adverse life events to a larger extent than extrinsic religiosity (e.g., Johnson & Spilka (1991), review by Pargament (2001)). Intrinsic religiosity involves private prayer and ones personal relation to God, while extrinsic religiosity means using religion to achieve non-religious goals and thus does not necessarily indicate religious *beliefs*. While a person with an intrinsic religious orientation believes in his/her religion (to a larger or smaller extent), an example of extrinsic religiosity is a person going to church to gain food or shelter. Koenig *et al.* (1988) found that the most frequently mentioned coping strategies among 100 older adults dealing with three stressful events were faith in God, prayer, and gaining strength from God. Social church-related activities were less commonly noted. Similarly, a medical study by Miller *et al.* (2014) found that individuals for whom religion is more important in their lives experienced reduced depression risk (measured by cortical thickness), while frequency of church attendance was not associated with thickness of the cortices.[15] The available data on religiosity allows testing the differential effects of earthquakes on intrinsic versus extrinsic religiosity. Intrinsic religiosity is affected in the short run, while churchgoing is not. In the longer term, both types of religiosity are affected, but intrinsic religiosity is more robust to various checks.

Other studies have investigated the impact of other shocks on religiosity, such as unemployment and divorce (Clark & Lelkes (2005)), rainfall variability (Ager & Ciccone (2014)), and financial crisis (Chen (2010)). The latter two studies explain the effect on religiosity by the economic effects of the shocks. The current study shows that disasters can influence religiosity globally, even in areas that do not necessarily suffer economically.

2.2 Broader literature

This study relates more broadly to a growing literature investigating the endogenous emergence of potentially useful beliefs. This literature has linked differences in gender roles to past agricultural practices (Alesina *et al.* (2013), Hansen *et al.* (2015)), individualism to past trading strategies (Greif (1994)), trust to the slave trade in Africa, historical literacy, institutions, and climatic risk (Nunn & Wantchekon (2011), Tabellini (2010),

[15] Koenig *et al.* (1998) found that time to remission was reduced among 111 hospitalised individuals engaging in intrinsic religiosity, but not for those engaging in church going.

Durante (2010)), anti-Semitism to the Black Death and temperature shocks (Voigtländer & Voth (2012), ?), and time preference to geographical variation in land productivity (Galor & Özak (2016)). The current study links a cultural value with evident implications for economic outcomes (religiosity) to one of its potential roots; disaster risk.

3 Cross-section analysis

This part of the empirical analysis investigates whether individuals living in areas with higher long-term earthquake risk are more religious.

3.1 Data on religiosity

The data on religiosity used in the main analysis (Sections 3.3 and 4) is the pooled World Values Survey (WVS) and European Values Study (EVS) carried out for 6 waves in the period 1981-2009.[16] This dataset includes information on 424,099 persons interviewed in 96 countries.

The individuals in the pooled WVS-EVS were asked several questions about cultural values, including their religious beliefs. Inglehart & Norris (2003) single out six measures that span global variation in religiosity. These are listed in Table 1 and the particular questions are (when nothing else is indicated, these are dummy variables with 1="yes", 0="no"): (1) How important is God in your life? (0="not at all important",..., 10="very important"), (2) Do you get comfort and strength from religion?, (3) Do you believe in God?, (4) Are you a religious person? (1="not a religious person", 2="religious person"), (5) Do you believe in a life after death?, and (6) How often do you attend religious services? (1="Never, practically never", ..., 7="More than once a week").[17] All measures

[16] Available online at http://www.worldvaluessurvey.org and http://www.europeanvaluesstudy.eu. Since the first revision of this paper, an additional wave came out (2010-2014) for some of the religiosity measures. However, the subnational district names in the pooled WVS-EVS 1981-2009 do not match the names in the new wave. Country-aggregates are shown including the recent wave, but not all six main religiosity measures are available in the new wave, which means that the results using the composite measure will be unaltered.

[17] The original variables are: (1): f063, (2): f064, (3): f050, (4): f034, (5): f051, and (6): f028. An earlier version of this paper includes additional measures of religiosity, arriving at the same conclusions. The original variable f034 also had a category for convinced atheists. Following Inglehart & Norris (2003), people who rank themselves as not religious or atheist were grouped into one category, as there are very few respondents in the latter group. The original variable f028 had 8 categories: More than once a week; once a week; once a month; only on special holy days/Christmas/Easter; other specific

were rescaled to lie between 0 and 1.

Table 1. Summary statistics of the main religiosity measures

	Data with district information		Full WVS-EVS dataset	
Measure	N	Mean	N	Mean
How important is God in your life?[i]	203,514	.728	396,596	.680
Are you a religious person?	197,137	.711	385,416	.702
How often do you attend religious services?[i]	201,674	.492	398,237	.468
Do you find comfort in God?	130,384	.738	287,553	.682
Do you believe in God?	134,201	.868	293,537	.838
Do you believe in life after death?	123,968	.645	271,632	.601

Notes. The unit is an individual. All variables, except those marked with an i, are indicator variables. The two first columns show summary statistics for the dataset where information on the subnational district in which the individual was interviewed is available. The two last columns show the entire pooled WVS-EVS 1981-2009 dataset.

Whether or not these measures of religiosity are comparable across countries is not an issue in the current analysis, as information on the subnational district in which the interview took place is exploited in order to include country fixed effects throughout. In addition, the event study adds district fixed effects, meaning that here the measures are only compared across time within each district. Information on the subnational district is available for half of the respondents. The main sample thus includes 212,157 individuals from 914 districts in 85 countries, covering most of the inhabited parts of the world, depicted in Appendix Figure A1.[18]

Table 1 shows summary statistics for the six religiosity measures in the sample with information on the subnational district in which the interview took place in the first two columns and the full WVS-EVS dataset in the last two columns. Religiosity levels

holy days; once a year; less often; never, practically never. The two categories "only on special holy days/Christmas/Easter" and "other specific holy days" were aggregated due to few observations in the latter and since it is not obvious how to rank the two.

[18]The number of districts in a country ranges from 2 to 41. The mean (median) number of districts per country is 15.9 (14). The average (median) district has 766 (466) respondents in total, or 335 (235) respondents per year of interview. Throughout, only districts with more than 10 respondents in each year are included in the estimations. Including the full set of districts does not alter the results, neither does restricting the required number of respondents further, or weighting the results with the number of respondents (Appendix B.3).

are similar in the two samples: For instance, 84-87% of the respondents believe in God, 61-65% believe in life after death.

The main results are shown for all six measures of religiosity and two composite measures: Factor component analysis is performed on all six measures to construct Inglehart & Norris (2003)'s *Strength of Religiosity Scale (SRS)*, and to construct the *Strength of Intrinsic Religiosity Scale (SIRS)* which aggregates all measures except churchgoing. The two aggregated scales correlate with 0.987. Some robustness checks involve changing many parameters, so in order to keep the tables from exploding in size, the preferred composite measure, *SIRS*, is used.[19] This measure excludes mechanisms that involve churchgoing, and is thus the most direct test of the religious coping effect.

The six measures also differ in terms of whether they measure the intensive margin or the extensive margin of religious beliefs. While importance of God and church attendance measure the *degree* of believing or churchgoing, the remaining measures all indicate the extensive margin; *whether or not* these individuals rate themselves as believers or not. While the religious coping literature finds evidence for effects along both margins, conversion rates are harder to influence than the degree of believing. This is also the expectation regarding the effect of earthquakes.

The data on religiosity used in the study of children of immigrants is described in Section 5.

3.2 Data on long-term earthquake risk

The main measure of earthquake risk in the cross-district study (Section 3.3) and the persistency study (Section 5) is based on data on earthquake zones, provided by the United Nations Environmental Programme as part of the Global Resource Information Database (UNEP/GRID) and depicted in Figure 1.[20] Earthquake risk is divided into 5 categories, 0-4, based on various parameters such as ground acceleration, duration of earthquakes, subsoil effects, and historical earthquake reports. The intensity is measured on the Modified Mercalli (MM) Scale and the zones indicate the probability that an

[19] A previous version of the paper used the Strength of Religiosity Scale throughout producing very similar results.

[20] Data is available online at http://geodata.grid.unep.ch/. Data on, e.g., losses from natural disasters would be inappropriate for the current analysis, as losses are highly endogenous to economic development, which in itself might correlate with religiosity.

earthquake of a certain size hits the particular grid cell within the next 50 years. Zone zero indicates earthquakes of size moderate or less (V or below on the MM Scale), Zone one indicates strong earthquakes (VI on the MM Scale), Zone two indicates very strong (VII), three indicates severe (VIII), and Zone four indicates violent or extreme earthquakes (IX or X).

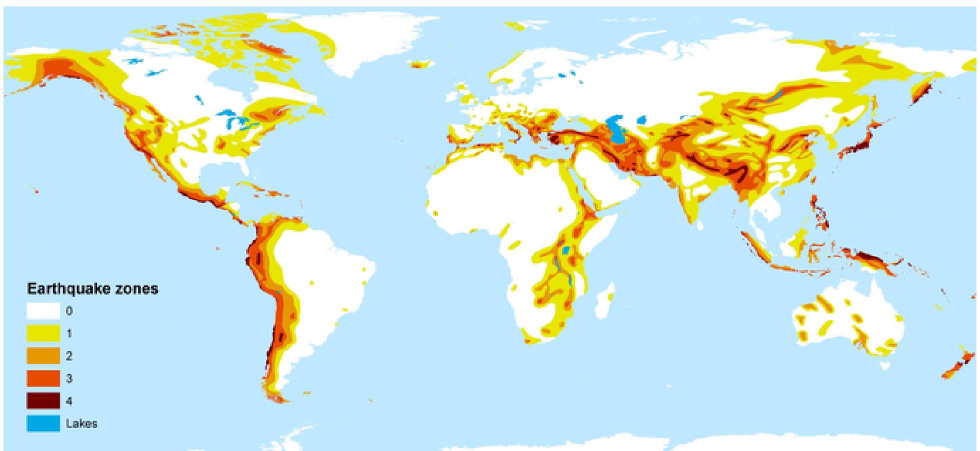


Figure 1. Earthquake zones

Notes. Darker colour indicates higher earthquake risk. Zones described in the text. Source: UNEP/GRID

The individual-level data on religiosity is matched to the earthquake risk data at the subnational district level, which encompass first administrative units from ESRI.com. Using ArcGIS software, the main measure of long-term earthquake risk, $dist(earthquakes)_{dc}$, is calculated as the geodesic distance from the border of subnational district d within country c to the closest high-intensity earthquake zone. The choice of "high-intensity" is a balance between choosing zones that are represented in as many parts of the world as possible and choosing zones with high enough risk to potentially matter for peoples' lives. In an attempt to maximize both precision and relevance, the two top earthquake zones (3 and 4) are defined as high intensity zones in the main analysis. Thus, $dist(earthquakes)_{dc}$ measures the distance from district borders to zones 3 or 4 (dark red and dark orange on the map). The results are robust to choosing different high-intensity zones and also to taking the logarithm of the distance (Appendix B.2).

Another measure of earthquake risk is the average value of earthquake zones across pixels in a district, $mean(earthquakes)_{dc}$, which correlates with $dist(earthquakes)$ with

-0.65. Results hold using $mean(earthquake)$ (Appendix B.2), but there are reasons to prefer the distance measure. Take two districts with $mean(earthquake) = 0$. One district neighbours a district that is hit frequently by earthquakes, while the other is located, say, 2000 km from the nearest high-intensity earthquake zone. The inhabitants of the former are arguably more aware of earthquakes and perhaps used to live in the neighbouring high-risk district or have family members there. Earthquakes probably play a minor role in the lives of the inhabitants of the district located far from the high risk earthquake zone. In addition, $mean(earthquake)$ varies only little within countries for many countries. Further, different disaster measures can be more easily compared when using distances. For instance, the data on earthquake-, storm-, and volcanic eruption- risk are based on zones, while the tsunami data are based on instances of tsunamis. It is not clear how to construct a mean measure for the latter that is comparable with the zones data. Last, $dist(earthquakes)$ wins the horse race between the two when included simultaneously (Appendix B.2).

Based on the distance measure, the district with the lowest earthquake risk in the sample is a region on the Eastern tip of Brazil (Paraíba), located 3,355 km from the nearest high-intensity earthquake zone. Examples of districts located within earthquake zones 3 or 4 are Sofia in Bulgaria, the Kanto region of Japan, and Jawa Tengah in Indonesia. The mean (median) distance to earthquake zones 3 or 4 is 441 (260) km.

3.3 Analysis

Whether individuals are more religious when living in areas hit more frequently by earthquakes is tested using equations of the form:[21]

$$religiosity_{idct} = \alpha + \beta earthquakerisk_{dc} + \gamma_{ct} + X'_{dct}\eta + Z'_{idct}\delta + \varepsilon_{idct}, \tag{1}$$

where $religiosity_{idct}$ is the level of religiosity of individual i interviewed in subnational district d within country c at time t, $earthquakerisk_{dc}$ is long-term earthquake risk in district d of country c. The *baseline controls* include country-by-year-of-interview fixed effects (γ_{ct}), a vector of standard individual level controls (Z_{idct}): age, age squared, sex,

[21] The original country weights provided by the pooled WVS-EVS are used throughout (variable s017). The estimates are similar without weights.

and marital status, and district-level controls (X_{dct}) for distance to the coast, absolute latitude, and dummies for actual earthquakes in year t and year t-1.[22] Distance to the coast is added to account for the fact that high-risk earthquake zones are often clustered around coastal areas, since most tectonic plates meet in the ocean. Absolute latitude is added as a catch-all control for geographic confounders at the district level. Actual recent earthquakes are added to ensure that the long-term results are not caused by or blurred by short-term effects.

Additional controls included are: Individual level controls for eight education dummies, ten income decile dummies, unemployment status, trust, and eleven alternative cultural values, and district level controls for district area, population density, arable land, average temperature, average precipitation level and variation, lights per square km, and dummies for actual earthquakes up to ten years ago (Panel B of Table 2, Appendix B.4 and B.6).

The estimate of β may still be biased by omitted confounders, which is the motivation for the event study in Section 4.

Panel A of Table 2 shows results from estimating equation (1) for the six measures of religiosity and the two composite measures, Strength of Religiosity Scale (column 7) and the Strength of Intrinsic Religiosity Scale (column 8), including the baseline set of controls throughout (the same conclusion is reached without controls, Appendix B.5). The measure of long term earthquake risk is distance to nearest high intensity earthquake zone, $dist(earthquakes)$. People living in areas with high earthquake risk are more religious, independent of the choice of religiosity measure.[23]

[22] These are earthquakes of magnitude 6 or above hitting within 100 km of the district border. The data on earthquake events is described in Section 4.1.

[23] The conclusions are unchanged using probit or ordered probit estimation and for six additional measures of religiosity (see a previous version of the paper).

Table 2. OLS of Religiosity on Earthquake risk

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Dependent variable:	impgod	relpers	service	comfort	believe	afterlife	SRS	SIRS
Panel A. Baseline results								
Dist(earthq), 1000km	-0.052***	-0.044**	-0.035**	-0.059***	-0.035**	-0.115***	-0.062***	-0.063***
	(0.014)	(0.019)	(0.015)	(0.020)	(0.018)	(0.026)	(0.016)	(0.016)
	[0.015]	[0.022]	[0.018]	[0.026]	[0.021]	[0.028]	[0.016]	[0.017]
	[0.011]	[0.016]	[0.012]	[0.017]	[0.015]	[0.020]	[0.013]	[0.013]
Observations	198,264	192,120	196,860	126,195	129,910	120,072	103,282	104,040
R-squared	0.407	0.208	0.278	0.263	0.226	0.202	0.337	0.325
Districts	884	880	868	611	592	592	591	591
Countries	85	84	83	67	66	66	66	66
Panel B. Adding controls for district level development and dummies for individual education								
Dist(earthq), 1000km	-0.053***	-0.049**	-0.036**	-0.055***	-0.038**	-0.118***	-0.064***	-0.065***
	(0.014)	(0.020)	(0.015)	(0.020)	(0.018)	(0.026)	(0.016)	(0.017)
Observations	187,770	180,656	185,141	117,021	121,469	112,453	97,033	97,523
R-squared	0.400	0.195	0.276	0.252	0.233	0.211	0.339	0.329
Districts	869	866	854	586	578	578	577	577
Panel C. Excluding districts with high earthquake risk								
Dist(earthq), 1000km	-0.039***	-0.041**	-0.029*	-0.058***	-0.037*	-0.106***	-0.055***	-0.058***
	(0.014)	(0.021)	(0.016)	(0.022)	(0.020)	(0.026)	(0.017)	(0.018)
Observations	167,430	162,276	165,571	103,071	106,076	97,917	84,418	84,975
R-squared	0.408	0.199	0.291	0.268	0.232	0.195	0.340	0.327
Districts	748	744	732	506	488	488	487	487
Panel D. Adding a squared term								
Dist(earthq), 1000km	-0.091***	-0.087***	-0.064**	-0.087***	-0.058**	-0.166***	-0.083***	-0.088***
	(0.023)	(0.032)	(0.025)	(0.034)	(0.027)	(0.040)	(0.025)	(0.027)
Dist(earthq) squared	0.023***	0.025**	0.017**	0.023	0.019	0.041**	0.017	0.020
	(0.007)	(0.010)	(0.008)	(0.020)	(0.014)	(0.017)	(0.013)	(0.014)
Observations	198,264	192,120	196,860	126,195	129,910	120,072	103,282	104,040
R-squared	0.407	0.208	0.279	0.263	0.226	0.202	0.337	0.325
Impact at 500 km	-0.0793	-0.0746	-0.0557	-0.0759	-0.0491	-0.145	-0.0743	-0.0775
Baseline controls	Y	Y	Y	Y	Y	Y	Y	Y

Notes. OLS estimates. The unit of analysis is an individual. The dependent variables are the six measures of religiosity listed in Table 1 and their composite measures (the Strength of Religiosity Scale in col 7 and the Strength of Intrinsic Religiosity Scale in col 8). Dist(earthquake) measures the distance in 1000 km to the nearest high-intensity earthquake- zone. Baseline controls are included throughout and described under equation (1). Panel A includes only the baseline controls. Panel B adds 8 education FE and district level light density. Panel C excludes all districts located in high earthquake risk zones. Panel D includes a squared term of earthquake risk. All columns include a constant. Standard errors are clustered at the level of subnational districts in parenthesis, at the country level in the first set of squared brackets, and Conley' s(1999) standard errors are provided in the second set of squared brackets (cutoff = 500 km).

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

RESULTS: Districts more frequently hit by earthquakes are more religious, even controlling for actual recent earthquakes and development. And also when excluding districts frequently hit by earthquakes.

According to the secularization hypothesis (e.g., Inglehart & Baker (2000)), development may influence an individual's degree of believing. At the same time, earthquakes may affect local development, which could be what is driving the results. The literature is inconclusive about the effect of earthquakes on economic outcomes (see e.g., Ahlerup (2013) for a positive effect, Cavallo *et al.* (2013) for a negative impact). Nevertheless, Panel B of Table 2 adds proxies for individual and district level development: Dummies indicating individuals' education levels, where 1 indicates "Inadequately completed elementary education" and 8 indicates "University with degree / Higher education" and lights visible by night per square km based on NASA's pixel level lights data, widely used in recent research as a proxy for local development. As expected, the wealthier the district and the more educated the individual is, the lower the level of religiosity (not shown here). The impact of earthquake risk on religiosity remains unchanged. One should interpret these results with caution, though, as education and income are potentially endogenous to religiosity. The pooled WVS-EVS dataset also includes a variable measuring individual income deciles, but only for a subset of respondents. Disaster risk continues to have a positive effect on all measures of religiosity when ten dummies for income deciles are included (Appendix B.6). The effect is significant for all measures, except for beliefs in God, which may be a deeper dimension of religiosity, harder to influence (the reason for insignificance could also simply be smaller sample). The result persists after including alternative measures of development; unemployment status, population density, and share of arable land (Appendix B.6).

Panel C excludes the districts located within high-risk earthquake zones (zones 3 and 4 on the map in Figure 1). The results are not driven by these districts.

Panel D checks the linearity of the effect of earthquake frequency on religiosity. Even if the religious coping hypothesis was true, we would not expect that individuals in districts located 2,000 km from an earthquake zone are more religious than those living in districts located 2,100 km away. Both of these districts are located sufficiently far from earthquake zones that 100 km should not matter much. Panel D confirms the diminishing impact of distance across all religiosity measures, but only significantly for the three religiosity measures with most observations (columns (1)-(3)) and for answers to "Do you believe in an Afterlife?".[24]

[24] A previous version of this paper checks the linearity by excluding districts in increments of 500 km

The estimated standard errors in parenthesis in Table 2 are clustered at the subnational district level to account for potential spatial dependence. Clustering at the country-level produces similar results, shown in the first set of squared brackets in Panel A. And so does using instead Conley (1999)'s standard errors, shown in the second set of squared brackets. A more conservative way to account for spatial dependence at the district (country) level is to average religiosity across districts (countries). Whichever method is used, religiosity continues to be significantly higher in districts (countries) with higher earthquake frequency (added variable plots in Appendix B.7). The added variable plots further reveal that the aggregated results are not driven by individual observations.

