Supporting Information for

Religion and global cultural diversity

Jeanet Sinding Bentzen, Anne Sofie Beck Knudsen, Lena Lindbjerg Sperling, and Ara Norenzayan

Jeanet Sinding Bentzen.
E-mail: jeanet.bentzen@econ.ku.dk

This PDF file includes:

Supporting Information Text

Replication

The results of this paper were replicated in multiple different ways.

Alternative datasets. The first version of this article was based on data from the six waves of the World Values Survey (WVS) and four waves of the European Values Study (EVS) available at the time. The current version of this article includes all seven waves of the WVS and five waves of the EVS, which are currently available. The results were unchanged from using either version of the data.

Alternative methodology. Instead of using the Cultural Fixation index as is done in the current article, the first version of this article used an approach, where the explanatory power of country fixed effects was examined. The rationale was that a higher explanatory power of country fixed effects would cover larger differences across countries in the particular cultural dimensions. By doing so, we arrived at the same conclusion as the current article: The explanatory power of country fixed effects was larger for religiosity, compared to other cultural values, indicating that the diversity of religiosity is higher than other values. That is, the conclusion was unaltered.

Replication by an external agency. We had the results of this article replicated by an external agency. We supplied the external agency with five datasets that were used in the original analysis, containing our pre-processed data of the World Values Survey and European Values Study. The first dataset contained data relevant for the histogram plots from the original analysis while the remaining four datasets contained data relevant for the time series plots from the original analysis (one dataset per question group). For our original analysis, we used `Stata`. The replication was done using the R programming language. Initial pre-processing of the datasets by the external agency involved ensuring relevant data variables were of the right data type (e.g., numeric), and that variables in the dataset were matched correctly with the variables used in the original analysis.

To reproduce Figure A10 specifically, additional pre-processing was done on the first dataset to generate separate "decade" datasets for each of the four question groups, as well as generate a "decade" variable based on the wave in which the observations were collected. The decade variable in the original analysis was generated using the first year of the corresponding survey wave, and rounding to the "floor" decade (e.g., "2017-2021" would correspond to decade "2010"). To construct each "decade" dataset, any countries' data that was not present in all three decades ("1990", "2000", "2010") were removed.

Regarding the reproduction of the figures, custom R functions were created to generate the relevant figure measures (CF, variances, means, etc.) and to plot these measures using the R package "ggplot2". For the non-decade barplots, (e.g., barplots found in Figure 1), for each value in the question group and using the relevant grouping variable (e.g., "country"), the following measures were computed: (1) Overall Mean, (2) Total Variance, (3) Between Group Variance, (4) Within Group Variance, and (5) the CF Index. The first two were easily reproduced using the simple "mean" and "var" commands within R (omitting missing values). The third and fourth measures were computed by determining the group-specific means (e.g., "country-specific" means) and then computing these measures manually using this information and the raw variable values. Note that this was done using the methodology that is employed specifically by "xtsum" in `Stata`, in which the mean of the group means is used instead of the overall mean for Between Group Variance computation. The CF index is then computed using the ratio between the Between Group Variance and the sum of the Between Group Variance and the Within Group Variance (to represent the "total" variance). Note also that this does not necessarily correspond to the Total Variance measure computed (item 2 above). Regarding the other two sets of plot types (time series plots and decade barplots), the approach used is largely the same, except repeated for each corresponding timepoint along the time dimension (i.e. for each "half-decade" or decade).

In terms of the figures that were ultimately reproduced, this includes Figures 1, 2, A3, A4, A5 and A10. A review of the results indicated that there was correspondence with the results computed in the original analysis, and so the results were successfully reproduced.

Supplementary Methods

This section provides additional information necessary for replication of the paper, in addition to that described in the Methods section in the main paper.

All data processing and analysis were conducted in `Stata`.