Taking the estimate in column (8) of Table 2, Panel A at face value, individuals living in districts located 1,000 km closer to a high-risk earthquake zone are 6.3 percentage points more religious. This difference in religiosity amounts to the difference between Canada (median religiosity) and Chile (66^{th} percentile). The mean level of religiosity in the sample is 77.5% (based on the SIRS measure) and the mean distance to high risk earthquake zones is 360 km. Regarding the relative magnitude of the effect, the estimate on earthquake distance amounts to 70% of the estimate on the male dummy.[25] Thus, the impact also seems economically significant.

3.4 Alternative disasters

One concern is that there is something special about earthquakes that drives the results. Table 3 shows the impact on religiosity of the four main geophysical and metereological disasters: Earthquakes, tsunamis, volcanic eruptions, and tropical storms.[26] The measure of religiosity is the Strength of Intrinsic Religiosity Scale. All columns include the full set of baseline controls. Column (1) reproduces the main result using earthquake frequency. Distance to tsunamis has a similar effect on religiosity as earthquakes (column 2). Column (3) includes the average distance to earthquakes and tsunamis:

from earthquake zones. The same conclusion is reached.

[25] While it is statistically infeasible to estimate standardized beta coefficients with clustered standard errors, the standardized beta coefficients from the un-clustered estimation can be compared in size. Performing this exercise for column (8) of Panel A in Table 2 yields $\frac{beta_{dist(earthq)}}{beta_{male}} = \frac{-0.093}{-0.137} = 0.68$.

[26] These are the worst types of geophysical and meteorological disasters across the globe based on the map of natural disasters from Munich Re (www.munichre.com). The correlation between distance to earthquake zones and the other measures are: 0.457 (volcanic eruptions), 0.381 (tsunamis), and 0.196 (storms), respectively. All disaster data are described in Appendix B.9.

$\frac{dist(earthquakes)+dist(tsunamis)}{2}$, whereas column (4) includes the minimum distance to either of the two: $min(dist(earthquakes), dist(tsunamis))$. People are affected more if they live in an area hit by both tsunamis and earthquakes, compared to an area hit by only one of the two.

Column (5) includes volcanic eruptions. While the sign of the estimate is still negative, it is not significantly different from zero, probably because volcanic eruptions hit too few districts of the world to leave an average effect. The absolute size of the estimate increases threefold when restricting the sample to districts located within 1000 km of a volcanic eruption zone, becoming statistically different from zero.

The impact of storms on religiosity is indistinguishable from zero in the full sample and also after restricting the sample to districts located within 1000 km of a storm zone (columns 7 and 8). This latter finding is consistent with the religious coping literature (see Sections 2 and 6).

Table 3. Varying disaster measures

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Disaster:	Earthq	Tsunami	Avg	Min	Volcano	Volcano	Storm	Storm
Dependent variable: Strength of Intrinsic Religiosity Scale								
Dist(disaster)	-0.063***	-0.067***	-0.094***	-0.089***	-0.008	-0.026**	-0.014	0.012
	(0.016)	(0.017)	(0.021)	(0.019)	(0.007)	(0.013)	(0.014)	(0.029)
Observations	104,040	104,040	104,040	104,040	104,040	59,132	104,040	38,643
R-squared	0.325	0.326	0.326	0.326	0.325	0.333	0.325	0.328
Baseline controls	Y	Y	Y	Y	Y	Y	Y	Y
Sample	Full	Full	Full	Full	Full	<1000 km	Full	<1000 km
Districts	591	591	591	591	591	321	591	129

Notes. OLS estimates. The dependent variable is the Strength of Intrinsic Religiosity Scale. The disaster measure is distance to earthquake zones 3 or 4 in column (1), tsunamis in column (2), the average distance to earthquake zones and tsunamis in column (3), the minimum distance to earthquake zones or tsunamis in column (4), distance to volcanic eruption zones in columns (5) and (6), and distance to tropical storm zones in columns (7) and (8). The sample is restricted to districts within 1000 km of high risk disaster zones in columns (6) and (8). All disaster data are described in Appendix B.9. All columns include a constant. Standard errors (in parenthesis) are clustered at the level of subnational districts. Asterisks ***, **, and * indicate significance at the 1, 5, and 10% level, respectively.

RESULTS: Elevated long-term risk of earthquakes, tsunamis, and volcanic eruptions increase religiosity. Storm risk does not.

3.5 Further robustness checks

The analysis reveals that inhabitants of all continents respond to higher earthquake risk by elevated believing (Appendix B.8, where earthquake risk is interacted with dummies for each continent). Likewise for all followers of the major religions represented in the data (Christians, Muslims, and Hindus).[27] Furthermore, there is no significant difference in the size of the impact across denominations, except that Catholics respond significantly less than the rest in terms of increased believing.[28]

The effect of earthquakes is similar across people with different incomes or education, and across individuals living in districts with different average light intensity (Appendix B.11, where earthquake risk is interacted with these development indicators). The effect *does* differ with employment status; religiosity increases significantly more with earthquake risk for unemployed individuals, even controlling for income. In general, these results are consistent with the religious coping literature, but cannot be used to distinguish between alternative explanations (elaborated more upon in Appendix C.9, where results are also compared to the event study findings).

Adding additional controls (trust, population density, unemployed dummy, individual level income, light density at night, arable land shares, average temperature, average and variance of precipitation, and a dummy equal to one if the district is located within zones 3 or 4) do not change the results (Appendix B.6). Indeed, the estimate of interest stays remarkably constant throughout. Compared to the specification with baseline controls, the variables resulting in the largest reduction in the estimate of earthquake risk on religiosity is district area and variance in precipitation, which reduce $\hat{\beta}$ from 0.063 to 0.061. Were any omitted variable to explain $\hat{\beta}$ entirely, its inclusion should result in a thirty times larger reduction in $\hat{\beta}$ compared to the reduction caused by area and precipitation variance (Altonji *et al.* (2005)).

To investigate whether the results are driven by other values, numerous measures of cultural values from the pooled WVS-EVS could be used. In order to tie hands somewhat, eleven values from one widely used survey question is used. Namely, the question asking the respondent to mention which of eleven values are important to pass on to ones children. These values are manners, independence, hard work, feeling of responsibility, imagination, tolerance and respect for other people, thrift saving money and things, determination and

[27] Buddhists do not seem to respond to elevated earthquake risk by increased believing, but there are only 817 individuals in the sample categorising themselves as Buddhists.

[28] This may be explained by the fact that Catholicism is a much more community-based religion, while for instance Calvin's doctrine of salvation is based on the principle of "faith alone" (Weber (1930)). This gives Catholics an additional coping alternative to intensified believing, namely their social networks.

perseverance, religious faith, unselfishness, and obedience. The estimate on earthquake risk stays remarkably constant throughout (Appendix B.6).

4 Event study

The time-dimension in the pooled WVS-EVS data is now exploited to account for district-level unobservables. The same individuals are not followed over time, but a third of the subnational districts are measured more than once, which makes it possible to construct a synthetic panel, where the panel dimension is the subnational district and the time dimension is the year of interview.[29]

4.1 Data on earthquake events

The Advanced National Seismic System (ANSS) at the US Geological Survey (USGS) provides data on the timing, location, and severity of all earthquakes since 1898.[30] Due to improvements in earthquake-detection technology, earthquakes of magnitudes below 5 cannot be compared over time, and neither can earthquakes before 1973.[31] The analysis exploits the 68,711 earthquakes that hit the globe's surface between 1973 and 2014 of magnitude 5 or above. Figure 2 splits these earthquakes into two categories; those of magnitude 5-5,999 (dark blue dot) and those of magnitude 6 or above (larger red dot).

A measure of earthquake events in each subnational district is constructed by combining again the ESRI shapefile of subnational districts with all earthquake occurences

[29] Restricting the sample in Table 2 to the sample of districts that were surveyed more than once does not alter the estimates on earthquake risk.

[30] Downloadable from the Comprehensive Earthquake Catalogue: http://earthquake.usgs.gov/monitoring/anss/. The U.S. Geological Survey provides the best available estimate of an earthquake's magnitude. Each method to measure magnitudes works over a limited range of magnitudes. Some methods are based on body waves (which travel deep within the structure of the earth) and some are based on surface waves (which primarily travel along the uppermost layers). All of the methods are designed to agree well over the range of magnitudes where they are reliable. Earthquake magnitude is a logarithmic measure of earthquake size, which means that the shaking will be 10 times as large during a magnitude 6 earthquake as during a magnitude 5 earthquake. The total amount of energy released by the earthquake, however, goes up by a factor of 32.

[31] The number of earthquakes of all magnitudes in the data increase up until 1973 and the number of earthquakes of magnitudes below 5 increase over the entire period. While the world has not seen an increased number of earthquakes in reality, the implication is that earthquake detection technology must have improved over time. There has been no trend in the number of earthquakes of magnitude 5 or above since 1973.

over the periode 1973-2014 of magnitudes 5 or above. A district is defined as being hit by an earthquake if the earthquake hit within X km of the district border. X is chosen low enough to ensure that the earthquake was likely to influence the people in the particular district, but high enough to ensure that potentially influential earthquakes are not lost. For the main analysis, a district is defined as being hit when an earthquake hit within 100 km of the district border. The results are robust to alternative cut-off levels (Appendix C.1).

As expected, larger earthquakes influence religiosity more (Appendix C.8 shows that earthquakes of magnitudes 6 or above increase religiosity more than earthquakes of magnitudes between 5 and 6). The choice of magnitude cutoff used in the main analysis is a weighing between this phenomenon and the fact the there are rather few larger earthquakes. To maximize the likelihood of detecting an impact of the particular earthquake, magnitudes of 6 or above are chosen as the cutoff in the main analysis.[32] The results are robust to choosing similar magnitudes. The three districts in the sample that experienced the largest average number of earthquakes of magnitude 6 or above were the Russian Far East with 3.4 yearly earthquakes, the South of Mexico with 2.8 yearly earthquakes, and Hokkaido Tohoku in Japan with 1.9 yearly earthquakes.

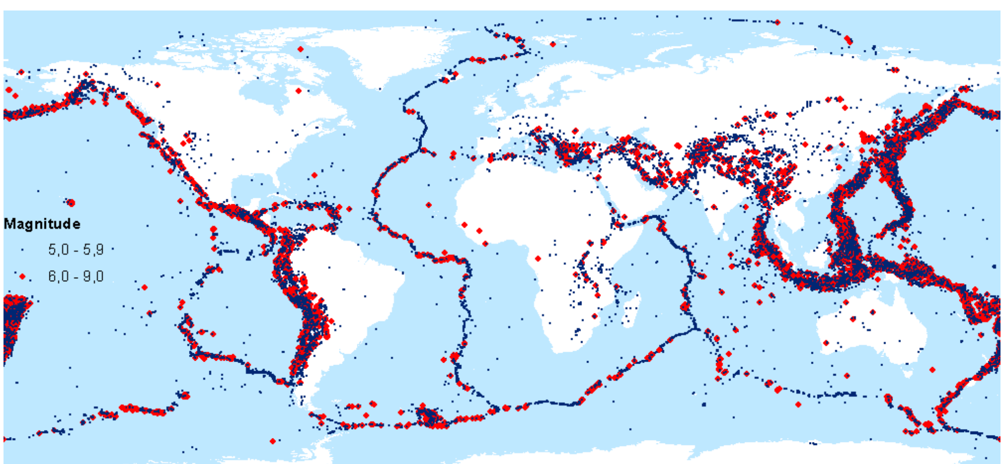


Figure 2. Epicentres of earthquakes of magnitude 5 or above, 1973-2014

Source: US Geological Survey (USGS).

[32]Compared to the earthquake risk measure in the cross-district analysis, earthquake zones 3-4 correspond to earthquakes with magnitudes above 6.0 on the Richter scale. As the cross-district analysis uses the distance to these zones, it implicitly also includes the smaller earthquakes. The earthquakes in the event study are measured in terms of magnitude, which includes the Richter Scale, but also other comparable scales.

The most detailed information on time in the WVS-EVS dataset is the year of interview for the majority of the individuals. It is therefore not possible to identify whether an earthquake that hit in the year of the interview hit before or after the interview. District-years are therefore dropped when an earthquake hit in the same year as the WVS interview. This means dropping 38 observations in the main regressions.[33] Dropping these observations also means dropping the districts that are most often hit by earthquakes, including the three extremes described above. The results are qualitatively robust to including the particular observations.

With these data it is possible to test whether more or less surprising earthquakes matter more. The dummy, $frequent_{dc}$, is constructed to equal one for districts that are frequently hit by earthquakes, zero otherwise. Being frequently hit is defined as hit by 7 or more earthquakes over the period 1973-2014, where 7 is the 95^{th} percentile in the distribution of the number of earthquakes. There are 13 such districts in the sample. The results are robust to other definitions of districts with "frequent earthquakes" (Appendix C.3).

4.2 Data on religiosity

Religiosity is aggregated to the district-level for each year of interview, but only a third of the districts are measured more than once. Therefore, the event study suffers from having rather few observations. Three of the questions on religiosity used above, though, are rather spread out geographically across 250 districts located in more than 30 countries: "How important is God in your life?", "Are you a religious person?", and "How often do you attend religious services?" The remaining three (Beliefs in God, finding comfort in God, and beliefs in an Afterlife) are available for only half the number of districts in half the number of countries. Earthquakes do not affect these remaining three measures of religiosity (Appendix C.7). This may be because conversion rates are more difficult to influence (the share of religious persons is also less affected than importance of God). But it could also be due to the much smaller sample or a rejection of the religious coping

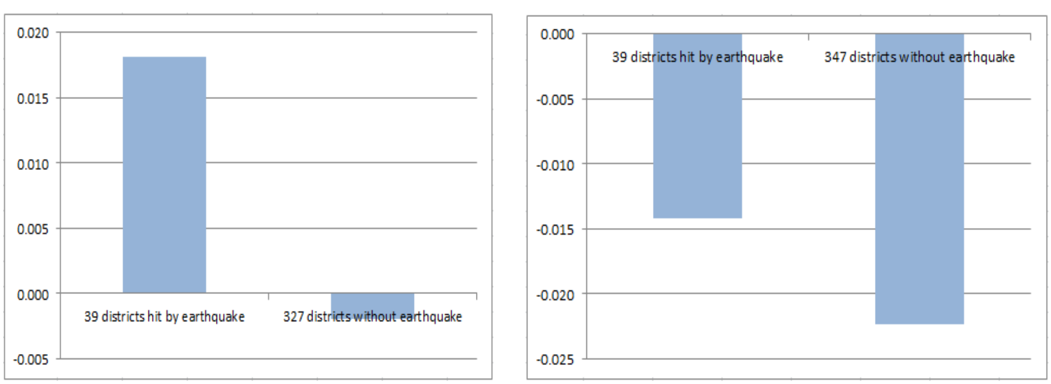
[33] The WVS provides information on the month of the interview for a third of the sample. Hence, if distance to the nearest earthquake in each month was calculated, a maximum of 12 observations could be gained (a third times the 38 observations), provided that none of the earthquakes hit in the same month as the interview. However, there may be a selection bias when comparing these districts with those with only yearly information.

hypothesis for these particular measures.

The panel is highly unbalanced; individuals in some districts are interviewed in two consecutive years and some with 18 years in between. Also, the distribution of years in between interviews is highly skewed with a spike at 5 years and a narrow tail up to 18 years (see histogram in Appendix C.2). Since the impact of earthquakes abates after a period of up to 12 years (Appendix C.6), analysing across very long windows of observation may miss out on important short-term effects. Therefore, the main sample is restricted to districts measured with 10 years or less apart. This particular period length cut-off is chosen to centre the distribution of period lengths. The main results are qualitatively maintained without restricting the sample (Appendix C.6).

4.3 Analysis

According to the religious coping hypothesis, earthquakes likely increase intrinsic religiosity. To investigate this in the raw data, Figure 3 splits the samples on intrinsic religiosity in two: The district-years with one or more earthquakes during the period and those without. Average importance of God increased by 1.8 percentage points in the 39 district-years that were hit compared to a fall of 0.2 percentage points in the 327 district-years that were not. The difference has a p-value of 0.14. The share of religious persons has fallen in both samples, but more in areas that were not hit by earthquakes; both in accordance with the religious coping hypothesis. The latter difference has a p-value of 0.39, though, and more formal analysis is needed to investigate whether these differences are statistically different from zero.



Change in average importance of God

Change in the share of religious persons

Figure 3. Change in religiosity by earthquake or not

The formal analysis relies on the following equation consisting of first differences of the district-aggregates of equation (1):

$$\Delta religiosity^{Z}_{dcw} = \alpha + \beta \Delta earthquakes_{dcw} + \lambda_{cw} + \Delta X'_{dcw}\delta + \Delta\varepsilon_{dcw}, \tag{2}$$

where $\Delta religiosity^{Z}_{dcw} = religiosity^{Z}_{dcw} - religiosity^{Z}_{dcw-1}$ measures the change in district-level religiosity between interview waves $w-1$ and w in district d. Since religiosity is not measured yearly, $w-1$ can indicate a lag of several years, as opposed to $t-1$ which indicates one year lag. Z indicates whether individual-level controls are accounted for before aggregating the data.[34] $\Delta earthquakes_{dcw} = earthquakes_{dcw} - earthquakes_{dcw-1}$ indicates either the number of earthquakes that hit in between interview waves or a dummy equal to one if one or more earthquakes hit in between the waves. *Baseline controls* include country-by-year fixed effects (λ_{cw}), individual-level controls for sex, marital status, age, and age squared, district-level controls ($\Delta X'_{dcw}$) for the number of years between interviews and the number of years since an earthquake hit, where districts that did not experience an earthquake since 1973, are coded to 100.

Additional controls are lagged religiosity, education fixed effects, income fixed effects, religious denomination fixed effects, a year trend, and lagged earthquakes (Appendix C).

The results are robust to estimating the levels-regressions of the district-aggregate of equation (1) with district fixed effects instead of taking first-differences (Appendix Table A21).[35] This method also circumvents the issue of unbalancedness.

To test whether more or less surprising earthquakes matter more, an interaction with the frequency of earthquakes in the district is added:

$$\Delta religiosity^{W}_{dct} = \alpha + \beta \Delta earthquakes_{dct} + \gamma \Delta earthquakes_{dct} \times frequent_{dc} + \lambda_{ct} + \Delta X'_{dct}\delta + \Delta\varepsilon_{dct}, \tag{3}$$

[34] $religiosity^{Z}_{dcw}$ is based on information at the individual level aggregated up to the district level, using appropriate weights (variable s017), s_{idcw}: $religiosity^{Z}_{dcw} = \frac{1}{N}\sum_{i=1}^{N} s_{idcw} \cdot \widehat{religiosity}_{idcw}$, where $\widehat{religiosity}_{idcw}$ measures the residuals of a regression of $religiosity_{idcw}$ on the particular individual-level controls.

[35] Thanks to an anonymous referee for suggesting this.

where $frequent_{dc}$ is a dummy equal to one if the district is frequently hit by earthquakes (described in Section 4.1). The religious coping hypothesis predicts that $\beta > 0$ and $\gamma < 0$: Religion is used for coping with earthquakes, but more so if the earthquake hit a district that is otherwise rarely hit.

Table 4 shows the results from estimating equation (2) and (3) for the three religiosity measures and the two measures of earthquake events.[36] Baseline controls are included throughout and eight education dummies are added in even columns. Panel A shows that earthquakes increase intrinsic religiosity, including all baseline controls and also the eight education fixed effects. Churchgoing is not affected significantly, in keeping with the religious coping literature. The difference between the parameter estimates on earthquake risk across the different religiosity measures is even more pronounced than in the cross-section results. This may be due to spillover-effects between the different measures of religiosity. For instance, increased believing in the short-term may induce people to go to church in the longer term, even though the stressful event, earthquakes, do not increase churchgoing in the short-term.

Panel B documents that nearly all measures of intrinsic religiosity increase more in response to earthquakes in districts that are otherwise rarely hit compared to those often hit.[37] Thus, earthquakes that come as a surprise increase religiosity more than other earthquakes in line with the results for different disasters in Table 3.

Panel C regresses instead changes in religiosity on earthquakes that hit in the period *after* religiosity was measured. This is meant as a placebo test, and shows that future earthquakes have no effect on past changes in religiosity, comfortingly.[38] Thus, the results are not driven by some district-level trends that correlate with both earthquakes and the change in religiosity.

[36] Standard errors are clustered at the country-level throughout. Conclusions are unaltered if using instead unclustered standard errors.

[37] This finding is not driven by the fact that religiosity is higher in high risk districts: The finding is robust to adding initial religiosity and its' interaction with earthquakes (Appendix C.4).

[38] To construct future earthquakes in years after the latest measure of the religiosity measure, five-year period lengths are chosen, as this is the most common period length between measurements of the religiosity measure (Appendix C.2).