Data. We combined all seven waves of the World Values Survey (1981–2022) and five waves of the European Values Study (1981–2021) to form a comprehensive dataset of cultural values across the globe. To do this, we followed the instructions provided by the European Values Study, which included downloading the trend files from the respective websites and running a code file that harmonized variable codings, making sure that similar questions across different waves are coded in a uniform way.[1]

We analyzed four sets of cultural items. These sets were chosen as they included at least one question on religion and had responses from at least 350,000 individuals across the combined dataset. The sets of cultural items include:

1. **Personal Values**: Importance of family, friends, leisure, politics, work, and religion (599,313 respondents, 117 countries).

[1] See instructions on https://europeanvaluesstudy.eu/methodology-data-documentation/integrated-values-surveys.

2. **Child Qualities**: Values to teach children, e.g., independence, hard work, religious faith (640,110 respondents, 117 countries).

3. **Membership**: Belonging to voluntary organizations, e.g., religious, cultural, political (344,149 respondents, 100 countries).

4. **Active Membership**: Non-member, member, or active member status in voluntary organizations (321,507 respondents, 101 countries).

Cultural Fixation Index. The Cultural Fixation Index (CF_{st}) was computed following the methodological framework in Muthukrishna et al. (2020) and White et al. (2021) (1, 2). While their approach focuses on dyadic comparisons of cultural distances, we adapted the metric to capture variance across individuals within and between specified groups, such as countries or sub-national districts.

Using the `xtsum` command in `Stata`, we calculated the within-group and between-group variances for each cultural value. These were then used to calculate the Cultural Fixation Index using Equation 1 in the main text. Additional refinements involved removing variation from specific covariates (e.g., country effects, religious denominations) as described below.

Sample Sizes and Panel Balancing. Sample sizes vary depending on the specific cultural items analyzed and the type of aggregation used. To investigate overall diversity, such as in the left panels of Figure 1, we use the full samples (reported above for each cultural item) to calculate the Cultural Fixation Index.

For the sub-national district analysis in Figures 2 and S4, we exclude respondents where district of residence is not available. This limits the sample as follows: 435,241 respondents in 2,252 districts in 109 countries for cultural items in *Personal Values*, 467,690 respondents in 2,333 sub-national districts in 109 countries for *Child Qualities*, 198,560 respondents across 1,601 districts in 89 countries for *Membership*, and 305,818 respondents across 1,809 districts in 97 countries for *Active membership*.

When analyzing cultural diversity over time (as done for instance in the right panels of Figure 1), we ensure balanced samples so that each country is observed in every time period. For the main analysis using birth years as the time variable, we restrict the sample to countries with at least 10 respondents born in each half-decade between 1930 and 1994. This limits the sample to 502,666 respondents in 85 countries for *Personal Values*, 535,540 respondents in 87 countries for *Child Qualities*, 260,688 respondents in 64 countries for *Membership*, and 231,417 respondents in 59 countries for *Active Membership*. These samples constitute the right panels of Figures 1, S1, S2, and S3. In a robustness test (Figure S8), we instead use interview year as the time variable. In this analysis, we include countries with respondents interviewed in every decade of the 1990s, 2000s, and 2010s. Respondents are grouped by decade using the first year of each wave's time interval, with 2020 included in the 2010s (3).

Removing Variation in Cultural Items. To remove specific sources of variation in cultural items, we employed the `reghdfe` command in `Stata`. For each cultural item, we regressed the particular cultural item on fixed effects from categorical variables, such as country dummies, religious denominations, and socioeconomic categories (using the `absorb` option in the `reghdfe` command). We then used the `predict` command to save the residuals of this regression and used these residuals to calculate the Cultural Fixation Index. This method was used to restrict comparison to within countries in Figures 2 and S4 (including fixed effects for countries), within each gender and age in Figure S5 (including age and gender fixed effects), within each gender in Figure S6 (including gender fixed effects), within each age in Figure S7 (including age fixed effects), within continents in Figure S9 (including continent fixed effects), within religious denominations in Figure S10 (including religious denomination fixed effects), within each education category in Figure S11 (including education category fixed effects), within each income category in Figure S12 (including income fixed effects).