Table 4. First-difference estimation of religiosity on earthquake events

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Dependent variable	D.impgod		D.relpers		D.service		D.impgod		D.relpers		D.service	
Earthquake measure:	Earthquake dummy						Number earthquakes					
Panel A. Linear effects of earthquakes												
Earthquake measure	0.076***	0.074***	0.053**	0.046**	0.034	0.031	0.027**	0.024***	0.022***	0.020***	0.015	0.014
	(0.023)	(0.021)	(0.021)	(0.019)	(0.030)	(0.037)	(0.010)	(0.008)	(0.007)	(0.006)	(0.009)	(0.010)
R-squared	0.335	0.314	0.414	0.413	0.509	0.507	0.325	0.304	0.413	0.412	0.508	0.506
Panel B. Allowing for differential effects depending on how frequent the district is hit												
Earthquake measure	0.093***	0.086***	0.062**	0.060**	0.024	0.018	0.058**	0.053**	0.044***	0.043***	0.017	0.016
	(0.028)	(0.023)	(0.027)	(0.023)	(0.044)	(0.052)	(0.021)	(0.020)	(0.014)	(0.012)	(0.022)	(0.025)
Earthq x Frequent earthq	-0.073**	-0.060*	-0.058	-0.063*	0.014	0.046	-0.053***	-0.048**	-0.046**	-0.044***	-0.018	-0.017
	(0.029)	(0.031)	(0.041)	(0.033)	(0.077)	(0.090)	(0.019)	(0.019)	(0.018)	(0.014)	(0.025)	(0.029)
R-squared	0.338	0.316	0.417	0.415	0.513	0.513	0.333	0.311	0.417	0.415	0.513	0.512
Panel C. Placebo regressions												
Earthquake measure w+1	-0.027	-0.017	0.023	0.027	-0.064	-0.057	-0.025	-0.017	0.007	0.012	-0.050	-0.040
	(0.021)	(0.026)	(0.041)	(0.046)	(0.047)	(0.044)	(0.018)	(0.021)	(0.031)	(0.033)	(0.034)	(0.033)
Earthq w+1 x Frequent earthq	-0.015	-0.031	-0.005	-0.016	0.110*	0.120**	0.016	0.009	-0.007	-0.010	0.037	0.031
	(0.021)	(0.028)	(0.046)	(0.052)	(0.062)	(0.056)	(0.017)	(0.021)	(0.029)	(0.032)	(0.034)	(0.033)
R-squared	0.320	0.299	0.414	0.413	0.518	0.516	0.320	0.299	0.414	0.412	0.517	0.514
Observations	350	324	370	333	384	347	350	324	370	333	384	347
Baseline controls	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Education dummies	N	Y	N	Y	N	Y	N	Y	N	Y	N	Y
Districts	236	230	250	240	264	254	236	230	250	240	264	254
Countries	31	30	31	30	32	31	31	30	31	30	32	31
Number Fixed effects	46	50	47	49	48	50	46	50	47	49	48	50

Notes. OLS estimates. Unit of analysis is districts at time w. The dependent variable is the change in average importance of God in col (1)-(2) and (7)-(8), the change in the share of religious persons in col (3)-(4) and (9-10), and the change in average of churchgoing in col (5)-(6) and (11)-(12). The earthquake measure is a dummy equal to one if one or more earthquakes hit the district in between interview waves, zero otherwise (col 1-6) and the actual number of earthquakes (col 7-12). Panel A estimates the simple linear effect of earthquakes, while Panel B includes an interaction between earthquakes and a dummy variable equal to one if the district is frequently hit by earthquakes. All columns include baseline controls. Even columns include eight education dummies. All columns include a constant. Standard errors (in parenthesis) are clustered at the country level. Asterisks ***, **, and * indicate significance at the 1, 5, and 10% level, respectively.

RESULTS: Earthquakes increase intrinsic religiosity and not churchgoing. The effect is larger in districts that are rarely hit. No future earthquakes affect current religiosity.

Taking the estimate in column (1) of Table 4, Panel A at face value, having been struck by one or more earthquakes increases religiosity by 7.6 percentage points compared to districts that did not experience any earthquakes. This corresponds to increasing religiosity from the median district (in terms of changes in religiosity) to the 80^{th} percentile. The difference is even larger in the 223 districts that are not often hit by earthquakes, where the increase is 9.3 percentage points. Earthquakes increase the conversion rate (share of religious persons) by 5.3-6.2 percentage points, corresponding to an increase from the median district to the 66^{th}-69^{th} percentile.

The tendency for earthquakes to affect the average importance of God more than the share of religious persons is not surprising. The former measures the degree of believing, while the latter measures conversion rates, which are harder to affect by any means. This also explains why average importance of God is more robust to various changes of the specifications performed in the Appendix.

4.4 Further robustness checks

Further robustness checks are performed in Appendix C of the intrinsic measures of religiosity.

The data allow investigating the impact of earthquakes of magnitudes of 5 or above, and within these magnitudes, it turns out that only earthquakes of magnitude 5.5 or above increase the degree of believing (measured by importance of god, Appendix C.8). Magnitudes should be as high as 6 or above to increase conversion rates. Both dimensions of religiosity are affected when restricting the sample further to earthquakes of magnitudes 6.5 or above (additional restriction on magnitudes is not possible due to too few of these large earthquakes).

As in the cross-districts analysis, earthquakes increase believing across all denominations and across all continents (Appendix C.10), and the impact on religiosity is similar for individuals from all income and education groups (Table A21). Contrary to the cross-districts results, earthquakes increase religiosity more in districts with lower *aggregate* development levels, when measuring development by aggregate individual incomes or education levels, not by light density or unemployment rates (Table A22).

Last, consistent with other studies on cultural values (e.g., Perrin & Smolek (2009) and Dinesen & Jæger (2013)), the impact of earthquakes on religiosity abates after a while (Appendix C.6). In particular, the impact on believing lasts up to 9-12 years, while the impact on conversion rates lasts only 3 years.

4.5 Linking long run and short run results

In general, the short-term results corroborate the long-term results. They do differ in some respects, though. First, while the short-term effect abates after a while, the long-term results indicate that a residual may survive over time, adding up to significant differences in the long-term. This is investigated further in the following section, but as a first consistency check, the standardized beta coefficients can be compared. Indeed, the standardized beta coefficient on the short-term effect is double the size of the long-term effect, which corroborates the dynamics envisioned.[39]

The two analyses also differ with regards to whether churchgoing is affected. While only intrinsic religiosity is affected in the short term, both extrinsic and intrinsic religiosity are affected in the long term. If anything, it seems that short-term effects on intrinsic religiosity spill into longer term effects on churchgoing.

A last notable difference between the short-term and long-term analyses is whether the impact of earthquakes on religiosity depends on income, education, and employment status. Most results reveal no dependence, while the results that do show a difference point in the direction that the effect is more pronounced for the less well off.

5 Persistency

The religious coping hypothesis concerns the immediate effect on religiosity from adverse life events. Whether religiosity is passed on through generations can be investigated in a model of cultural transmission, such as the one by Bisin & Verdier (2001). In this model, parents transmit a particular cultural trait to their children if this grants utility to either parents or children. Evidence suggests that religion may well be such a trait. Studies find that religious individuals often have better mental health (Miller *et al.* (2014), Park

[39] See footnote 24 for thoughts on comparing standardized beta coefficients in this setting. The calculation is the following: $\frac{|beta_{dist(earthq)}|}{|beta_{male}|} = \frac{0.204}{0.093} = 2.088$.

et al. (1990)), higher life satisfaction (Ellison *et al.* (1989), Campante & Yanagizawa-Drott (2015)), are better able to cope with adverse life events (Clark & Lelkes (2005)), and engage less in deviant behavior (Lehrer (2004)).[40] Thus, religiosity might have some benefits that parents would like to transmit to their children.

This section investigates whether children of immigrants are more religious when their parents came from a country with higher earthquake risk, compared to those with parents from lower earthquake risk countries.[41] The data used is the European Social Survey (ESS), which currently includes five survey rounds (2004, 2006, 2008, 2010, and 2012) for 17,587 individuals whose parents were born in 171 different countries.[42,43] The data includes three questions on religiosity: (1) How often do you pray? (1="Never", ..., 7="Every day"), (2) How religious are you? (1="Not at all religious", ..., 10="Very religious"), and (3) How often do you attend religious services? (1="Never", ..., 6="Weekly or more often").[44] The variables were rescaled to lie between 0 and 1. In cases where the parents migrated from different countries, the mothers' country of origin is chosen. The results are robust to focusing on the fathers' country of origin instead (Appendix Table A30).

The estimation includes equations of the form:

$$religiosity_{cjat} = \alpha + \beta earthquake_a + a_{ct} + X'_{cjt}\eta + W'_a\delta + V'_{ajt}\eta + \varepsilon_{cjat}$$

where $religiosity_{cjat}$ is the level of religiosity of individual j interviewed at time t living in country c in which he/she was born, and with parents who migrated from country a. $earthquake_a$ is the long term earthquake risk in the country of origin, measured by the distance to the nearest earthquake zone 3 or 4 (described in Section 3.3). a_{ct} is a vector of country of residence by year of interview fixed effects. This removes any time-varying or constant country-level factors in the child of immigrants' current environment, such as

[40] See also reviews by Smith *et al.* (2000) and Pargament (2001).

[41] The method is also called the epidemiological approach by Fernandez (2011).

[42] The ESS is available online at http://www.europeansocialsurvey.org/.

[43] Another dataset with information on immigrants' levels of religiosity and country of origin is the General Social Survey (GSS) for the United States. However, the information on the origin of the immigrants is only available across 32 units (comprising 30 countries and two broad regions), compared to 171 countries in the ESS.

[44] The frequency of attending religious services was originally a variable running from 1="Never" to 7="Every day". Due to few observations in the latter category, 7 and 6="Weekly or more often" were merged. The results are unchanged if using the original variable.

institutions, culture, earthquake frequency, and average level of religiosity. X_{cjt} is a vector of immigrant-level controls. W_a are geographic factors in the child of immigrants' country of origin, which might correlate with disaster frequency. V_{ajt} is a vector of socioeconomic characteristics of the child of immigrants' mother and father.

β measures the impact of earthquake risk in person j's country of origin on person j's current religiosity. Standard errors are clustered at the country of origin and the current country of residence.

Columns (1)-(3) of Table 5, Panel A show that children of immigrants whose parents came from a country with high earthquake risk pray more often than those whose parents came from less disaster prone countries. The specifications include country-of-current-residence-by-year fixed effects throughout. The result is robust to adding controls for geographical factors in the parents' country of origin (absolute latitude, continent dummies, and distance to the coast) in column (2) and individual-level controls for parent characteristics (five fixed effects for mother's and father's education), and child of immigrant characteristics (age, age squared, sex, and the five education fixed effects) in column (3). Likewise, children of immigrants whose mother or father came from a country with higher earthquake risk rank themselves as more religious (col 4-6) and attend religious services more often (col 7-9). The results are unchanged when adding ten individual income fixed effects (Appendix Table A31) and when using instead ordered logit estimation.

As a sanity check, Panel B adds the squared term of distance to high-risk earthquake zones. Corroborating the cross-district result in Panel D of Table 2, the impact of distance to earthquake zones diminishes with distance as expected.

Panel C performs the analysis using exclusively children of immigrants whose parents came from countries not directly located in a high-risk earthquake zone. The estimates of interest are unchanged.

Table 5. OLS of religiousness on disasters in parents' home country

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Dependent variable:		pray			religious person			service	
Panel A. Simple linear effect									
Dist(earthq), 1000 km	-0.050***	-0.036***	-0.028**	-0.054***	-0.039***	-0.031**	-0.041***	-0.027**	-0.021**
	(0.014)	(0.011)	(0.011)	(0.017)	(0.014)	(0.013)	(0.014)	(0.011)	(0.010)
Observations	17,155	17,058	14,156	17,271	17,174	14,250	17,334	17,236	14,304
R-squared	0.122	0.129	0.175	0.074	0.085	0.129	0.100	0.110	0.127
Org countries	171	166	155	171	166	155	171	166	155
Panel B. Including a squared term									
Dist(earthq), 1000 km	-0.130***	-0.079***	-0.068**	-0.121***	-0.059**	-0.048*	-0.090***	-0.042**	-0.033
	(0.021)	(0.024)	(0.027)	(0.027)	(0.026)	(0.027)	(0.027)	(0.019)	(0.021)
Dist(earthq) squared	0.049***	0.024*	0.023	0.041***	0.011	0.010	0.029**	0.009	0.007
	(0.010)	(0.014)	(0.017)	(0.013)	(0.014)	(0.017)	(0.012)	(0.010)	(0.008)
Observations	17,155	17,058	14,156	17,271	17,174	14,250	17,334	17,236	14,304
R-squared	0.123	0.130	0.175	0.075	0.085	0.129	0.101	0.110	0.127
Impact at 500 km	-0.105	-0.0666	-0.0566	-0.101	-0.0532	-0.0432	-0.0749	-0.0377	-0.0293
Panel C. Excluding countries of origin in high-risk zones									
Dist(earthq), 1000 km	-0.044***	-0.038***	-0.026**	-0.047***	-0.039***	-0.030**	-0.036***	-0.027**	-0.018**
	(0.015)	(0.011)	(0.011)	(0.017)	(0.013)	(0.014)	(0.012)	(0.010)	(0.009)
Observations	15,787	15,784	9,367	15,894	15,891	9,407	15,957	15,954	9,435
R-squared	0.105	0.112	0.159	0.062	0.072	0.122	0.094	0.102	0.127
Org countries	139	136	123	139	136	122	139	136	123
Country-year FE	Y	Y	Y	Y	Y	Y	Y	Y	Y
Geo controls	N	Y	Y	N	Y	Y	N	Y	Y
Parent and indl controls	N	N	Y	N	N	Y	N	N	Y

Notes. OLS estimates. The unit of analysis is a child of immigrants. When parents are not from the same country of origin, the mother's country of origin is chosen. When the mother is not an immigrant, the father's country of origin is used. The dependent variable is answers to the question: "How often do you pray?" in col (1)-(3), "How religious are you?" in col (4)-(6), and "How often do you attend religious services?" in col (7)-(9). Dist(earthquake) measures the distance to the nearest high risk earthquake zone. "Geo controls" indicates geographic controls of the country of origin: six continent dummies (Africa, Asia, Australia and Oceania, Europe, North America, and South America), absolute latitude, and distance to the coast. "Parent and indl controls" indicates five fixed effects for each of the mother's, father's, and child of immigrant's level of education, and controls for the child of immigrants's age, age squared, and sex. Standard errors (in parenthesis) aretwo-way clustered at the level of current country and parents' country of origin. Asterisks ***, **, and * indicate significance at the 1, 5, and 10% level, respectively.

RESULTS: Children of immigrants from countries with higher earthquake risk are more religious than their peers living currently in the same country, but whose parents came from countries with lower earthquake risk.

5.1 Further robustness

Parents from the same country of origin have most likely migrated from different areas within the same country with different earthquake risk. However, the earthquake risk measure in Table 5 aggregates various potentially different within-country earthquake risks. This potential bias is larger the larger the country, since the likelihood that parents come from different areas in a country is larger in this case and the potential difference in earthquake risk is also larger. Therefore, the size of the bias can be estimated by investigating whether the effect depends on the size of the country. This does not seem to be driving the results in Table 5; restricting the sample to the 75 or 90% smallest countries produces similar results (Appendix Table A32).

The exercise in Table 5 implicitly assumes that the results obtained in Section 3.3 are true in the country of origin; higher earthquake risk increases religiosity. It also assumes that this higher religiosity is transferred across generations. As a consistency check of this assumption, Appendix Table A33 replaces earthquake risk in the parents' home country with the Intrinsic Religiosity Scale and find a significant and positive effect on the children's level of religiosity. Thus, these central underlying assumptions seem to hold.

The results in Table 5 are consistent with the idea that high earthquake risk may fascilitate a culture of high religiosity which is passed on through generations. Thus, people who have perhaps never themselves experienced an earthquake can still be influenced by the disasters experienced by earlier generations, in terms of increased religiosity.

6 Mechanisms

The mechanism through which earthquakes increase religiosity is now investigated by checking the consistency of each potential mechanism against the results from all three analyses.

6.1 Selection and migration

One potential mechanism through which earthquakes could affect religiosity is selection or migration. One idea could be that atheists (or less traditional individuals in general) move out of earthquake areas, while the religious are more likely to stay (perhaps because they see the earthquake as a consequence of own actions, thus making moving less of a solution). This out-migration of atheists would increase average religiosity across the people remaining in the district after an earthquake and would thus be consistent with the cross-district results in Panel A of Table 2. However, additional results across all three analyses are inconsistent with this hypothesis. First, the fact that religiosity falls back towards the long-term level after 6-12 years is difficult to explain in this context (Appendix C.6). If this is due to selection, it requires atheists to move in and out repeatedly before and after earthquakes over periods of only 6-12 years, which seems unlikely. In the analysis across children of immigrants, selection would predict that migrants moving out of earthquake areas are *less* religious than those staying behind, which is the opposite of what Table 5 shows.[45] Last, if the cross-district results were driven by migration, the effect of earthquakes should be larger across smaller districts, where it is more likely that moving away from the earthquake area means moving out of the district. Yet, the long-term impact of earthquakes does *not* depend on the size of the districts (Table A13, col 9 and 10).

Thus, selection cannot explain the results.

6.2 Evolution of a special culture

Another potential explanation is that areas hit frequently by earthquakes have historically attracted a special type of people, who might be more inclined to respond to earthquakes by increased believing than other people. However, additional results across all three analyses are inconsistent with this explanation. First, the event study shows the opposite; mainly people living *outside* of high-risk areas respond to earthquakes by increased believing (Panel B of Table 4). Likewise, the cross-district and children of immigrants results are robust to excluding districts located directly in high-risk zones (Panel C of Tables 2 and 5). Thus, the results are not driven by something particular to high-risk earthquake areas.

A related explanation could be that earthquakes influence various other types of cultural values, which correlate with religiosity and are the true drivers of the impact of

[45] A proper investigation of the issue would be to compare immigrants' religiosity to the religiosity of the inhabitants of their country of origin. I have not found a way to do so.

earthquakes. To investigate, one widely used question from the pooled WVS-EVS is exploited (Appendix B.6). In particular, parents are asked to state which of eleven values are important to teach to ones' children. The estimate on earthquake risk is unchanged when including either value.

6.3 Direct economic explanations

Another set of potential explanations involves the direct economic damages of earthquakes. For instance, religion could act as economic insurance; the church provides money, food, and shelter for individuals affected economically by an earthquake. This elevated churchgoing could then drive the surge in intrinsic religiosity. This explanation is inconsistent with central uncovered results across all three analyses.

An explanation based purely on the economic damages of natural disasters would predict that disasters of similar severity in terms of death tolls or monetary losses have similar effects on religiosity. Storms involve similar death tolls, number people affected, and economic damage as earthquakes (Figure A4). Yet, Table 3 shows that storms do not affect religiosity. Only earthquakes, tsunamis, and volcanic eruptions do.

Further, if economic factors were an important channel, actual recent earthquakes should be driving most of the long-term results. However, the long-term impact of earthquake risk on religiosity is unaffected when controlling for recent earthquakes (Tables 2, 5, and Table A6).

In addition, the fact that the results hold for individuals living outside high risk earthquake areas is inconsistent with a story involving the direct economic consequences of earthquakes. These individuals do not suffer much economically, yet still exhibit elevated religious beliefs. It could be, though, that earthquake resistant houses are built in high-risk earthquake areas and that earthquakes therefore impose larger economic damage in less earthquake-prone areas. Thus, the need for churchgoing to obtain material aid would be larger in less risky areas. This is inconsistent with the finding that earthquakes do not increase churchgoing in the short run, though (Table 4).

Of somewhat more indicative evidence, the inter-generational effects are difficult to explain by pure economic insurance, where religion is just a practical matter of getting material aid, while obtaining a closer relation to God seems a more permanent human experience.

6.3.1 Secularization hypothesis

Another set of explanations that focus on the direct economic damage of earthquakes is that the increase in religiosity may be due to a general fall in economic prosperity caused by the earthquakes, in keeping with the secularization hypothesis. First, the literature is inconclusive as to whether earthquakes increase or decrease aggregate levels of prosperity. Further, this explanation is inconsistent with several of the outlined results above documenting that the direct economic damages cannot be driving the results. The explanation is also inconsistent with the fact that the results are robust to adding controls for income and education across all three analyses.

Something in addition to the economic impact of earthquakes is driving the results.

6.4 Religious coping

It turns out that the only explanation capable of explaining all results is religious coping, which views religion as a psychological tool to cope with adverse life events.

The literature on religious coping predicts that religion is used mainly to cope with unpredictable life events, while predictable events instigate other types of coping. In support, the current analysis shows that unpredictable disasters, such as earthquakes, volcanic eruptions, and tsunamis, increase religiosity; predictable ones, such as storms, do not (Table 3). Likewise, earthquakes in districts otherwise rarely hit arguably come as a larger surprise than those hitting districts that often experience earthquakes. In support, the results show that earthquakes in areas otherwise rarely hit, increase religiosity more (Panel B of Table 4 and most tables in Appendix C).

The finding that only intrinsic religiosity, and not churchgoing, is affected in the short run is consistent with the literature on religious coping (e.g., Koenig *et al.* (1988) and Miller *et al.* (2014)). A personal relation to God or other religious figures is apparently more important for stress relief compared to the extrinsic use of religion. That churchgoing *is* affected in the long run (Table 2 and 5) can be due to the fact that more intrinsically religious people go more to church.

Furthermore, the finding that the long-term impact persists once districts / countries often hit by earthquakes are removed (Panel C of Tables 2 and 5) is consistent with a psychological interpretation; earthquakes hitting nearby may affect family members, friends, and relatives. This might instigate a need for prayer, even though these individuals themselves are not hit. In other words, earthquakes can cause psychological distress for an individual without him or she experiencing direct economic losses. Likewise, the long-term results hold after controlling for actual earthquakes and various measures of development, indicating a psychological mechanism.

The short-term spike in religiosity can also be explained by religious coping: Praying reduces the stress caused by the earthquake, levelling off the need for prayer after a while.

7 Conclusion

Individuals become more religious when hit by earthquakes, and this elevated religiosity is transmitted across generations, resulting in persistent effects on religiosity of living in areas with high earthquake risk. The religious become more religious and a significant share of persons who previously did not regard themselves as religious, start believing. This is not due to the potential economic damage caused by earthquakes, nor because people go to church to obtain material aid, or because atheists move out of earthquake areas, or because a special type of individuals evolve in earthquake areas. Instead, the results *can* be explained within the religious coping framework, which regards religion as a psychological tool that individuals can use when faced with adverse life events. Historically, a dominating belief was that earthquakes and other disasters were an indication of God's anger. Today, even if most people agree that tectonic plates, not God, are the root to earthquakes, they can still use their religion to cope with the stress and disorder felt after a disaster. They obtain stress relief by praying, obtaining a closer relation to God or other religious figures, or rationalizing the event religiously.

This research further provides one explanation for the apparent paradox that religiosity has not declined everywhere with increased wealth and knowledge as otherwise suggested by the secularization hypothesis. Religion persists as a tool for explanation and relief in an ever more complex and changing world.

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Appendix - potentially for online publication

A Matching subnational districts

Steps in matching gridded data with the regional information in the pooled WVS/EVS:

1. The disaster data is available at the grid-cell level, while the finest spatial information in the pooled WVS/EVS 1981-2009 is variable x048 indicating the subnational district where the interview was conducted. The WVS/EVS "districts" can be both actual districts, but in a few cases also cities. The two types of information are matched with a shapefile from ESRI with first administrative districts across the globe, which means a unit of disaggregation just below the country-level.

2. The ESRI-shapefile also has information on the type of land within the district: Primary land, large island, medium island, small island, and very small island. To prevent averaging across for instance islands and primary land, the five categories are ranked with primary land as the preferred and very small island as the least preferred. When a district is divided into several polygons, only the highest ranked polygon is kept.

3. In many cases, the x048 variable varies across time. For instance, the same country can be divided into 15 districts in one year and only five larger districts in another year. The most disaggregate division is chosen, provided that it matches the shapefile for first administrative districts as well as possible.

4. For many countries, the level of aggregation in the ESRI shapefile is different from that in the district identifier, x048, from EVS/WVS. In these cases, the districts are aggregated to the finest level possible.

5. The districts are illustrated in Figure A1 below. The districts included in the cross-district analysis encompass both types of green, while the districts included in the event study are indicated with dark green.

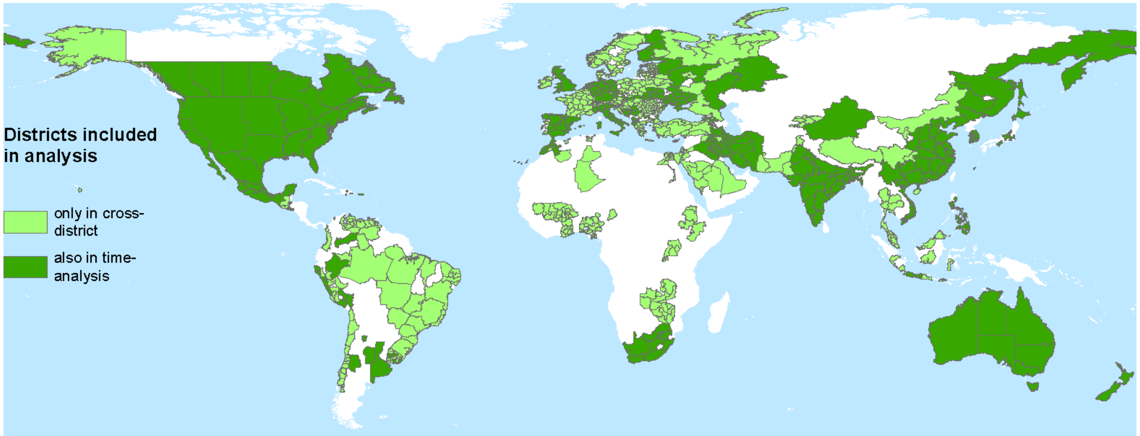


Figure A1. Subnational districts included in the analysis

Notes. Map of subnational districts from the pooled WVS/EVS 1981-2009. Dark green districts are measured more than once in the WVS-EVS, while light green indicates that the district is measured once. Source: Own matching of the variable x048 in the pooled EVS-WVS 1981-2009 dataset to the ESRI shapefile of global first administrative units.

B Additional results for cross-district analysis

Most robustness checks replicate Panel A of Table 2, but to keep the tables from exploding in size, checks replicate only column (8) of the same table when more parameters are changed. This specification uses the preferred aggregate measure, Strength of Intrinsic Religiosity Scale.

B.1 Summary statistics

Table A1. Summary statistics

Variable	Obs	Mean	Std. Dev.	Min	Max
Strength of Religiosity Scale	106,054	.736	.296	0	1
Strength of Intrinsic Religiosity Scale	107,022	0.775	0.311	0	1
Dist(earthquakes) 1000 km	211,883	.441	.544	0	3.355
Age	207,293	41.602	16.555	15	108
Male	209,899	.478	.500	0	1
Married dummy	211,193	.575	.494	0	1
Absolute latitude	211,883	34.174	15.064	.119	67.669
Dist(coast) 1000 km	211,883	.239	.257	0	1.990
Earthquake dummy period t	211,714	.068	.250	0	1
Earthquake dummy period t	211,714	.073	.259	0	1
Year	211,883	2002	6.060	1981	2009

B.2 Different earthquake measures

The main measure of earthquake intensity throughout Section 3.3 is the distance to earthquake zones 3 or 4. Table A2 reproduces column (8) of Panel A of Table 2 using distance (and log distance) to zones 1-4, 2-4, 3-4, and 4. Table A3 uses instead the average earthquake zone across pixels within a district. Panel A of Table A3 shows that the result is maintained across all religiosity measures when all controls, except country-by-year fixed effects, are included. Panel B shows that the mean-measure does not hold enough within-country variation to exert an effect on churchgoing and the feeling that God gives comfort within countries.

Table A2. Alternative earthquake measures

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Dependent variable: Strength of Intrinsic Religiosity Scale								
Distance to earthq zones 1-4	-0.061**							
	(0.029)							
Distance to earthq zones 2-4		-0.084***						
		(0.029)						
Distance to earthq zones 3-4			-0.063***					
			(0.016)					
Distance to earthq zone 4				-0.027***				
				(0.008)				
Log (1+) Dist(earthq zones 1-4)					-0.086**			
					(0.040)			
Log (1+) Dist(earthq zones 2-4)						-0.122***		
						(0.042)		
Log (1+) Dist(earthq zones 3-4)							-0.096***	
							(0.024)	
Log (1+) Dist(earthq zone 4)								-0.076***
								(0.018)
Observations	104,040	104,040	104,040	104,040	104,040	104,040	104,040	104,040
R-squared	0.325	0.325	0.325	0.325	0.325	0.326	0.325	0.326
Baseline controls	Y	Y	Y	Y	Y	Y	Y	Y
Regions	591	591	591	591	591	591	591	591
Countries	66	66	66	66	66	66	66	66

Notes. The dependent variable is the Strength of Intrinsic Religiosity Scale [0,1]. Baseline controls are the same as Panel A, Table 2.

Table A3. OLS of religiosity on average earthquake zones

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Dependent variable	impgod	relpers	service	comfort	believe	afterlife	rel	reli
Panel A. Excluding country-by-year FE								
Mean earthquake zone	0.123***	0.105***	0.036*	0.072**	0.087***	0.063*	0.063**	0.073***
	(0.032)	(0.030)	(0.020)	(0.033)	(0.029)	(0.035)	(0.026)	(0.027)
Observations	198,265	192,121	196,861	126,196	129,911	120,073	103,283	104,041
R-squared	0.192	0.054	0.151	0.100	0.085	0.058	0.145	0.130
District and indl controls	Y	Y	Y	Y	Y	Y	Y	Y
Panel B. Including country-by-year FE								
Mean earthquake zone	0.039***	0.025*	0.008	0.009	0.013*	0.042**	0.016*	0.019**
	(0.014)	(0.013)	(0.010)	(0.012)	(0.007)	(0.020)	(0.008)	(0.009)
Observations	198,264	192,120	196,860	126,195	129,910	120,072	103,282	104,040
R-squared	0.406	0.207	0.278	0.263	0.226	0.201	0.336	0.325
District and indl controls	Y	Y	Y	Y	Y	Y	Y	Y
Country-by-year FE	Y	Y	Y	Y	Y	Y	Y	Y
Panel C. Horse race								
Mean earthquake zone	0.029**	0.016	-0.000	-0.001	0.008	0.025	0.007	0.009
	(0.012)	(0.013)	(0.009)	(0.011)	(0.006)	(0.018)	(0.007)	(0.007)
Distance to earthq zones 3-4	-0.043***	-0.039**	-0.035**	-0.060***	-0.033*	-0.107***	-0.059***	-0.060***
	(0.014)	(0.020)	(0.016)	(0.021)	(0.018)	(0.026)	(0.016)	(0.016)
Observations	198,264	192,120	196,860	126,195	129,910	120,072	103,282	104,040
R-squared	0.407	0.208	0.278	0.263	0.226	0.202	0.337	0.325
District and indl controls	Y	Y	Y	Y	Y	Y	Y	Y
Country-by-year FE	Y	Y	Y	Y	Y	Y	Y	Y

Notes. The table replicates Panel A of Table 2 with the average of earthquake zones as an alternative measure of long-term earthquake risk. District and individual controls refers to controls for distance to coast, absolute latitude, individuals' age, age squared, sex, and marital status.

B.3 Number individuals in each subnational district

While the main regressions are estimated for districts with more than 10 respondents per year, Table A4 shows the results for the full sample and the sample excluding districts with less than 10, 20, 30, 40, 50, 75, and 100 respondents respectively.

Table A4. Robustness to number of respondents within each district

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Dependent variable: Strength of Intrinsic Religiosity Scale								
Dist(earthq), 1000km	-0.063***	-0.063***	-0.064***	-0.064***	-0.063***	-0.065***	-0.069***	-0.071***
	(0.016)	(0.016)	(0.017)	(0.017)	(0.017)	(0.017)	(0.019)	(0.021)
Observations	104,122	104,040	103,651	102,860	101,421	99,022	94,590	88,688
R-squared	0.325	0.325	0.325	0.325	0.325	0.325	0.323	0.321
Baseline controls	Y	Y	Y	Y	Y	Y	Y	Y
Sample	Full	>10	>20	>30	>40	>50	>75	>100
Districts	600	591	565	529	501	450	383	315

Notes. OLS estimates. The table replicates column (8) of Panel A of Table 2, varying the criteria for the minimum number of respondents in the district. Sample refers to whether the sample is unrestricted (full sample) or restricted to districts with more than 10, 20, 30, 40, 50, 75, or 100 respondents, respectively.

Table A5 replicates Panel A of Table 2, weighting the observations by the number of respondents in each district.

Table A5. OLS of religiosity on earthquake distance weighted by number respondents

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Dependent variable:	impgod	relpers	service	comfort	believe	afterlife	rel	reli
Dist(earthq), 1000km	-0.050***	-0.062***	-0.047**	-0.039*	-0.026*	-0.124***	-0.055***	-0.054***
	(0.016)	(0.020)	(0.021)	(0.022)	(0.015)	(0.023)	(0.015)	(0.016)
Observations	198,527	192,387	197,121	126,291	130,019	120,170	103,363	104,122
R-squared	0.393	0.173	0.267	0.233	0.204	0.176	0.313	0.297
Baseline controls	Y	Y	Y	Y	Y	Y	Y	Y
Regions	911	907	893	620	602	602	600	600
Countries	85	84	83	67	66	66	66	66

Notes. The table replicates Panel A of Table 2 where observations are weighted with the number of respondents in each district.

B.4 Actual earthquakes

While the main results include controls for actual earthquakes in year t and t-1, Table A6 replicates the result of column (8) of Panel A of Table 2 controlling for additional past earthquakes. Compared to Table 2, the sample is restricted to the sample without districts hit by an earthquake in the year of interview. The reason is that the pooled WVS-EVS only provides data on the year in which the interview took place. Thus, it is not possible to tell whether an earthquake that hit in the same year, hit before or after the interview, which jeopardizes the intrepretation. Column (12) interacts long-term earthquake risk with the dummy indicating whether an earthquake hit in the year before the interview. The interaction is positive, but insignificant. However, only 24 districts in the sample were hit within the last year, so this result should be taken with caution.

Table A6. Accounting for actual earthquakes

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Dep. var.: Strength of Intrinsic Religiosity Scale [0;1]												
Dist(earthq), 1000km	-0.062***	-0.063***	-0.062***	-0.062***	-0.063***	-0.063***	-0.063***	-0.065***	-0.064***	-0.065***	-0.065***	-0.063***
	(0.017)	(0.017)	(0.017)	(0.017)	(0.017)	(0.017)	(0.017)	(0.018)	(0.018)	(0.018)	(0.018)	(0.017)
Earthquake year t-1		-0.003	-0.006	-0.005	-0.004	-0.004	-0.002	-0.002	-0.004	-0.003	-0.006	-0.005
		(0.008)	(0.008)	(0.008)	(0.008)	(0.008)	(0.007)	(0.007)	(0.007)	(0.007)	(0.008)	(0.009)
Earthquake year t-2			0.007	0.009	0.009	0.009	0.009	0.011	0.011	0.011	0.014	
			(0.009)	(0.009)	(0.009)	(0.010)	(0.010)	(0.010)	(0.009)	(0.009)	(0.009)	
Earthquake year t-3				-0.006	-0.006	-0.006	-0.006	-0.006	-0.006	-0.006	-0.009	
				(0.010)	(0.010)	(0.010)	(0.010)	(0.010)	(0.010)	(0.010)	(0.011)	
Earthquake year t-4					-0.005	-0.005	-0.004	-0.003	-0.009	-0.013	-0.011	
					(0.008)	(0.008)	(0.008)	(0.008)	(0.008)	(0.008)	(0.009)	
Earthquake year t-5						-0.000	0.000	-0.000	-0.001	-0.003	-0.004	
						(0.013)	(0.013)	(0.013)	(0.012)	(0.012)	(0.012)	
Earthquake year t-6							-0.005	-0.004	-0.010	-0.010	-0.011	
							(0.009)	(0.009)	(0.009)	(0.009)	(0.009)	
Earthquake year t-7								-0.011	-0.010	-0.011	-0.010	
								(0.018)	(0.018)	(0.018)	(0.017)	
Earthquake year t-8									0.019*	0.016	0.016	
									(0.011)	(0.011)	(0.011)	
Earthquake year t-9										0.013	0.014	
										(0.010)	(0.011)	
Earthquake year t-10											-0.011	
											(0.009)	
Dist(earthq) X earthq t-1												0.080
												(0.098)
Observations	96,811	96,811	96,811	96,811	96,811	96,811	96,811	96,811	96,811	96,809	96,809	96,811
R-squared	0.321	0.321	0.321	0.321	0.321	0.321	0.321	0.321	0.321	0.321	0.321	0.321
Baseline controls	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y

Notes. The table replicates column (8) of Panel A, Table 2 on a sample restricted to districts that were not hit in the year of interview.

B.5 Main results without baseline controls

Table A7 replicates Panel A of Table 2 without controls in Panel A and with country-by-year fixed effects in Panel B. Churchgoing turns insignificant in the specification without country-by-year fixed effects. This could be either due to problems of comparability across countries or it could be in consistence with the findings in the religious coping literature that churchgoing is less affected than intrinsic religiosity.

Table A7. Main results adding controls consequtively

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Dependent variable:	impgod	relpers	service	comfort	believe	afterlife	rel	reli
Panel A. No controls								
Dist(earthq), 1000km	-0.069***	-0.028*	-0.024	-0.123***	-0.086***	-0.077***	-0.094***	-0.099***
	(0.020)	(0.017)	(0.020)	(0.028)	(0.021)	(0.026)	(0.023)	(0.022)
R-squared	0.012	0.001	0.001	0.016	0.015	0.006	0.021	0.021
Panel B. Country-by-year fixed effects								
Dist(earthq), 1000km	-0.056***	-0.049**	-0.039**	-0.070***	-0.042**	-0.122***	-0.068***	-0.072***
	(0.015)	(0.020)	(0.015)	(0.021)	(0.018)	(0.032)	(0.017)	(0.018)
R-squared	0.383	0.182	0.263	0.230	0.207	0.185	0.304	0.292
Observations	203,100	196,721	201,254	130,139	133,948	123,744	105,947	107,022
Regions	884	880	868	611	592	592	591	591
Countries	85	84	83	67	66	66	66	66

Notes. Panel A of Table 2 without controls in Panel A and with country-by-year fixed effects in Panel B.

B.6 Additional controls

Panel A of Table A8 replicates Panel A of Table 2 on the restricted sample, where information on individual income is available. Panel B adds the ten income dummies (variable x047 in the WVS-EVS dataset).

Table A8. Including income dummies

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Dependent variable:	impgod	relpers	service	comfort	believe	afterlife	rel	reli
Panel A. Restricted sample with information on income								
Dist(earthq), 1000km	-0.046***	-0.037*	-0.029*	-0.039**	-0.020	-0.102***	-0.055***	-0.054***
	(0.014)	(0.019)	(0.015)	(0.020)	(0.016)	(0.029)	(0.014)	(0.015)
R-squared	0.415	0.212	0.275	0.255	0.223	0.220	0.312	0.308
Panel B. Including income dummies								
Dist(earthq), 1000km	-0.044***	-0.036*	-0.028*	-0.035*	-0.018	-0.100***	-0.052***	-0.051***
	(0.014)	(0.019)	(0.015)	(0.020)	(0.016)	(0.029)	(0.014)	(0.015)
R-squared	0.417	0.212	0.275	0.257	0.224	0.220	0.314	0.310
Observations	150,035	145,632	148,251	85,447	88,709	82,755	70,827	71,376
Baseline controls	Y	Y	Y	Y	Y	Y	Y	Y

Notes. Panel A replicates Panel A of Table 2, but on the restricted sample, where information on individual income is available. Panel B adds the ten income dummies (variable x047 in the WVS-EVS dataset).

Table A9 replicates column (8) of Panel A of Table 2 adding controls for trust (variable a165 from the pooled EVS-WVS), unemployment dummy,[46] population density in year 2000, arable land shares (calculated based on irrigated and rainfed agriculture, plate 47 from FAO), average temperatures 1961-1990 (spatial data from GAEZ), average precipitation and variation therein (spatial data from GAEZ), district area in square km, and a dummy equal to zero if the distance to earthquake zones 3 or 4 is equal to zero.[47] The coefficient on long term eartquake risk stays remarkably stable throughout. Column (12) includes all variables simultaneously with no change to the results.

[46] The unemployment dummy is equal to one if the person indicated his/her unemployment status as "Unemployed", zero otherwise (variable x028 in the pooled WVS-EVS).

[47] In line with the work by Ager & Ciccone (2014), the results show that increased within-year variation in precipitation increases religiosity.

Table A9. Adding additional control variables

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
Dependent variable: Strength of Intrinsic Religiosity											
Dist(earthq), 1000km	-0.063***	-0.064***	-0.063***	-0.063***	-0.063***	-0.063***	-0.063***	-0.061***	-0.060***	-0.067***	-0.058***
	(0.016)	(0.016)	(0.016)	(0.016)	(0.016)	(0.016)	(0.016)	(0.016)	(0.016)	(0.017)	(0.016)
Trust		0.001									0.002
		(0.003)									(0.003)
Unemployed dummy			0.002								0.002
			(0.004)								(0.004)
Popdens 2000				-0.003**							-0.003**
				(0.001)							(0.001)
Arable land (%)					-0.003						-0.022**
					(0.010)						(0.011)
Avg temp 1961-90						0.001					0.000
						(0.001)					(0.001)
Prec 1961-90							0.016				-0.005
							(0.010)				(0.017)
Var(prec) 1961-90								0.134***			0.170**
								(0.048)			(0.078)
Area 1000km									-0.000		-0.000***
									(0.000)		(0.000)
Disaster>0										0.012	0.015
										(0.010)	(0.011)
Observations	104,040	100,371	101,045	103,489	104,040	103,365	103,365	102,434	104,040	104,040	96,012
R-squared	0.325	0.325	0.330	0.325	0.325	0.325	0.325	0.326	0.326	0.325	0.330
Baseline controls	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Regions	591	591	586	590	591	589	589	583	591	591	578

Notes. The table replicates column (8) of Panel A of Table 2 including additional control variables.

Table A10 replicates column (8) of Panel A of Table 2 including all eleven values from one particular question in the pooled WVS-EVS. The question sounds: Here is a list of qualities that a child can be encouraged to learn at home. Which, if any, do you consider to be especially important? Please choose up to five.[48] The list of qualities includes: Manners (column 1), independence (column 2), hard work (3), feeling of responsibility (4), imagination (5), tolerance and respect for other people (6), thrift saving money and things (7), determination and perseverance (8), religious faith (9 and 10), unselfishness (11), and obedience (12).

[48]Respondents that answered yes to more than five of the values were removed.