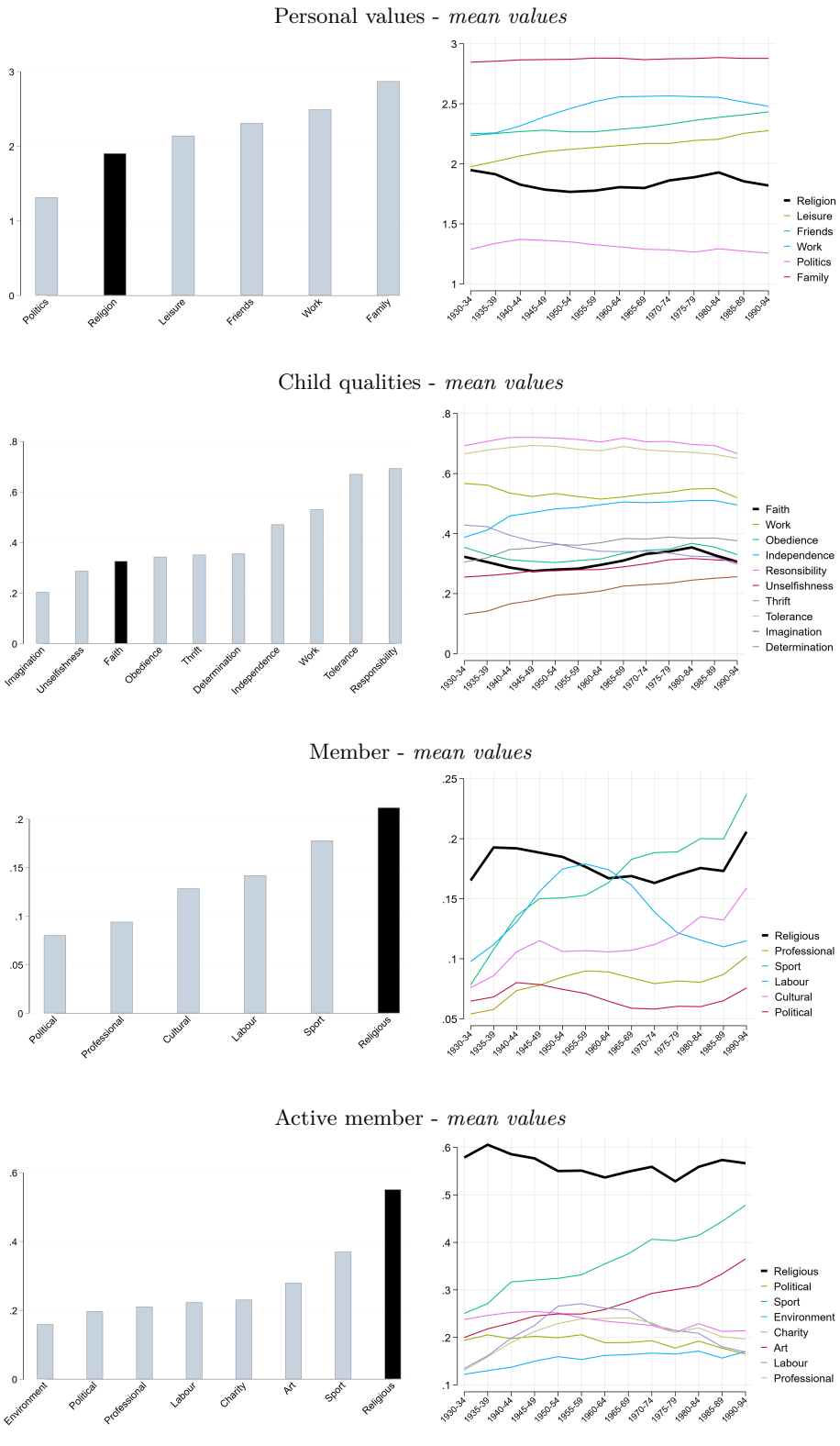

Fig. S1. Mean values of cultural dimensions. *Note*: The left panels show the mean values across all respondents in the full sample, and the right panels show the mean values for respondents grouped by birth cohort. The samples used are the same as in Fig. 1. The variables are measured on different numerical scales: Personal values (0–3), Child qualities (0-1), Membership (0-1), and Active membership (0–2).
Result: The mean values of the examined cultural dimensions do not follow the same pattern as observed in diversity.