Table A10. Adding alternative values as controls and dependent variables

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
Alternative value:	Manners	Independence	Work	Responsibility	Imagination	Respect	Thrift	Perseverence	Faith	Unselfish	Obedience
Panel A: Dependent variable: Strength of Intrinsic Religiosity Scale											
Dist(earthq), 1000km	-0.073***	-0.072***	-0.074***	-0.075***	-0.072***	-0.074***	-0.074***	-0.074***	-0.064***	-0.074***	-0.073***
	(0.019)	(0.019)	(0.019)	(0.019)	(0.019)	(0.019)	(0.019)	(0.019)	(0.020)	(0.019)	(0.019)
Alternative value	0.030***	-0.052***	-0.004	-0.019***	-0.047***	0.002	-0.011***	-0.041***	0.181***	-0.008**	0.024***
	(0.004)	(0.004)	(0.003)	(0.003)	(0.005)	(0.003)	(0.004)	(0.003)	(0.009)	(0.004)	(0.003)
R-squared	0.312	0.317	0.311	0.312	0.314	0.311	0.311	0.314	0.364	0.311	0.312
Observations	69,857	69,857	69,857	69,857	69,857	69,857	69,857	69,857	69,857	69,857	69,857

Notes. OLS estimates. The table replicates column (8) of Panel A of Table 2.

B.7 Added variable plots

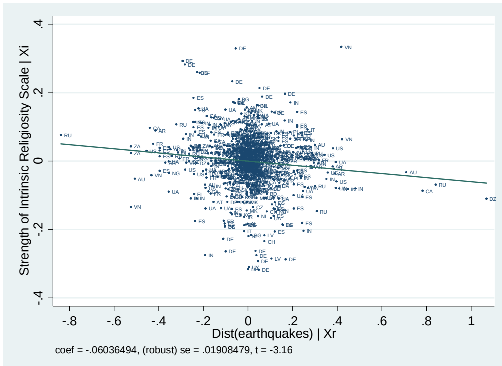
The added variable plots in Figure A2 show results for regressions equivalent to column (8) of Table 2, Panel A, aggregated to the district level in the left column and country level in the right column. The dependent variable is the Strength of Intrinsic Religiosity Scale aggregated to the district (country) level in the left (right) panels. The district-level aggregation is done in the following way: $religiosity_{dct} = \frac{1}{N}\sum_{i=1}^{N} w_{idct} \cdot \widehat{religiosity}_{idct}$, where the weights, w_{idct}, are based on variable s017 used throughout. $\widehat{religiosity}_{idct}$ measures the residuals of a regression of $religiosity_{idct}$ on the particular individual-level controls for age, age squared, married, and male. Panel A has 591 districts and 75 countries.

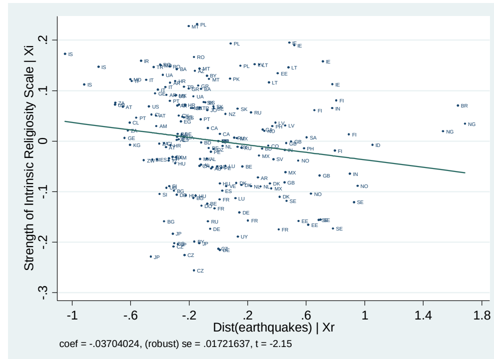
In addtion to the controls included in Panel A of Table 2, the country-level aggregates also include a dummy for whether the country is communist together with continent fixed effects.[49] Whichever level of aggregation is used, the estimate remains significantly different from zero.

Panel B excludes outliers, where Cooks D is larger than 1, while Panel C excludes those where Cooks D is larger than 0.1.

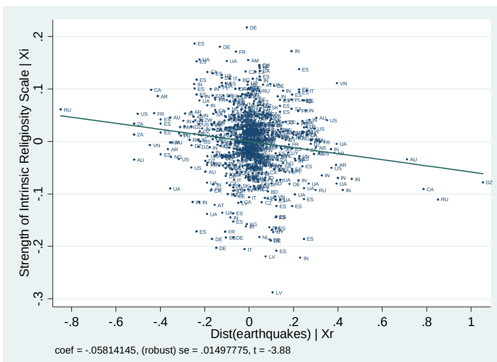
[49]Excluding these additional control variables leaves the parameter estimate on earthquake risk and the level of significance unchanged (-0.032 (se 0.017)).

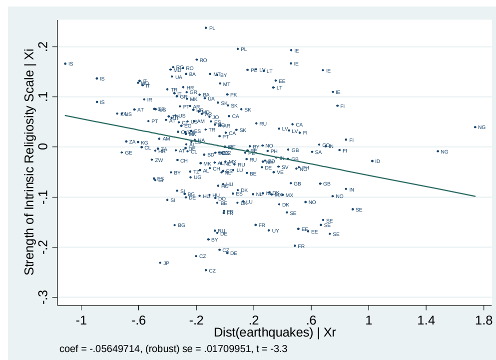
Panel A. Full sample



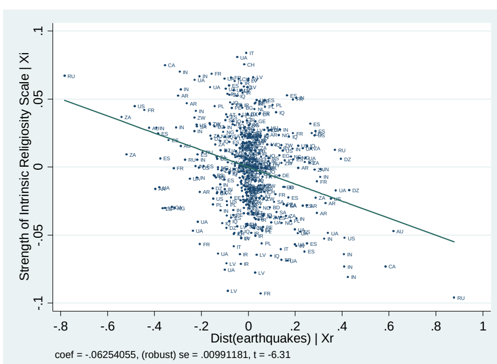


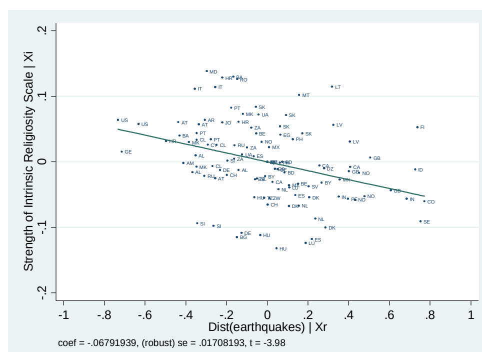
Panel B. Excluding outliers (diff<=1)





Panel B. Excluding outliers (diff<=0.1)





District aggregates | Country aggregates

Figure A2. Added variable plots of religiosity on long-term earthquake risk

Notes. AV-plots of OLS estimation across district aggregates in the left panels and across country aggregates in the right. The estimation corresponds to that in column (8) of Panel A in Table 2, where the individual-level controls are accounted for before aggregation. Panel A includes the full sample, Panel B excludes outliers based on Cooks D $>$ 1, and Panel C excludes outliers based on Cooks D $>$ 0.1. Labels: Country ISO codes.

B.8 Global extent of the impact

To investigate whether people from different denominations engage differently in religious coping, the following equation is estimated:

$$religiosity_{idct} = \alpha + \beta_1 disasters_{dc} + \beta_2 disasters_{dc} \cdot I^g_{idct} + \beta_3 I^g_{idct} + \gamma_{ct} + X'_{dc}\eta + W'_{idct}\delta + \varepsilon_{idct} \quad (4)$$

where I^g are dummy variables equal to one if individual i belonged to the religious denomination g at time t. g refers to one of the major religions: Christianity (split into Catholicism and Protestantism), Islam, Buddhism, Hinduism and Other religions.[50] $\beta_1 + \beta_2$ is the impact of earthquake frequency for individuals belonging to religion g.

Table A11 shows estimation results for equation (4). Column (1) includes no interaction effects, but restricts the sample to the sample where information on individuals' religious denomination is available. The estimate drops in absolute value from -0.063 (column 8, Panel A, Table 2) to -0.043 on this restricted sample. This is probably because we are now comparing people with more similar levels of religiosity.

Column (2) shows that on average, Christians do not respond differently than the rest to increased earthquake risk, but splitting Christians into Catholics and Protestants (col 3 and 4) reveals that Catholics react less than average, while Protestants react no different than the average person in the sample. Columns (5), (6), and (8) show that neither Muslims, Hindus, nor the Other category react differently than average. Column (7) shows that Buddhists tend to respond less to earthquake risk than the rest, leaving the composite effect for Buddhists insignificant (p-value 0.273). But note that Buddhists are very poorly represented in the sample with only 817 individuals categorising themselves as Buddhists.

The finding that Catholics respond more to earthquakes than the rest of the world is consistent with the idea from the religious coping literature that those with more coping alternatives use religion less in coping. One major alternative mentioned is social networks. Catholicism is a relatively community-based religion, while for instance Calvin's doctrine of salvation is based on the principle of "faith alone" (Weber (1930)). This gives Catholics an additional coping alternative to intensified believing, namely their social networks.

[50] The major religions are based on answers to the question "Which religious denomination do you belong to?" (question f025). There are 84 different answers, which are grouped into the major religions and "Other". The latter covers mainly religious denominations reported as "Other" (54%), Jews (21%), and Ancestral worshipping (13%).

Table A11. Across religious denominations

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Dep. var.: Strength of Intrinsic Religiosity Scale								
Dist(earthquakes), 1000 km	-0.043***	-0.054***	-0.056***	-0.038**	-0.039***	-0.037***	-0.044***	-0.044***
	(0.014)	(0.017)	(0.015)	(0.015)	(0.014)	(0.012)	(0.014)	(0.015)
Dist(earthquakes) X Christian		0.018						
		(0.012)						
Dist(earthquakes) X Catholic			0.030**					
			(0.012)					
Dist(earthquakes) X Protestant				-0.017				
				(0.012)				
Dist(earthquakes) X Muslim					-0.018			
					(0.012)			
Dist(earthquakes) X Hindu						-0.038		
						(0.046)		
Dist(earthquakes) X Buddhist							0.105*	
							(0.055)	
Dist(earthquakes) X Other								0.012
								(0.014)
Observations	85,423	85,423	85,423	85,423	85,423	85,423	85,423	85,423
R-squared	0.237	0.238	0.237	0.237	0.240	0.237	0.237	0.237
Baseline controls	Y	Y	Y	Y	Y	Y	Y	Y
Districts	580	580	580	580	580	580	580	580
Individuals in group		54,233	41,269	12,244	22,053	4,968	817	3,352

Notes. The table replicates column (8) of Panel A of Table 2, including interaction terms between earthquake risk and the major religious denominations. All columns include both variables in the interaction term separately.

Table A12 allows the impact of distance to earthquakes to vary across continents by including the interaction term $disaster \cdot I_g$, where I_g is a dummy variable equal to one if the individual lives on that particular continent. The impact of distance to earthquake zones does not vary across continents.

Table A12. OLS results across continents

	(1)	(2)	(3)	(4)	(5)	(6)
Dep. var.: Strength of Intrinsic Religiosity Scale						
Dist(earthquakes), 1000 km	-0.063***	-0.067***	-0.046***	-0.066***	-0.069***	-0.067***
	(0.016)	(0.021)	(0.016)	(0.018)	(0.019)	(0.017)
Dist(earthquakes) X America		0.016				
		(0.032)				
Dist(earthquakes) X Europe			-0.062			
			(0.044)			
Dist(earthquakes) X Asia				0.011		
				(0.049)		
Dist(earthquakes) X Africa					0.031	
					(0.029)	
Dist(earthquakes) X Oceania						0.051
						(0.048)
Observations	104,040	104,040	104,040	104,040	104,040	104,040
R-squared	0.325	0.325	0.326	0.325	0.325	0.325
Baseline controls	Y	Y	Y	Y	Y	Y
Districts	591	591	591	591	591	591
Districts in group		97	287	145	53	9

Notes. The table replicates column (8) of Panel A of Table 2, including interaction terms between earthquake risk and continents. All columns include both variables in the interaction term separately.

B.9 Data on additional disasters

The data on tropical storm intensity zones are based on the probability of occurrence of storms falling within five wind speed categories of the Saffir-Simpson Hurricane Scale.[51] The five wind speed categories are: 1) 118-153 km/h, 2) 154-177 km/h, 3) 178-209 km/h, 4) 210-249 km/h, and 5) 250+ km/h. The Storm Intensity Zone layer shows areas where each of these wind speed categories has a 10% probability of occurring within the next 10 years. For each district, the distance to storm intensity zones 2 or above is calculated. Storm intensity zones 2 or above are depicted in Figure A3 below as the dark blue areas.

The data on volcanic eruption intensity zones measure the density of volcanic eruptions based on the explosivity index for each eruption and the time period of the eruption. Eruption information is spread to 100 km beyond point source to indicate areas that could be affected by volcanic emissions or ground shaking. The source of the data is worldwide historical volcanic eruptions occurring within the last 10,000 years (to 2002) from Siebert & Simkin (2002).[52] The volcanic eruptions were rated using the Volcanic

[51] Available online at U.S. Geological Survey: http://www.usgs.gov/.

[52] The data were digitalized by the Smithsonian Institution's Global Volcanism Program, http://www.volcano.si.edu/index.cfm.

Explosivity Index (VEI), which is a simple 0-to-6 index of increasing explosivity, with each successive integer representing about an order of magnitude increase. For each district, the distance to volcanic eruption risk zones 2 or above is calculated. These zones are depicted by the orange areas in Figure A3.

Similar zone data for tsunamis do not exist. Instead, the tsunami measure is simply the distance from each district to the nearest tsunami ever recorded. The data on tsunami events is from the Global Historical Tsunami Database from the National Geophysical Data Center (NOAA). The events since 2000 BC were gathered from scientific and scholarly sources, regional and worldwide catalogues, tide gauge reports, individual event reports, and unpublished works. The tsunamis are depicted as the triangles in Figure A3.

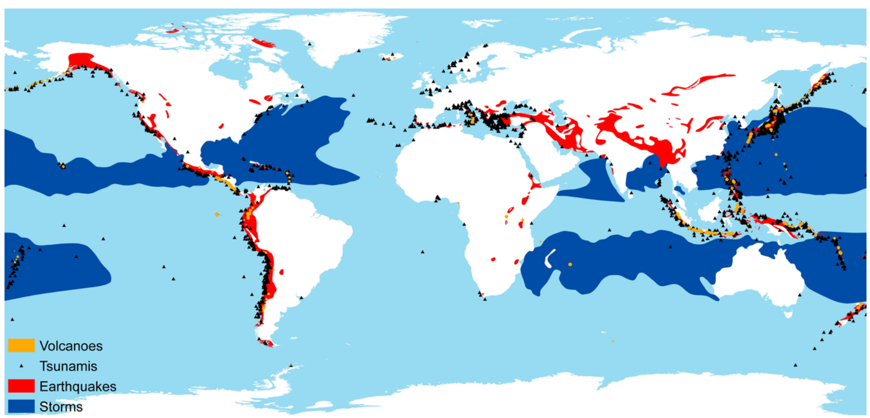
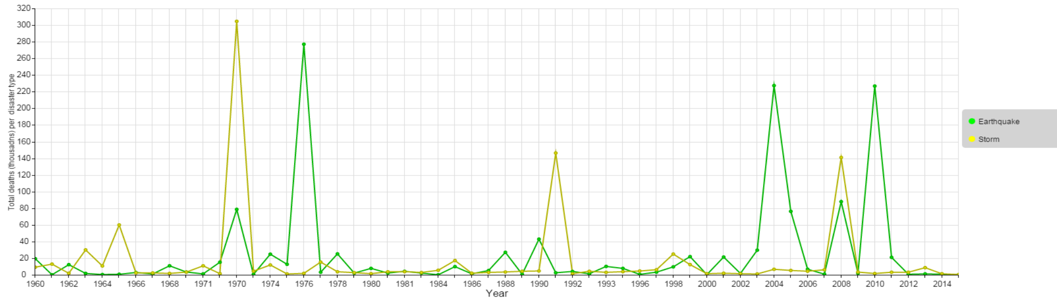
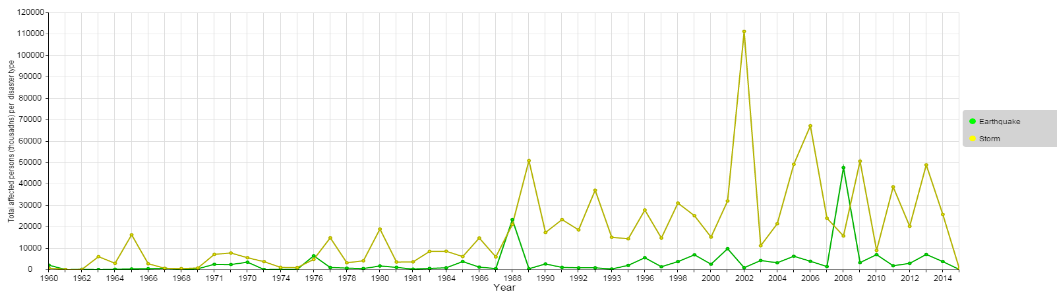


Figure A3. Disaster zones.

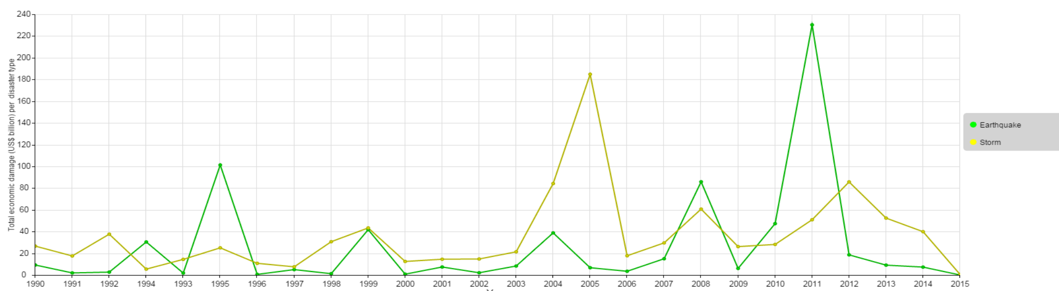
B.10 Severity of earthquakes vs storms



Panel A. Deaths from storms and earthquakes



Panel B. People affected by storms and earthquakes



Panel C. Economic damage by storms and earthquakes

Figure A4. Damage by storms and earthquakes

Source: Data from Emdat (int.nat disaster database), 1960-2014.

B.11 Differential effects across groups

Table A13 replicates column (8) of Panel A in Table 2, checking whether the effect of earthquake risk differs across income, education, or employment status. Columns (1), (3), and (5) add interactions between earthquake risk and individual income, education, employment status, and the average district-level light density. Columns (2), (4), and (6) add interactions with the individual deciles or the income measures and the different categories of education. The impact of earthquake risk does not vary systematically within different income or education levels.

Earthquake risk does increase religiosity significantly more for the unemployed (column 7), even controlling for the ten income fixed effects (column 8). The literature on religious coping finds both dampening effects of income (e.g., Gurin *et al.* (1960)) and no effects (e.g., Carl Pieper *et al.* (1992)). On the other hand, the literature on religious coping agrees that individuals with fewer coping alternatives in general should be more inclined to use religion for coping. One major alternative is social networks to turn to in times of need (e.g., Pargament (2001)). Thus, the finding that unemployed individuals respond more to earthquakes with increased believing, even conditioning on income, is consistent with the religious coping literature.

Columns (9) and (10) include an interaction between earthquake risk and the size of the district area that the individual was interviewed in. This is meant as a test of selection in the cross-section analysis; if the results were driven by atheists moving out of high-risk areas, this effect should be larger for smaller districts, where moving is more likely to mean moving out of the district. If anything, the opposite seems to be the case; earthquake risk increases religiosity slightly more for larger districts.

Table A13. Religious coping interactions

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Dependent variable: Strength of Intrinsic Religiosity Scale [0,1]										
Measure of development	income		light		education		unemployment			
Dist(earthq), 1000km	-0.048***		-0.063***		-0.061***		-0.059***	-0.048***	-0.057***	-0.047***
	(0.017)		(0.016)		(0.018)		(0.016)	(0.015)	(0.017)	(0.016)
Dist(earthq) x development	-0.001		-0.000		-0.001		-0.036***	-0.026***		
	(0.002)		(0.000)		(0.001)		(0.008)	(0.007)		
Dist(earthq) x Area									-0.029*	-0.014
									(0.018)	(0.017)
Dist(earthq) x dev1		-0.053***		-0.111***		-0.053***				
		(0.016)		(0.033)		(0.018)				
Dist(earthq) x dev2		-0.042**		-0.060***		-0.055***				
		(0.016)		(0.018)		(0.018)				
Dist(earthq) x dev3		-0.052***		-0.060***		-0.051***				
		(0.015)		(0.016)		(0.018)				
Dist(earthq) x dev4		-0.056***		-0.050***		-0.077***				
		(0.016)		(0.018)		(0.018)				
Dist(earthq) x dev5		-0.054***		-0.034		-0.073***				
		(0.017)		(0.030)		(0.021)				
Dist(earthq) x dev6		-0.047***		-0.063***		-0.072***				
		(0.016)		(0.020)		(0.017)				
Dist(earthq) x dev7		-0.053***		-0.120***		-0.051***				
		(0.017)		(0.035)		(0.018)				
Dist(earthq) x dev8		-0.038**		-0.078**		-0.068***				
		(0.016)		(0.036)		(0.018)				
Dist(earthq) x dev9		-0.071***		-0.081***						
		(0.022)		(0.028)						
Dist(earthq) x dev10		-0.059***		-0.063**						
		(0.023)		(0.028)						
Observations	71,376	71,376	103,284	103,284	98,278	98,278	101,045	68,569	104,040	71,376
R-squared	0.310	0.310	0.325	0.327	0.329	0.330	0.330	0.317	0.326	0.310
Baseline controls	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Income FE	N	N	N	N	N	N	N	Y	N	Y

Notes. The table replicates column (8) of Panel A of Table 2, allowing for interactions with development in columns (1)-(8) and district area in columns (9)-(10). dev1 refers to income decile 1 or educational level 1 (inadequately completed elementary education), dev2 refers to income decile 2 or educational level 2 (completed compulsory elementary education), dev3 refers to income decile 3 or educational level 3 (incomplete secondary school, technical), dev4 refers to income decile 4 or educational level 4 (complete secondary school, technical), dev5 refers to income decile 5 or educational level 5 (incomplete secondary school, university), dev6 refers to income decile 6 or educational level 6 (complete secondary school, university), dev7 refers to income decile 7 or educational level 7 (some university without degree), dev8 refers to income decile 8 or educational level 8 (university with degree), dev9 and dev10 are the last income deciles. Both variables in interaction terms are included separately.