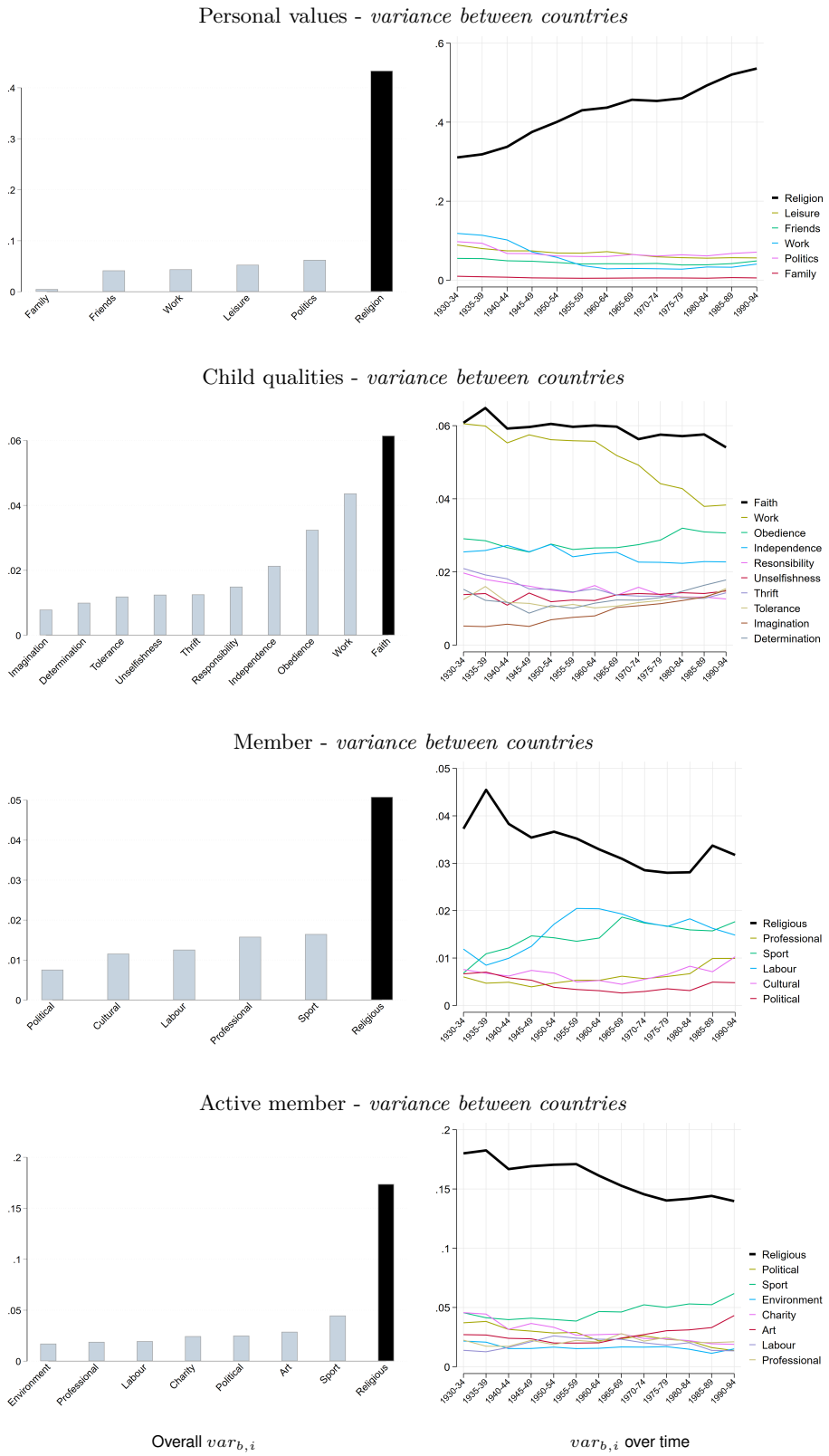

Fig. S2. Variance between countries ($var_{b,i}$). *Note*: The left panels show the variance between countries for the full sample, and the right panels show the variance between countries for each birth cohort. The samples used are the same as in Fig. 1.
Result: Between-country variation follows a similar pattern to that of CF_{st}.

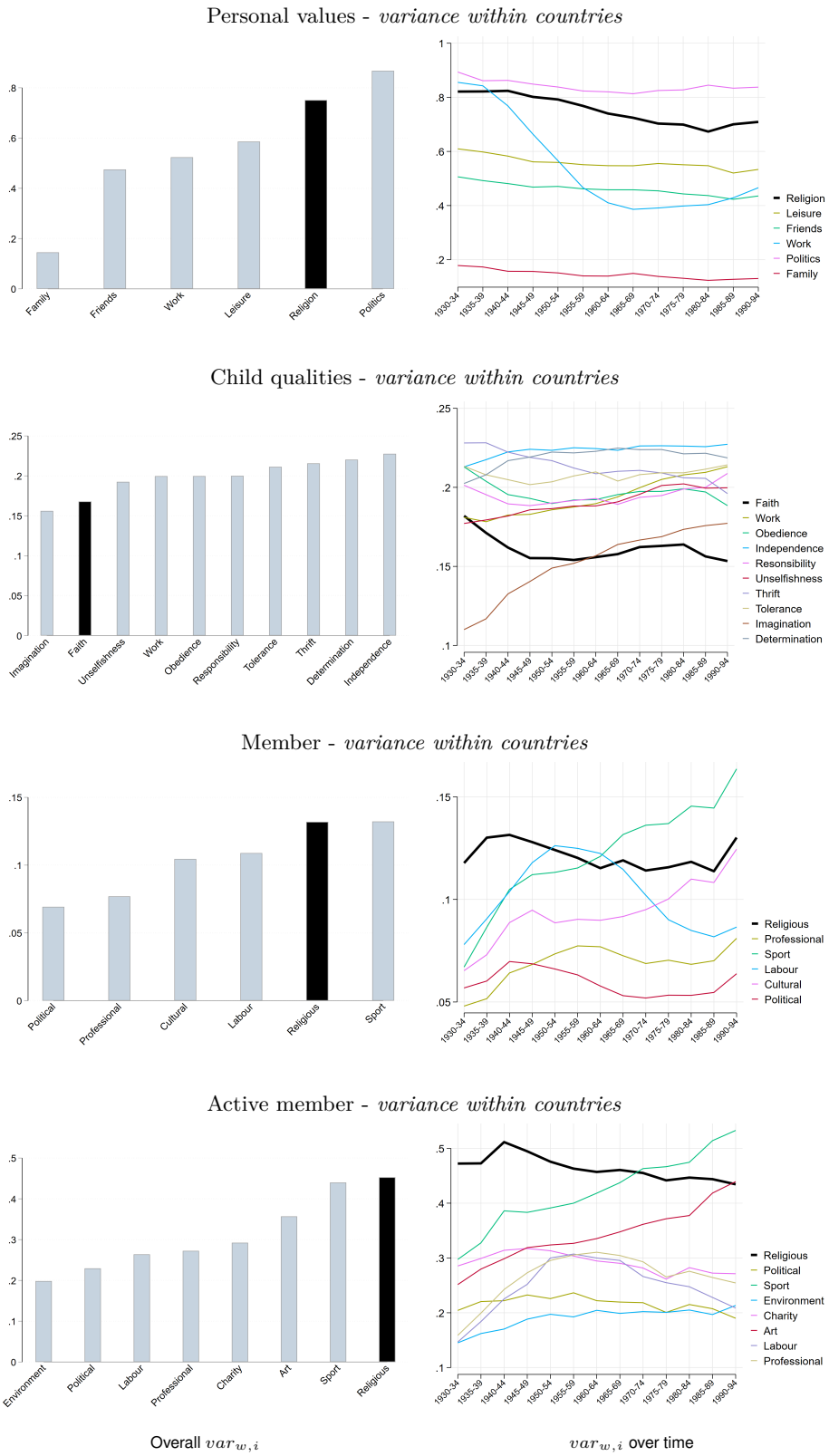

Fig. S3. Variance within countries ($var_{w,i}$). *Note*: The left panels show the variance within countries for the full sample, and the right panels show the variance within countries for each birth cohort. The samples used are the same as in Fig. 1.
Result: Within-country variance does not exhibit a similar pattern to CF_{st} and, therefore, cannot explain the main results.