C Additional results for within districts analysis

This section investigates the robustness of the main results in Panel B of Table 4. The checks involve exclusively intrinsic religiosity as impacts on extrinsic religiosity (church-going) may be due to the channel through economic damage per se, which is not the focus here. Overall, results using the share of religious persons are less robust to changes, while the average importance of God in a district is robust to most changes. This is not surprising, since whether or not individuals regard themselves as religious involves a much larger change than how important they rank God in their lives on a scale from zero to ten. Thus, the test using the share of religious persons is a more demanding one.

C.1 Varying cut-off levels

The main analysis defines a district as being hit by an earthquake if the earthquake hit within 100 km of the district borders. Panels A and B of Table A14 show that the results are robust to varying the cut-off level from 0 to 200 km in increments of 50 km when using importance of God as the measure of religiosity. Panel C shows that the results using the share of religious persons are less robust to choice of cut-off levels. Part of the sensitivity seems to be mainly due to a few outliers, though (removed in Panel D).

The reason for the varying number of observations is that district-years are excluded if an earthquake hit in the year of the interview, discussed in the main text.

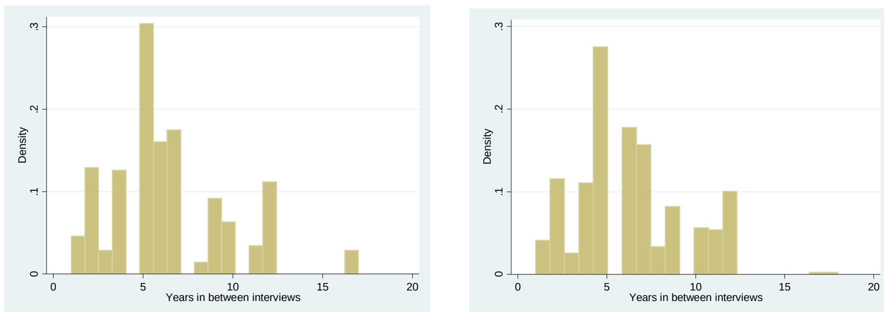
Table A14. Varying cut-off levels

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Earthquake measure:	Earthquake dummy					Number earthquakes				
Panel A. Dependent variable: D. Importance of God										
Earthquake measure	0.107***	0.089**	0.093***	0.070***	0.067***	0.107***	0.074**	0.058**	0.044***	0.030***
	(0.035)	(0.035)	(0.028)	(0.022)	(0.018)	(0.035)	(0.033)	(0.021)	(0.009)	(0.009)
Earthq x Frequent earthquakes	-0.094**	-0.081**	-0.073**	-0.027	0.027	-0.103***	-0.083**	-0.053***	-0.040***	-0.019
	(0.037)	(0.035)	(0.029)	(0.024)	(0.080)	(0.033)	(0.032)	(0.019)	(0.012)	(0.014)
Observations	370	353	350	335	326	370	353	350	335	326
R-squared	0.341	0.336	0.338	0.319	0.317	0.340	0.334	0.333	0.316	0.310
District-years with earthquake	13	25	33	41	46	13	25	33	41	46
Panel B. No outliers										
Earthquake measure	0.092***	0.054***	0.066***	0.045*	0.042*	0.092***	0.046***	0.052***	0.033***	0.023***
	(0.030)	(0.015)	(0.015)	(0.026)	(0.024)	(0.030)	(0.013)	(0.011)	(0.010)	(0.008)
Earthq x Frequent earthquakes	-0.080**	-0.047**	-0.039**	-0.047**	0.007	-0.089***	-0.058***	-0.047***	-0.029***	-0.021**
	(0.034)	(0.018)	(0.016)	(0.018)	(0.006)	(0.029)	(0.014)	(0.011)	(0.009)	(0.009)
Observations	352	337	334	319	306	352	335	331	320	307
R-squared	0.412	0.405	0.408	0.391	0.402	0.412	0.406	0.406	0.388	0.399
District-years with earthquake	13	24	31	40	44	13	24	29	40	44
Panel C. Dependent variable: D. Religious person										
Earthquake measure	-0.002	0.031	0.062**	0.040	-0.002	-0.002	0.024	0.044***	0.028	0.011
	(0.036)	(0.033)	(0.027)	(0.054)	(0.028)	(0.036)	(0.021)	(0.014)	(0.026)	(0.019)
Earthq x Frequent earthquakes	0.011	0.007	-0.058	-0.079	0.069+	0.007	-0.028	-0.046**	-0.027	0.021
	(0.041)	(0.038)	(0.041)	(0.067)	(0.042)	(0.038)	(0.024)	(0.018)	(0.029)	(0.022)
Observations	390	373	370	355	345	390	373	370	355	345
R-squared	0.414	0.416	0.417	0.411	0.397	0.414	0.415	0.417	0.410	0.400
District-years with earthquake	14	25	33	38	42	14	25	33	38	42
Panel D. Dependent variable: D. Religious person (No outliers)										
Earthquake measure	-0.023	0.026+	0.064***	0.083**	0.028	-0.023	0.023*	0.046***	0.053***	0.031**
	(0.036)	(0.016)	(0.014)	(0.035)	(0.028)	(0.036)	(0.012)	(0.007)	(0.010)	(0.013)
Earthq x Frequent earthquakes	0.031	0.014	-0.046	-0.089***	0.039	0.028	-0.030**	-0.049***	-0.053***	0.015
	(0.039)	(0.028)	(0.034)	(0.031)	(0.059)	(0.037)	(0.014)	(0.012)	(0.014)	(0.018)
Observations	374	356	351	337	329	374	354	351	338	326
R-squared	0.495	0.514	0.517	0.523	0.498	0.495	0.515	0.517	0.517	0.500
District-years with earthquake	14	25	32	36	41	14	25	32	37	39
Cutoff	0	50	100	150	200	0	50	100	150	200
Baseline controls	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y

Notes. OLS estimates. The dependent variable is the change in the district average of importance of God in Panels A and B and district share of religious persons in Panels C and D. Earthquakes are measured with the dummy variable in columns (1)-(5) and the number of earthquakes in columns (6)-(10). Outliers detected based on Cooks D>1.

C.2 Years between interviews

The main regressions exclude district-years measured more than 10 years apart. Figure A5 shows the distribution of years between interviews in the full sample.



Importance of God   Religious person

Figure A5. Distribution of the number of years between interviews

C.3 Different measures of frequent earthquakes

In the main analysis, a district is defined as having been hit frequently by earthquakes if the district lies in the top 95^{th} percentile in terms of the number of earthquakes that hit during the period for which there is comparable data on earthquake instances, 1973-2014. This turns out to equal seven earthquakes or more. Columns (1)-(3) and (5)-(7) of Table A15 show that the results do not depend on the exact choice of percentile, particularly when measuring religiosity along the intensive margin (importance of God). Again the extensive margin (share of religious persons) is somewhat less robust. The results are also robust to using instead a dummy equal to one if the district is located within the earthquake zone 3 or 4 as defined in the cross-district analysis (columns 4 and 8).

Table A15. Different high-frequency measures

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Dependent variable	D.importance of God				D.religious person			
Panel A. Earthquake dummy								
Earthquake dummy	0.131***	0.093***	0.078***	0.098**	0.062	0.062**	0.052**	0.071***
	(0.046)	(0.028)	(0.024)	(0.037)	(0.050)	(0.027)	(0.022)	(0.025)
Earthq x Frequent earthquakes	-0.093+	-0.073**	-0.045*	-0.048	-0.031	-0.058	0.008	-0.041
	(0.058)	(0.029)	(0.024)	(0.042)	(0.050)	(0.041)	(0.022)	(0.030)
R-squared	0.342	0.338	0.335	0.338	0.416	0.417	0.414	0.415
Panel B. Number earthquakes								
Number earthquakes	0.100**	0.058**	0.030**	0.058*	0.050+	0.044***	0.023***	0.029*
	(0.043)	(0.021)	(0.012)	(0.030)	(0.033)	(0.014)	(0.007)	(0.016)
Earthq x Frequent earthquakes	-0.088*	-0.053***	-0.024*	-0.044+	-0.038	-0.046**	-0.006	-0.012
	(0.047)	(0.019)	(0.012)	(0.030)	(0.033)	(0.018)	(0.007)	(0.016)
R-squared	0.337	0.333	0.326	0.331	0.416	0.417	0.413	0.414
Observations	350	350	350	350	370	370	370	370
High risk measure	>=90 pct	>=95 pct	>=99 pct	zone	>=90 pct	>=95 pct	>=99 pct	zone
Baseline controls	Y	Y	Y	Y	Y	Y	Y	Y

Notes. OLS estimates. The dependent variable is the change in the district aggregate of importance of God in columns (1)-(4) and the change in the share of religious persons in columns (5)-(8). Panel A measures earthqakes with a dummy equal to one if the district was hit by one or more earthquakes. In Panel B, the earthquake measure is the actual number of earthquakes. Baseline controls are the same as those in Table 4.

C.4 Initial religiosity

Columns (1) and (4) of Table A16 replicate the corresponding columns in Panel B of Table 4. Columns (2)-(3) and (5)-(6) add initial religiosity and its interaction with earthquakes. The impact of earthquakes on religiosity does not depend on the initial level of religiosity. The main results are unchanged.

Table A16. Accounting for initial religiosity

	(1)	(2)	(3)	(4)	(5)	(6)
Dependent variable:	D.impgod			D.relpers		
Panel A. Earthquake dummy						
Earthquake dummy	0.093***	0.072***	0.072**	0.062**	0.052***	0.045**
	(0.028)	(0.017)	(0.030)	(0.027)	(0.016)	(0.020)
Earthq x Frequent earthquakes	-0.073**	-0.063***	-0.063***	-0.058	-0.055**	-0.048**
	(0.029)	(0.017)	(0.017)	(0.041)	(0.023)	(0.022)
Initial religiosity		-0.616***	-0.615***		-0.577***	-0.580***
		(0.137)	(0.137)		(0.091)	(0.092)
Earthq x initial religiosity			-0.008			0.068
			(0.125)			(0.065)
R-squared	0.338	0.540	0.540	0.417	0.584	0.584
Panel B. Number earthquakes						
Number earthquakes	0.058**	0.045***	0.051***	0.044***	0.038***	0.033***
	(0.021)	(0.012)	(0.018)	(0.014)	(0.009)	(0.011)
Earthq x Frequent earthquakes	-0.053***	-0.048***	-0.056**	-0.046**	-0.045***	-0.033**
	(0.019)	(0.012)	(0.021)	(0.018)	(0.012)	(0.014)
Initital religiosity		-0.620***	-0.617***		-0.578***	-0.579***
		(0.138)	(0.138)		(0.091)	(0.091)
Earthq x initial religiosity			-0.038			0.030
			(0.049)			(0.019)
R-squared	0.333	0.538	0.538	0.417	0.584	0.584
Observations	350	350	350	370	370	370
Baseline controls	Y	Y	Y	Y	Y	Y

Notes. OLS estimates. The dependent variables are changes in district average of importance of God in columns (1)-(3) and the share of religious persons in columns (4)-(6). Panel A measures earthqakes with a dummy equal to one if the district was hit by one or more earthquakes. In Panel B, the earthquake measure is the actual number of earthquakes. Baseline controls are the same as those in Table 4.

C.5 Additional controls

Table A17 adds ten income fixed effects. The sample is restricted to the sample with information on individual income in uneven columns of Table A17, while ten income fixed effects are added to the set of baseline controls in even columns. Table A18 adds the same measures of cultural values as added in Table A10.

Table A17. Adding individual income fixed effects

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Earthquakes measure:	Earthquake dummy		Number earthquakes		Earthquake dummy		Number earthquakes	
Dependent variable:	D.Importance of God				D.Religious person			
Earthquake measure	0.087***	0.084***	0.054**	0.053***	0.065**	0.054*	0.045***	0.039***
	(0.029)	(0.026)	(0.020)	(0.018)	(0.027)	(0.027)	(0.013)	(0.012)
Earthq x Frequent earthq	-0.068**	-0.074**	-0.049**	-0.052***	-0.061	-0.078*	-0.047**	-0.048**
	(0.029)	(0.027)	(0.018)	(0.017)	(0.041)	(0.039)	(0.018)	(0.018)
Observations	276	276	276	276	296	296	296	296
R-squared	0.349	0.282	0.344	0.278	0.435	0.388	0.435	0.389
Income FE	N	Y	N	Y	N	Y	N	Y
Baseline controls	Y	Y	Y	Y	Y	Y	Y	Y

Table A18. Adding controls for various alternative values

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
Alternative value:		Manners	Independence	Work	Responsibility	Imagination	Respect	Thrift	Perseverence	Faith	Unselfish
Panel A. Dependent variable: D.importance of God											
Earthquake dummy	0.093***	0.140*	0.090***	0.091***	0.089***	0.096***	0.093***	0.092***	0.084***	0.096***	0.090***
	(0.028)	(0.071)	(0.030)	(0.029)	(0.025)	(0.028)	(0.028)	(0.030)	(0.028)	(0.032)	(0.029)
Earthq dummy x Frequent earthq	-0.073**	-0.093	-0.069**	-0.072**	-0.070**	-0.064**	-0.074**	-0.074**	-0.065**	-0.089**	-0.069**
	(0.029)	(0.075)	(0.032)	(0.030)	(0.030)	(0.031)	(0.030)	(0.031)	(0.030)	(0.033)	(0.030)
Observations	350	65	350	334	350	331	350	350	331	350	331
R-squared	0.338	0.397	0.348	0.336	0.343	0.339	0.344	0.339	0.352	0.265	0.340
Difference p-value		0.527	0.924	0.941	0.886	0.919	0.999	0.982	0.763	0.916	0.921
Number earthquakes	0.058**	0.140*	0.057**	0.056**	0.056***	0.061***	0.058**	0.057**	0.052**	0.064***	0.055**
	(0.021)	(0.072)	(0.023)	(0.022)	(0.020)	(0.022)	(0.022)	(0.023)	(0.021)	(0.023)	(0.023)
Number earthq x Frequent earthq	-0.053***	-0.236***	-0.048**	-0.052**	-0.052***	-0.055**	-0.053***	-0.053**	-0.047**	-0.057***	-0.050**
	(0.019)	(0.072)	(0.022)	(0.020)	(0.019)	(0.020)	(0.019)	(0.021)	(0.019)	(0.021)	(0.020)
R-squared	0.333	0.404	0.344	0.331	0.338	0.334	0.339	0.333	0.348	0.262	0.334
Difference p-value		0.283	0.972	0.937	0.933	0.870	0.977	0.984	0.799	0.776	0.911
Panel B. Dependent variable: D.Religious person											
Earthquake dummy	0.062**	0.184**	0.061**	0.052*	0.059**	0.054**	0.060**	0.060**	0.046	0.053*	0.052*
	(0.027)	(0.080)	(0.026)	(0.028)	(0.024)	(0.026)	(0.027)	(0.028)	(0.029)	(0.030)	(0.027)
Earthq dummy x Frequent earthq	-0.058	0.071*	-0.055	-0.052	-0.056	-0.043	-0.057	-0.058	-0.042	-0.046	-0.048
	(0.041)	(0.034)	(0.039)	(0.043)	(0.036)	(0.040)	(0.041)	(0.041)	(0.043)	(0.049)	(0.042)
Observations	370	76	370	354	370	354	370	370	351	351	354
R-squared	0.417	0.631	0.421	0.282	0.419	0.292	0.414	0.415	0.285	0.405	0.284
Difference p-value		0.162	0.981	0.732	0.902	0.776	0.949	0.946	0.602	0.790	0.744
Number earthquakes	0.044***	0.184**	0.044***	0.037**	0.042***	0.041***	0.043***	0.043***	0.035**	0.043***	0.038**
	(0.014)	(0.081)	(0.014)	(0.014)	(0.013)	(0.013)	(0.014)	(0.015)	(0.014)	(0.015)	(0.014)
Number earthq x Frequent earthq	-0.046**	-0.272***	-0.042**	-0.040**	-0.044**	-0.042**	-0.045**	-0.044**	-0.035*	-0.035**	-0.039**
	(0.018)	(0.080)	(0.018)	(0.019)	(0.017)	(0.018)	(0.018)	(0.018)	(0.018)	(0.017)	(0.018)
R-squared	0.417	0.632	0.421	0.282	0.419	0.292	0.414	0.415	0.286	0.406	0.284
Difference p-value		0.117	0.965	0.653	0.924	0.844	0.971	0.945	0.564	0.981	0.673
Baseline controls	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y

Notes. OLS estimates. The table replicates Panel B of Table 4 adding various additional values as controls. All are described by Table A10.
Difference p-value indicates the p-value of the test that the estimate equals the estimate in column (1).

C.6 Dynamics

Table A19 exploits the difference in period lengths in order to investigate the short-term dynamics of the effect of earthquakes. The main analysis excludes districts with more than 10 years in between interviews. Column (1) shows that the results are robust to using the full sample of period lengths. Columns (2)-(9) narrows the window of observation more as we move to the right in the table from 12 years or below to 5 years or below. The reason for not reducing the window of observation further is that the interaction with "Frequent earthquakes" cannot be estimated in this sample. The impact of earthquakes increases when narrowing the window of observation, consistent with the idea that the impact falls over time. Table A20 shows that this is not because the period length depends on characteristics such as earthquakes, district-level average income, education, age of the respondents, fraction males, or fraction married.

Table A19. Religious coping dynamics

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Periodlength	All	<=12	<=11	<=10	<=9	<=8	<=7	<=6	<=5
Panel A. Dependent variable: D.Importance of God									
Avg period length	6.327	6.111	5.540	5.369	5.058	4.747	4.692	4.172	3.701
Earthquake dummy = 1	0.087***	0.084***	0.091***	0.093***	0.097***	0.097***	0.097***	0.133**	0.200**
	(0.026)	(0.026)	(0.027)	(0.028)	(0.030)	(0.030)	(0.030)	(0.052)	(0.077)
Earthq x Frequent earthquakes	-0.049	-0.047	-0.071**	-0.073**	-0.078**	-0.078**	-0.078**	-0.089**	-0.142*
	(0.030)	(0.030)	(0.028)	(0.029)	(0.032)	(0.032)	(0.032)	(0.041)	(0.068)
R-squared	0.456	0.407	0.348	0.338	0.327	0.320	0.321	0.326	0.384
Number earthquakes	0.056***	0.054***	0.057**	0.058**	0.059**	0.059**	0.059**	0.138**	0.220***
	(0.019)	(0.018)	(0.021)	(0.021)	(0.023)	(0.023)	(0.023)	(0.052)	(0.061)
Earthq x Frequent earthquakes	-0.045***	-0.043***	-0.052***	-0.053***	-0.054**	-0.054**	-0.054**	-0.120**	-0.188***
	(0.016)	(0.016)	(0.019)	(0.019)	(0.021)	(0.021)	(0.021)	(0.047)	(0.058)
R-squared	0.453	0.405	0.343	0.333	0.320	0.313	0.314	0.327	0.388
Observations	404	396	361	350	328	304	299	244	194
Panel B. Dependent variable: D.Religious person									
Avg period length	6.261	6.233	5.715	5.443	5.155	4.870	4.740	4.254	3.708
Earthquake dummy = 1	0.049*	0.049*	0.052*	0.062**	0.059*	0.059*	0.059*	0.049	0.098+
	(0.028)	(0.028)	(0.028)	(0.027)	(0.029)	(0.029)	(0.029)	(0.065)	(0.057)
Earthq x Frequent earthquakes	-0.066	-0.066	-0.075+	-0.058	-0.056	-0.056	-0.056	0.023	0.024
	(0.046)	(0.046)	(0.049)	(0.041)	(0.043)	(0.043)	(0.043)	(0.059)	(0.061)
R-squared	0.465	0.465	0.429	0.417	0.417	0.415	0.414	0.418	0.453
Number earthquakes	0.027	0.027	0.039**	0.044***	0.042***	0.042***	0.042***	0.048	0.110**
	(0.020)	(0.020)	(0.014)	(0.014)	(0.014)	(0.014)	(0.014)	(0.066)	(0.050)
Earthq x Frequent earthquakes	-0.048*	-0.048*	-0.062**	-0.046**	-0.044**	-0.044**	-0.044**	-0.041	-0.079+
	(0.026)	(0.026)	(0.024)	(0.018)	(0.018)	(0.018)	(0.018)	(0.063)	(0.048)
R-squared	0.466	0.466	0.431	0.417	0.417	0.415	0.414	0.418	0.452
Observations	425	424	389	370	348	324	311	256	195
Baseline controls	Y	Y	Y	Y	Y	Y	Y	Y	Y

Notes. OLS estimates. The dependent variables are changes in district average importance of God in Panel A and the share of religious persons in Panel B. Each panel includes two types of regressions using the earthquake dummy and the number of earthquakes.

Table A20. OLS of period lengths on main variables

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Earthquake measure:			Earthquake dummy						Number earthquakes			
Dependent variable: Period length												
Earthquake measure	-0.001	-0.019	0.033	-0.007	0.000	-0.006	0.006	0.012	0.049	0.022	0.027	0.022
	(0.018)	(0.049)	(0.072)	(0.056)	(0.064)	(0.055)	(0.010)	(0.041)	(0.059)	(0.043)	(0.052)	(0.046)
Earthq x Frequent earthquakes	0.106	0.316	0.230	0.233	0.251	0.236	0.021	0.025	-0.015	0.010	0.005	0.009
	(0.090)	(0.248)	(0.198)	(0.199)	(0.204)	(0.184)	(0.030)	(0.037)	(0.048)	(0.047)	(0.050)	(0.045)
Years since an earthquake hit	-0.000	-0.002	-0.001	-0.001	-0.001	-0.001	-0.000	-0.001	-0.001	-0.001	-0.001	-0.001
	(0.001)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.001)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
Average education		0.098						0.095				
		(0.109)						(0.106)				
Average income			0.119						0.118			
			(0.088)						(0.086)			
Share males				0.297						0.306		
				(0.455)						(0.449)		
Average age					0.001						0.001	
					(0.014)						(0.013)	
Share married						-0.000						-0.005
						(0.837)						(0.832)
Observations	2,159	717	669	785	775	788	2,159	717	669	785	775	788
R-squared	0.879	0.882	0.856	0.883	0.883	0.883	0.880	0.882	0.857	0.884	0.884	0.884

Notes. OLS estimates. The dependent variable is period length measured by the number of years between interviews. The measure of earthquakes is the earthquake dummy in columns (1)-(6) and the number of earthquakes in columns (7)-(12).

An alternative way to test the dynamics is to estimate the district aggregate of equation (1) with district fixed effects and adding lags of earthquakes. This is done in Table A21 on the full sample. Past earthquakes are aggregated into groups of three years, since there is too much noise and too few earthquakes in the year-intervals of 1 or 2 years. "Earthquakes t1-3" measures whether earthquakes hit the district within the past three years, measuring earthquakes by the earthquake dummy in columns (1)-(4) and the number of earthquakes in columns (5)-(8). "Earthquakes t4-6" measures whether earthquakes hit between four and six years ago, "Earthquakes t7-9" between seven and nine years ago, and "Earthquakes t10-12" between ten and twelve years ago. All columns include district fixed effects and country-by-year fixed effects. Even columns add the remaining baseline controls. Panel A estimates the simple linear effect, while Panel B includes the interaction with the "Frequent earthquakes" dummy.

Earthquakes that hit within the last nine years increase religiosity significantly more than earthquakes that hit longer time ago. The result is again stronger on the intensive margin; average importance of God is affected more than the share of religious persons.

Table A21. OLS of religiosity on earthquakes dynamics

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Earthquake measure	Earthquake dummy				Number earthquakes			
Dependent variable	impgod		relpers		impgod		relpers	
Panel A. Baseline regressions								
Earthquakes t1-3	0.064***	0.063***	0.035**	0.036**	0.021**	0.021*	0.011*	0.012*
	(0.016)	(0.016)	(0.016)	(0.016)	(0.010)	(0.011)	(0.006)	(0.007)
Earthquakes t4-6	0.008	0.010	-0.017	-0.018	0.006	0.005	-0.014	-0.013
	(0.018)	(0.019)	(0.024)	(0.023)	(0.006)	(0.006)	(0.010)	(0.010)
Earthquakes t7-9	0.032+	0.032+	0.025	0.027	0.012	0.015	0.014	0.015
	(0.021)	(0.020)	(0.024)	(0.023)	(0.013)	(0.012)	(0.014)	(0.014)
Earthquakes t10-12	0.009	0.011	0.030+	0.034*	0.002	0.003	0.010	0.011
	(0.011)	(0.011)	(0.020)	(0.020)	(0.007)	(0.006)	(0.011)	(0.011)
R-squared	0.951	0.950	0.922	0.926	0.950	0.949	0.922	0.926
Panel B. Interactions with high earthquake frequency								
Earthquakes t1-3	0.086***	0.087***	0.043**	0.045**	0.059***	0.061***	0.023	0.023
	(0.018)	(0.017)	(0.017)	(0.017)	(0.015)	(0.014)	(0.016)	(0.016)
x High frequency	-0.068***	-0.073***	-0.022	-0.023	-0.055***	-0.059***	-0.017	-0.016
	(0.019)	(0.020)	(0.025)	(0.025)	(0.016)	(0.015)	(0.016)	(0.017)
Earthquakes t4-6	0.048**	0.052**	-0.006	-0.006	0.030**	0.034**	-0.006	-0.006
	(0.022)	(0.022)	(0.036)	(0.034)	(0.014)	(0.014)	(0.023)	(0.022)
x High frequency	-0.108***	-0.114***	-0.048	-0.048	-0.041**	-0.048***	-0.022	-0.019
	(0.031)	(0.031)	(0.040)	(0.039)	(0.017)	(0.017)	(0.029)	(0.028)
Earthquakes t7-9	0.058**	0.061**	0.015	0.019	0.032	0.040**	0.006	0.008
	(0.026)	(0.023)	(0.027)	(0.026)	(0.025)	(0.019)	(0.017)	(0.017)
x High frequency	-0.048+	-0.055*	0.041	0.036	-0.022	-0.031+	0.027+	0.022
	(0.029)	(0.027)	(0.034)	(0.033)	(0.025)	(0.019)	(0.017)	(0.017)
Earthquakes t10-12	0.015	0.018+	0.022	0.027	0.011	0.014	0.014	0.018
	(0.012)	(0.011)	(0.021)	(0.022)	(0.011)	(0.010)	(0.017)	(0.017)
x High frequency	-0.035*	-0.039**	0.024	0.020	-0.020*	-0.024**	-0.013	-0.016
	(0.019)	(0.018)	(0.030)	(0.028)	(0.011)	(0.009)	(0.017)	(0.017)
R-squared	0.952	0.951	0.922	0.926	0.951	0.950	0.922	0.926
Observations	687	687	716	716	687	687	716	716
District FE	Y	Y	Y	Y	Y	Y	Y	Y
Country-by-year FE	Y	Y	Y	Y	Y	Y	Y	Y
Remaining baseline controls	N	Y	N	Y	N	Y	N	Y

Notes. OLS estimates. The unit of analysis is a district at time t. The dependent variable is average importance of God in columns (1)-(2) and (5)-(6) and the share of religious persons in columns (3)-(4) and (7-8). The earthquake measure is the earthquake dummy in columns (1)-(4) and the number of earthquakes in columns (5)-(8). Panel A estimates the simple linear effect, while Panel B includes the interaction between the earthquake measure and the dummy variable equal to one if the district was hit by 7 earthquakes or more over the period 1973-2014. All columns include a constant. Standard errors (in parenthesis) are clustered at the country level. Asterisks ***, **, *, and + indicate significance at the 1, 5, 10, and 15% level, respectively.

C.7 Alternative religiosity measures

The main analysis includes only the three measures of religiosity with the most observations. Table A22 shows the results for the remaining measures of religiosity. The results are robust to using the two composite measures Strength of Religiosity Scale and Strength of Intrinsic Religiosity Scale (columns 7-10). Earthquakes do not, however, increase believing when measured by the three individual measures; whether or not a person finds comfort in religion, believes in God, or believes in an Afterlife. A factor that reduces the precision of the estimation is that these religiosity measures are available for only half the number of individuals in half the number of countries compared to the measures in the text. A factor that reduces the size of the estimates is that these are measures of religiosity on the extensive margin; *whether or not* the individuals believe. As found throughout, earthquakes are more likely to increase the *degree* of believing, compared to whether or not individuals believe.

Table A22. Alternative religiosity measures

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Dependent variable:	D.comfort		D.believe		D.after		D.reli		D.rel	
Panel A. Earthquake dummy										
Earthquake dummy	-0.001	-0.010	-0.001	0.001	0.062	0.072	0.048**	0.048**	0.045**	0.043*
	(0.018)	(0.016)	(0.013)	(0.011)	(0.071)	(0.074)	(0.018)	(0.019)	(0.020)	(0.021)
Earthq dummy x Frequent earthquakes	-0.023	0.041	-0.013	-0.008	-0.070	-0.079	-0.071**	-0.034+	-0.052	-0.021
	(0.027)	(0.029)	(0.010)	(0.011)	(0.073)	(0.082)	(0.026)	(0.022)	(0.036)	(0.032)
R-squared	0.240	0.240	0.355	0.355	0.382	0.401	0.456	0.487	0.430	0.451
Panel B. Number earthquakes										
Number earthquakes	0.000	-0.007	-0.001	-0.002	0.022	0.022	0.026*	0.024+	0.024*	0.021+
	(0.010)	(0.009)	(0.006)	(0.006)	(0.042)	(0.044)	(0.013)	(0.014)	(0.013)	(0.014)
Number earthq x Frequent earthquakes	-0.029	0.008	-0.012	-0.005	-0.032	-0.022	-0.049*	-0.024+	-0.036*	-0.018
	(0.026)	(0.010)	(0.009)	(0.008)	(0.044)	(0.043)	(0.024)	(0.015)	(0.019)	(0.017)
R-squared	0.245	0.239	0.358	0.356	0.377	0.393	0.457	0.482	0.428	0.445
Observations	181	174	181	174	181	174	180	173	180	173
Baseline controls	N	Y	N	Y	N	Y	N	Y	N	Y
Districts	125	125	125	125	125	125	125	125	125	125
Countries	16	16	16	16	16	16	16	16	16	16

Notes. OLS estimates. The dependent variable in columns (1)-(2) is the change in the district aggregate of answers to "Do you find comfort in God?", "Do you believe in God?" in columns (3-4), "Do you believe in Afterlife?" in columns (5-6), the Strength of Intrinsic Religiosity Scale in columns (7-8) and the Strength of Religiosity Scale in columns (9-10). All columns include a constant. Standard errors (in parenthesis) are clustered at the country level. Asterisks ***, **, *, and + indicate significance at the 1, 5, 10, and 15\% level, respectively.

C.8 Different magnitudes

The main results are based on earthquakes of magnitude 6 or above. Table A23 uses different magnitude cut-offs, ranging from 5 or above in columns (1) and (7) to 6.5 or above in columns (6) and (12). The magnitude scale is logarithmic, so the shaking felt at magnitude 6 is ten times larger than the magnitude felt at magnitude 5.

The estimate on earthquakes increases almost with all magnitude increases. Further, it takes larger earthquakes to influence the extensive margin compared to the intensive margin.

The reason for the change in the number of observations is that the analysis - in line with the main analysis - excludes district-years with earthquakes in the same year as the interview.

Table A23. Different magnitudes

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Earthquake measure:	Earthquake dummy						Number earthquakes					
Panel A. Dependent variable: D. importance of God												
Earthquake measure	0.012	0.044	0.052**	0.093***	0.088***	0.088***	0.009	0.018	0.034***	0.058**	0.054**	0.088***
	(0.016)	(0.031)	(0.020)	(0.028)	(0.031)	(0.029)	(0.009)	(0.015)	(0.012)	(0.021)	(0.021)	(0.029)
Earthquake x Frequent earthq			0.023	-0.073**	-0.087**	-0.080***			-0.030**	-0.053***	-0.052**	-0.088***
			(0.019)	(0.029)	(0.038)	(0.028)			(0.012)	(0.019)	(0.020)	(0.028)
Observations	278	282	318	350	350	365	278	282	318	350	350	365
R-squared	0.297	0.297	0.314	0.338	0.335	0.332	0.300	0.295	0.312	0.333	0.330	0.331
No. districts w earthq	57	48	32	29	26	15	57	48	32	29	26	15
Panel B. Dependent variable: D. religious person												
Earthquake measure	-0.054	-0.006	-0.010	0.062**	0.070***	0.066***	-0.001	0.010*	-0.014	0.044***	0.047***	0.065***
	(0.041)	(0.024)	(0.039)	(0.027)	(0.023)	(0.017)	(0.005)	(0.006)	(0.018)	(0.014)	(0.013)	(0.016)
Earthquake x Frequent earthq			-0.009	-0.058	-0.056	-0.003			0.027	-0.046**	-0.050**	-0.044*
			(0.040)	(0.041)	(0.048)	(0.037)			(0.018)	(0.018)	(0.021)	(0.026)
Observations	298	302	338	370	370	386	298	302	338	370	370	386
R-squared	0.393	0.379	0.401	0.417	0.418	0.419	0.383	0.380	0.401	0.417	0.417	0.417
No. districts w earthq	61	52	33	29	26	16	61	52	33	29	26	16
Magnitude	>=5	>5	>=5.5	>=6	>6	>=6.5	>=5	>5	>=5.5	>=6	>6	>=6.5
Baseline controls	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y

Notes. OLS estimates. The dependent variable is the change in the district aggregate of importance of God in your life in Panel A and the share of religious persons in Panel B. Earthquakes are measured using the dummy in columns (1)-(6) and the number of earthquakes in columns (7)-(12). Only earthquakes above magnitude x are included in the analysis, where x ranges from magnitude 5 in columns (1) and (7) to magnitude 6.5 in columns (6) and (12). Baseline controls are the same as those in Table 4.

C.9 Differential effects across groups

As the variables in the event study are aggregated to the district level, the interactions with individual characteristics, such as income levels, is done in a slightly different manner than in the cross-district study. The complication arises as individual-level controls are added at the individual level throughout, and thereafter residuals are aggregated.

The baseline result is reproduced in column (1) of Table A24. In column (2), average religiosity is calculated only among individuals with incomes in the lowest decile. Column (3) restricts the sample to individuals with income among the second decile, and so on until average religiosity is calculated in column (11) for individuals with the highest incomes only. Earthquakes influence religiosity similarly across all income deciles with no tendency for higher or lower incomes groups to respond more or less to earthquakes. The same results hold for all education groups and unemployed or not (Tables A25 and A26).

The same question is investigated in a slightly different manner in Table A27 with a focus on *district* level development. Religiosity is calculated based on the full sample of individuals and earthquakes are instead interacted with district level income, light intensity, education, and unemployment rates. The impact of earthquakes on religiosity is larger in districts with lower levels of average income or education, but the impact does not differ with light intensity or unemployment levels.

Table A24. Religiosity on earthquakes for different income deciles

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
Income decile	All	1	2	3	4	5	6	7	8	9	10
Panel A. Dependent variable: D.importance of God											
Earthquake dummy	0.093***	0.090***	0.094***	0.094***	0.095***	0.096***	0.095***	0.095***	0.096***	0.094***	0.094***
	(0.028)	(0.028)	(0.027)	(0.027)	(0.027)	(0.027)	(0.027)	(0.027)	(0.027)	(0.028)	(0.028)
Earthq dummy x Frequent earthq	-0.073**	-0.073**	-0.075**	-0.074**	-0.075**	-0.075**	-0.074**	-0.075**	-0.075**	-0.073**	-0.074**
	(0.029)	(0.029)	(0.028)	(0.029)	(0.028)	(0.028)	(0.028)	(0.028)	(0.028)	(0.029)	(0.028)
Observations	350	350	350	350	350	350	350	350	350	350	350
R-squared	0.338	0.339	0.337	0.339	0.339	0.338	0.335	0.335	0.331	0.332	0.315
Difference p-value		0.924	0.977	0.966	0.935	0.919	0.953	0.939	0.925	0.974	0.982
Number earthquakes	0.058**	0.057**	0.058***	0.058**	0.059***	0.059***	0.059***	0.059***	0.059***	0.059***	0.060***
	(0.021)	(0.021)	(0.021)	(0.021)	(0.021)	(0.021)	(0.021)	(0.021)	(0.021)	(0.021)	(0.020)
Number earthq x Frequent earthq	-0.053***	-0.053***	-0.055***	-0.054***	-0.055***	-0.055***	-0.055***	-0.055***	-0.055***	-0.054***	-0.056***
	(0.019)	(0.019)	(0.019)	(0.019)	(0.019)	(0.019)	(0.019)	(0.019)	(0.019)	(0.019)	(0.019)
R-squared	0.333	0.335	0.332	0.333	0.334	0.332	0.329	0.329	0.325	0.327	0.311
Difference p-value		0.969	0.976	0.980	0.967	0.949	0.955	0.957	0.938	0.965	0.903
Panel B. Dependent variable: D.Religious person											
Earthquake dummy	0.062**	0.060**	0.060**	0.061**	0.063**	0.064**	0.065**	0.065**	0.066**	0.065**	0.064**
	(0.027)	(0.026)	(0.026)	(0.027)	(0.026)	(0.027)	(0.027)	(0.027)	(0.027)	(0.027)	(0.028)
Earthq dummy x Frequent earthq	-0.058	-0.057	-0.059	-0.059	-0.059	-0.061	-0.061	-0.062	-0.061	-0.061	-0.061
	(0.041)	(0.040)	(0.041)	(0.041)	(0.040)	(0.041)	(0.041)	(0.041)	(0.041)	(0.041)	(0.042)
Observations	370	370	370	370	370	370	370	370	370	370	370
R-squared	0.417	0.420	0.420	0.419	0.419	0.419	0.417	0.421	0.414	0.418	0.413
Difference p-value		0.946	0.949	0.989	0.958	0.915	0.900	0.911	0.882	0.887	0.940
Number earthquakes	0.044***	0.043***	0.043***	0.044***	0.044***	0.045***	0.045***	0.044***	0.045***	0.045***	0.045***
	(0.014)	(0.013)	(0.013)	(0.013)	(0.013)	(0.013)	(0.013)	(0.013)	(0.014)	(0.014)	(0.014)
Number earthq x Frequent earthq	-0.046**	-0.045**	-0.046**	-0.046**	-0.047**	-0.048**	-0.047**	-0.047**	-0.047**	-0.047**	-0.048**
	(0.018)	(0.018)	(0.018)	(0.018)	(0.018)	(0.018)	(0.018)	(0.018)	(0.018)	(0.018)	(0.018)
R-squared	0.417	0.420	0.420	0.419	0.419	0.419	0.417	0.420	0.413	0.418	0.413
Difference p-value		0.948	0.975	0.995	0.959	0.914	0.919	0.957	0.911	0.921	0.922
Baseline controls	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y

Notes. The table replicates Panel B of Table 4, where religiosity is instead measured only across individuals from the particular income decile. Difference p-value indicates the p-value of the test that the estimate equals the estimate in column (1).

Table A25. Religiosity on earthquakes for different education categories

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Education category	All	1	2	3	4	5	6	7	8
Panel A. Dependent variable: D.importance of God									
Earthquake dummy	0.093***	0.093***	0.095***	0.093***	0.095***	0.095***	0.094***	0.098***	0.095***
	(0.028)	(0.027)	(0.027)	(0.028)	(0.028)	(0.027)	(0.027)	(0.027)	(0.027)
Earthq dummy x Frequent earthq	-0.073**	-0.075**	-0.075**	-0.072**	-0.073**	-0.074**	-0.074**	-0.075**	-0.075**
	(0.029)	(0.028)	(0.028)	(0.029)	(0.029)	(0.029)	(0.029)	(0.029)	(0.029)
Observations	350	350	350	350	350	350	350	350	350
R-squared	0.338	0.335	0.338	0.349	0.338	0.351	0.342	0.353	0.346
Difference p-value		0.988	0.927	0.995	0.956	0.933	0.970	0.850	0.948
Number earthquakes	0.058**	0.059***	0.059***	0.056**	0.058**	0.057**	0.058**	0.058**	0.058**
	(0.021)	(0.021)	(0.021)	(0.022)	(0.022)	(0.022)	(0.021)	(0.022)	(0.022)
Number earthq x Frequent earthq	-0.053***	-0.055***	-0.055***	-0.052**	-0.054***	-0.053**	-0.054***	-0.054**	-0.054***
	(0.019)	(0.019)	(0.019)	(0.020)	(0.019)	(0.020)	(0.019)	(0.020)	(0.019)
Observations	350	350	350	350	350	350	350	350	350
R-squared	0.333	0.330	0.332	0.343	0.333	0.344	0.336	0.346	0.340
Difference p-value		0.959	0.966	0.952	0.984	0.979	0.993	0.983	0.991
Panel B. Dependent variable: D.Religious person									
Earthquake dummy	0.062**	0.063**	0.061**	0.059**	0.062**	0.062**	0.064**	0.063**	0.064**
	(0.027)	(0.026)	(0.027)	(0.026)	(0.027)	(0.026)	(0.026)	(0.026)	(0.026)
Earthq dummy x Frequent earthq	-0.058	-0.060	-0.059	-0.054	-0.059	-0.057	-0.061	-0.058	-0.060
	(0.041)	(0.040)	(0.041)	(0.040)	(0.041)	(0.040)	(0.040)	(0.040)	(0.039)
Observations	370	370	370	370	370	370	370	370	370
R-squared	0.417	0.420	0.418	0.416	0.417	0.420	0.421	0.420	0.423
Difference p-value		0.969	0.976	0.933	0.989	0.997	0.935	0.952	0.916
Number earthquakes	0.044***	0.045***	0.044***	0.042***	0.044***	0.043***	0.044***	0.043***	0.044***
	(0.014)	(0.013)	(0.014)	(0.014)	(0.014)	(0.014)	(0.013)	(0.014)	(0.013)
Number earthq x Frequent earthq	-0.046**	-0.047**	-0.046**	-0.043**	-0.046**	-0.044**	-0.047**	-0.045**	-0.046**
	(0.018)	(0.017)	(0.018)	(0.018)	(0.018)	(0.018)	(0.018)	(0.018)	(0.017)
Observations	370	370	370	370	370	370	370	370	370
R-squared	0.417	0.420	0.418	0.416	0.417	0.420	0.421	0.420	0.423
Difference p-value		0.940	0.996	0.917	0.989	0.955	0.960	0.980	0.989
Baseline controls	Y	Y	Y	Y	Y	Y	Y	Y	Y

Table A26. Religiosity on earthquakes for different employment status

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Earthquake measure	Earthquake dummy					Number earthquakes				
Sample	All	Unemployed		Employed		All	Unemployed		Employed	
Panel A. Dependent variable: D.importance of God										
Earthquake measure	0.093***	0.094***	0.088***	0.092***	0.083***	0.058**	0.059***	0.056***	0.057**	0.053***
	(0.028)	(0.028)	(0.028)	(0.028)	(0.026)	(0.021)	(0.021)	(0.018)	(0.021)	(0.018)
Earthq x Frequent earthq	-0.073**	-0.073**	-0.070**	-0.073**	-0.073**	-0.053***	-0.055***	-0.054***	-0.053***	-0.052***
	(0.029)	(0.029)	(0.028)	(0.029)	(0.027)	(0.019)	(0.019)	(0.017)	(0.019)	(0.017)
Observations	350	350	276	350	276	350	350	276	350	276
R-squared	0.338	0.335	0.293	0.338	0.284	0.333	0.330	0.290	0.333	0.281
Difference p-value		0.979	0.848	0.976	0.720		0.952	0.930	0.988	0.780
Panel A. Dependent variable: D.religious person										
Earthquake measure	0.062**	0.061**	0.058**	0.061**	0.054*	0.044***	0.043***	0.040***	0.043***	0.039***
	(0.027)	(0.026)	(0.026)	(0.027)	(0.027)	(0.014)	(0.014)	(0.013)	(0.014)	(0.013)
Earthq x Frequent earthq	-0.058	-0.056	-0.074*	-0.058	-0.078*	-0.046**	-0.044**	-0.047**	-0.046**	-0.048**
	(0.041)	(0.040)	(0.037)	(0.041)	(0.039)	(0.018)	(0.017)	(0.017)	(0.018)	(0.018)
Observations	370	370	296	370	296	370	370	296	370	296
R-squared	0.417	0.420	0.391	0.417	0.388	0.417	0.420	0.391	0.417	0.388
Baseline controls	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Income FE	N	N	Y	N	Y	N	N	Y	N	Y
Difference p-value		0.984	0.895	0.981	0.767		0.947	0.796	0.993	0.738

Notes. The table replicates Panel B of Table 4, where religiosity is instead measured only across either employed or unemployed individuals. Difference p-value indicates the p-value of the test that the estimate equals the estimate in columns (1) and (6).

Table A27. Religiosity on earthquakes interacted with district-level development

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Earthquake measure		Earthquake dummy				Number earthquakes		
Panel A. Dependent variable: D.Importance of God								
Earthquake measure	0.510***	0.099***	0.251***	0.108**	0.488***	0.037**	0.131**	0.040
	(0.104)	(0.031)	(0.090)	(0.045)	(0.125)	(0.018)	(0.059)	(0.025)
Earthq x Frequent earthq	-0.037	-0.084**	-0.085***	-0.078**	-0.021	-0.063	-0.074	-0.066
	(0.027)	(0.036)	(0.030)	(0.031)	(0.017)	(0.041)	(0.046)	(0.040)
Earthq x Development	-0.094***	-0.002	-0.037**	-0.102	-0.096***	-0.001	-0.021**	-0.009
	(0.023)	(0.002)	(0.016)	(0.139)	(0.025)	(0.002)	(0.010)	(0.082)
Observations	276	350	348	348	276	350	348	348
R-squared	0.373	0.339	0.347	0.340	0.371	0.327	0.333	0.329
Panel B. Dependent variable: D.Religious person								
Earthquake measure	0.322**	0.068**	0.308***	0.065	0.131	0.025*	0.135**	0.019
	(0.132)	(0.028)	(0.095)	(0.048)	(0.139)	(0.014)	(0.057)	(0.019)
Earthq x Frequent earthq	-0.039	-0.069	-0.090*	-0.061	-0.038	-0.054	-0.079	-0.051
	(0.050)	(0.043)	(0.053)	(0.044)	(0.049)	(0.050)	(0.051)	(0.047)
Earthq x Development	-0.059**	-0.002	-0.056***	-0.020	-0.024	-0.000	-0.024**	0.056
	(0.027)	(0.002)	(0.017)	(0.170)	(0.028)	(0.003)	(0.012)	(0.070)
Observations	296	370	368	368	296	370	368	368
R-squared	0.444	0.418	0.426	0.418	0.440	0.416	0.422	0.416
Development	Inc	Light	Edu	Unempl	Inc	Light	Edu	Unempl
Baseline controls	Y	Y	Y	Y	Y	Y	Y	Y

C.9.1 Comparing to cross-district results

According to the literature on religious coping, individuals with fewer coping alternatives are more likely to use religion in coping (Pargament (2001)). The cross-district results support this; unemployed individuals use religion more as a reaction to earthquake risk (Appendix B.11). Even after controlling for income. Thus, employment seems to provide something in addition to income that reduces the need for religion in coping. Scheve & Stasavage (2006) argue that events such as job loss, divorce, or major sickness do not only impose monetary costs on individuals; they also create psychological costs. These psychological costs can involve damage to self-esteem, stress, or the loss of a social network. The unemployed, however, do not respond differently than the rest in the event study, which may shed doubt on this conclusion or it could be due to the reduced sample size.

Results in the cross-district study document that rich or poor, educated or uneducated respond in the same way to elevated earthquake risk. This finding is partly supported in the event study, where results also show that earthquakes hitting districts with lower education or income levels increase religiosity more. Studies investigating religious coping also find ambiguous results, and thus predictions cannot be made (e.g. review by

Pargament (2001)). Studies find either no differential effects of income or effects suggesting that poorer or less educated individuals use religion more in coping, consistent with the current findings. These ambiguous results, though, cannot help distinguish between religious coping and the other explanations.

C.10 Global extent of the impact

District-level religiosity is calculated for Christians, Muslims, etc in Table A28. Like Tables A24-A26, average religiosity is calculated for each denomination seperately and thereafter aggregated to the district level. Earthquakes increase religiosity for all denominations.

Table A28. Across religious denominations

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Religious denomination	All	Christian	Catholic	Protestant	Muslim	Buddhist	Hindu	Other
Panel A. D.importance of God on earthquake dummy								
Earthquake dummy	0.093***	0.093***	0.092***	0.097***	0.092***	0.089***	0.084***	0.094***
	(0.028)	(0.027)	(0.028)	(0.027)	(0.028)	(0.028)	(0.029)	(0.027)
Earthq x Frequent earthq	-0.073**	-0.074**	-0.074**	-0.075**	-0.075**	-0.074**	-0.069**	-0.075**
	(0.029)	(0.028)	(0.028)	(0.028)	(0.028)	(0.028)	(0.030)	(0.028)
Observations	350	350	350	350	350	350	350	350
R-squared	0.338	0.330	0.326	0.339	0.327	0.323	0.339	0.327
Panel B. D.importance of God on number earthquakes								
Number earthquakes	0.058**	0.059***	0.059***	0.059***	0.059***	0.059***	0.055**	0.059***
	(0.021)	(0.021)	(0.021)	(0.021)	(0.020)	(0.020)	(0.021)	(0.021)
Earthq x Frequent earthq	-0.053***	-0.055***	-0.055***	-0.054***	-0.056***	-0.055***	-0.051**	-0.055***
	(0.019)	(0.019)	(0.019)	(0.019)	(0.018)	(0.018)	(0.019)	(0.019)
Observations	350	350	350	350	350	350	350	350
R-squared	0.333	0.325	0.322	0.332	0.323	0.320	0.336	0.322
Panel C. D.religious person on earthquake dummy								
Earthquake dummy	0.062**	0.060**	0.059**	0.064**	0.059**	0.065**	0.060**	0.063**
	(0.027)	(0.027)	(0.027)	(0.026)	(0.026)	(0.027)	(0.026)	(0.028)
Earthq x Frequent earthq	-0.058	-0.058	-0.058	-0.060	-0.058	-0.062	-0.058	-0.063
	(0.041)	(0.041)	(0.041)	(0.040)	(0.041)	(0.041)	(0.040)	(0.042)
Observations	370	370	370	370	370	370	370	370
R-squared	0.417	0.418	0.417	0.420	0.417	0.418	0.421	0.416
Panel D. D.religious person on number of earthquakes								
Number earthquakes	0.044***	0.044***	0.044***	0.044***	0.044***	0.045***	0.043***	0.045***
	(0.014)	(0.013)	(0.013)	(0.013)	(0.013)	(0.013)	(0.013)	(0.014)
Earthq x Frequent earthq	-0.046**	-0.046**	-0.046**	-0.046**	-0.047**	-0.049**	-0.046**	-0.049**
	(0.018)	(0.018)	(0.018)	(0.018)	(0.018)	(0.018)	(0.017)	(0.018)
Observations	370	370	370	370	370	370	370	370
R-squared	0.417	0.418	0.417	0.420	0.417	0.417	0.421	0.416
Baseline controls	Y	Y	Y	Y	Y	Y	Y	Y

Notes. The dependent variable in Panels A and B is the district level change in the average importance of God, and the change in the share of religious persons in Panels C and D. The district level average in column (1) is calculated as in Table 4, while the average in column (2) is only based on Christians, Catholics in column (3), Protestants in column (4), etc.

As continents are measured at the district-level, this part of the analysis is done like the cross-districts analysis. Corroborating the finding of the cross-districts analysis, earthquakes increase religiosity across all continents. While there were no differences between continents in the cross-districts study, Table A29 shows that earthquakes in Europe increase religiosity more than other places, whereas earthquakes in Oceania only seem to have an impact on the share of religious persons and not importance of God. The latter only covers 9 districts, though.

Table A29. Across continents

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Earthquake measure:			Earthquake dummy						Number earthquakes			
Panel A. Dependent variable: D.Importance of God												
Earthquake dummy	0.093***	0.095***	0.095***	0.068**	0.098***	0.089***	0.058**	0.058**	0.058**	0.052***	0.060**	0.055**
	(0.028)	(0.030)	(0.028)	(0.025)	(0.030)	(0.028)	(0.021)	(0.022)	(0.022)	(0.018)	(0.023)	(0.020)
Earthq x Frequent earthquakes	-0.073**	-0.075**	-0.059**	-0.067***	-0.079**	-0.069**	-0.053***	-0.054**	-0.053***	-0.053***	-0.054**	-0.051***
	(0.029)	(0.032)	(0.022)	(0.024)	(0.032)	(0.029)	(0.019)	(0.020)	(0.018)	(0.018)	(0.020)	(0.018)
Earthquake x Africa		-0.032						-0.001				
		(0.038)						(0.032)				
Earthquake x America			-0.037						-0.005			
			(0.025)						(0.009)			
Earthquake x Asia				0.033						0.007		
				(0.038)						(0.017)		
Earthquake x Oceania					-0.075**						-0.063**	
					(0.035)						(0.027)	
Earthquake x Europe						0.086***						0.119***
						(0.029)						(0.022)
Observations	350	350	350	350	350	350	350	350	350	350	350	350
R-squared	0.338	0.338	0.338	0.339	0.339	0.339	0.333	0.333	0.333	0.333	0.334	0.334
Panel B. Dependent variable: D.Religious person												
Earthquake dummy	0.062**	0.062**	0.059**	0.106***	0.058*	0.061**	0.044***	0.044***	0.043***	0.067***	0.043***	0.043***
	(0.027)	(0.027)	(0.028)	(0.033)	(0.029)	(0.028)	(0.014)	(0.014)	(0.014)	(0.021)	(0.014)	(0.014)
Earthq x Frequent earthquakes	-0.058	-0.058	-0.080**	-0.069*	-0.055	-0.058	-0.046**	-0.046**	-0.050**	-0.048**	-0.046**	-0.045**
	(0.041)	(0.041)	(0.037)	(0.034)	(0.043)	(0.042)	(0.018)	(0.018)	(0.019)	(0.019)	(0.018)	(0.018)
Earthquake x America			0.066						0.029			
			(0.055)						(0.019)			
Earthquake x Asia				-0.054						-0.026		
				(0.040)						(0.017)		
Earthquake x Oceania					0.040						0.003	
					(0.036)						(0.049)	
Earthquake x Europe						0.013						0.031*
						(0.028)						(0.015)
Observations	370	370	370	370	370	370	370	370	370	370	370	370
R-squared	0.417	0.417	0.418	0.418	0.417	0.417	0.417	0.417	0.418	0.418	0.417	0.417
Baseline controls	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y

Notes. The dependent variable is the change in average importance of God in Panel A and the share of religious persons in Panel B. The mesaure of earthquakes is the earthquake dummy in columns (1)-(6) and the number of earthquakes in columns (7)-(12).

D Additional results across children of immigrants

The country of origin in Table 5 was the mother's country of origin unless the country of origin was missing, where the father's country of origin was used. Instead, Table A30 uses the father's country of origin at the outset, but uses the mother's country of origin when information for the father is missing. The same results emerge.

Table A30. OLS of religiousness on disasters in parents' home country, focus on the father

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Dependent variable:		pray			religious person			service	
Panel A. The simple linear effect									
Dist(earthquakes), 1000 km	-0.049***	-0.036***	-0.026*	-0.055***	-0.041***	-0.029**	-0.040***	-0.025**	-0.018
	(0.015)	(0.012)	(0.014)	(0.019)	(0.013)	(0.014)	(0.014)	(0.011)	(0.011)
Observations	17,078	16,983	14,138	17,190	17,095	14,231	17,251	17,155	14,284
R-squared	0.122	0.130	0.174	0.074	0.087	0.130	0.101	0.111	0.127
Org countries	170	165	154	170	165	154	170	165	154
Panel B. Adding a squared term of disaster distance									
Dist(earthquakes), 1000 km	-0.129***	-0.075**	-0.068**	-0.119***	-0.056*	-0.047	-0.084***	-0.033	-0.025
	(0.022)	(0.033)	(0.032)	(0.028)	(0.032)	(0.032)	(0.028)	(0.022)	(0.023)
Dist(earthq) squared	0.049***	0.023	0.025	0.039***	0.009	0.010	0.027**	0.005	0.004
	(0.010)	(0.017)	(0.019)	(0.013)	(0.017)	(0.020)	(0.013)	(0.012)	(8.135)
Observations	17,078	16,983	14,138	17,190	17,095	14,231	17,251	17,155	14,284
R-squared	0.123	0.130	0.175	0.075	0.087	0.130	0.101	0.111	0.127
Impact at 500 km	-0.104	-0.0637	-0.0558	-0.0996	-0.0512	-0.0419	-0.0706	-0.0308	-0.0232
Panel C. Excluding countries of origin in high-risk zones									
Dist(earthquakes), 1000 km	-0.041***	-0.036***	-0.023*	-0.047**	-0.040***	-0.028*	-0.034**	-0.025**	-0.018*
	(0.015)	(0.012)	(0.013)	(0.018)	(0.012)	(0.014)	(0.013)	(0.010)	(0.010)
Observations	15,717	15,714	9,347	15,820	15,817	9,389	15,881	15,878	9,415
R-squared	0.105	0.112	0.159	0.062	0.073	0.122	0.093	0.102	0.126
Org countries	138	135	120	138	135	119	138	135	120
Country-year FE	Y	Y	Y	Y	Y	Y	Y	Y	Y
Geo controls	N	Y	Y	N	Y	Y	N	Y	Y
Indl controls	N	N	Y	N	N	Y	N	N	Y

Notes. The table reproduces Table 5, where the father's country of origin is instead first chosen and replaced by the mother's when the father is not an immigrant.

Table A31. Including individual income fixed effects

	(1)	(2)	(3)	(4)	(5)	(6)
Dependent variable	pray		relpers		service	
Dist(earthquakes), 1000 km	-0.038**	-0.037**	-0.041**	-0.041**	-0.025**	-0.025**
	(0.014)	(0.014)	(0.016)	(0.016)	(0.012)	(0.011)
Observations	12,030	12,030	12,076	12,076	12,116	12,116
R-squared	0.161	0.166	0.115	0.119	0.128	0.129
Country-year FE	Y	Y	Y	Y	Y	Y
Geo controls	Y	Y	Y	Y	Y	Y
Indl controls	Y	Y	Y	Y	Y	Y
Indl income fixed effects	N	Y	N	Y	N	Y
Org countries	161	161	161	161	161	161

Notes. Columns (1), (3), and (5) replicate the corresponding columns in Panel A of Table 5, but restricted to the sample with information on individual income. Columns (2), (4), and (6) include individual income fixed effects.

Table A32. Reducing bias based on country of origin

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Dependent variable		pray			religious person			service	
Panel A. Full sample excluding areas>90th percentile									
Dist(earthq), 1000 km	-0.046***	-0.040***	-0.034***	-0.054***	-0.045***	-0.038***	-0.036**	-0.029**	-0.024**
	(0.015)	(0.011)	(0.011)	(0.018)	(0.013)	(0.013)	(0.016)	(0.012)	(0.011)
Observations	13,692	13,595	11,245	13,753	13,656	11,294	13,811	13,713	11,344
R-squared	0.120	0.130	0.179	0.082	0.097	0.143	0.105	0.118	0.137
Org countries	159	154	143	159	154	143	159	154	143
Panel B. Full sample excluding areas>75th percentile									
Dist(earthq), 1000 km	-0.043***	-0.044***	-0.040**	-0.049***	-0.047***	-0.042***	-0.027**	-0.030**	-0.029**
	(0.013)	(0.012)	(0.015)	(0.014)	(0.012)	(0.013)	(0.013)	(0.013)	(0.012)
Observations	12,230	12,133	10,014	12,280	12,183	10,055	12,340	12,242	10,105
R-squared	0.106	0.116	0.166	0.074	0.087	0.130	0.098	0.110	0.126
Org countries	136	131	122	136	131	122	136	131	122
Country-year FE	Y	Y	Y	Y	Y	Y	Y	Y	Y
Geo controls	N	Y	Y	N	Y	Y	N	Y	Y
Parent and indl controls	N	N	Y	N	N	Y	N	N	Y

Notes. The table replicates panel A of Table 5, excluding countries of origin with areas larger than the 90th percentile in Panel A and the 75th percentile in Panel B.

The estimates of Table A33 show the level of religiosity of the child of immigrants regressed on the level of religiosity in his/her parents' home country, where the latter is calculated as the country average across all waves of the WVS-EVS in Panel A, while the measure of religiosity in Panel B is calculated in 1990 or before. The precision of estimation increases in the latter case, which is consistent with the idea that most immigrants had probably left their home country by 1990. Thus measuring religiosity in the home country after 1990 might bias the results.

Table A33. Transmission of religiosity from parents' home country

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Dependent variable		pray			religious person			service	
Panel A. Full sample									
Intrinsic Religiosity Scale	0.150***	0.115***	0.080**	0.130***	0.085**	0.055	0.109***	0.062*	0.046
	(0.034)	(0.036)	(0.032)	(0.035)	(0.035)	(0.034)	(0.039)	(0.031)	(0.030)
Observations	15,072	14,975	12,517	15,175	15,078	12,602	15,236	15,138	12,653
R-squared	0.137	0.142	0.194	0.078	0.085	0.129	0.112	0.120	0.138
Org countries	78	74	73	78	74	73	78	74	73
Panel B. Religiosity before 1990									
Intrinsic Religiosity Scale	0.170***	0.137***	0.103**	0.165***	0.121***	0.108***	0.182***	0.100***	0.067**
	(0.044)	(0.048)	(0.048)	(0.040)	(0.025)	(0.035)	(0.036)	(0.016)	(0.025)
Observations	8,453	8,453	7,097	8,533	8,533	7,161	8,562	8,562	7,183
R-squared	0.123	0.124	0.192	0.056	0.058	0.107	0.120	0.123	0.151
Org countries	24	24	24	24	24	24	24	24	24
Country-year FE	Y	Y	Y	Y	Y	Y	Y	Y	Y
Geo controls	N	Y	Y	N	Y	Y	N	Y	Y
Parent and indl controls	N	N	Y	N	N	Y	N	N	Y

Notes. The table replicates panel A of Table 5, using the Strength of Intrinsic Religiosity Scale in the parents' home country instead of earthquake frequency. Both panels include controls for WVS-EVS respondents' sex, age, age squared, marital status, and year of interview. Panel A calculates the Strength of Intrinsic Religiosity Scale across all waves of the WVS-EVS, while Panel B restricts the sample to the countries measured in 1990 or before.