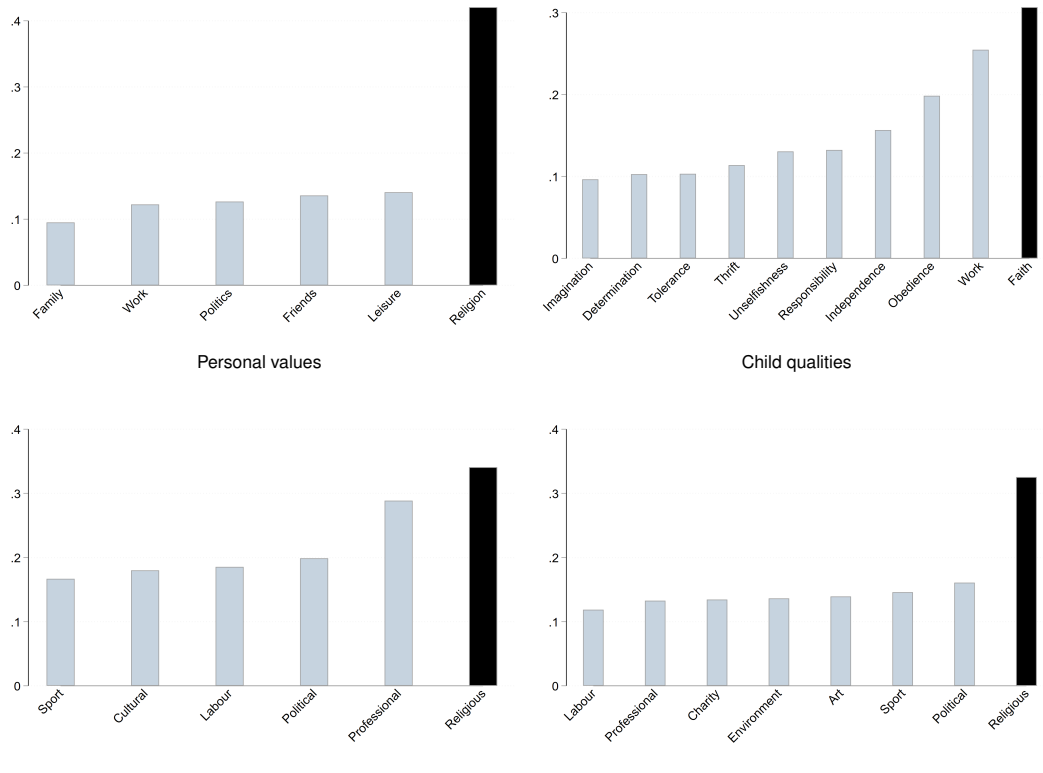

Fig. S4. CF_{st} **across sub-national districts, not controlling for country fixed effects**. *Note*: The samples used are the same as in Fig. 2. **Result**: Religious values continue to dominate global diversity when considering variation across sub-national districts.

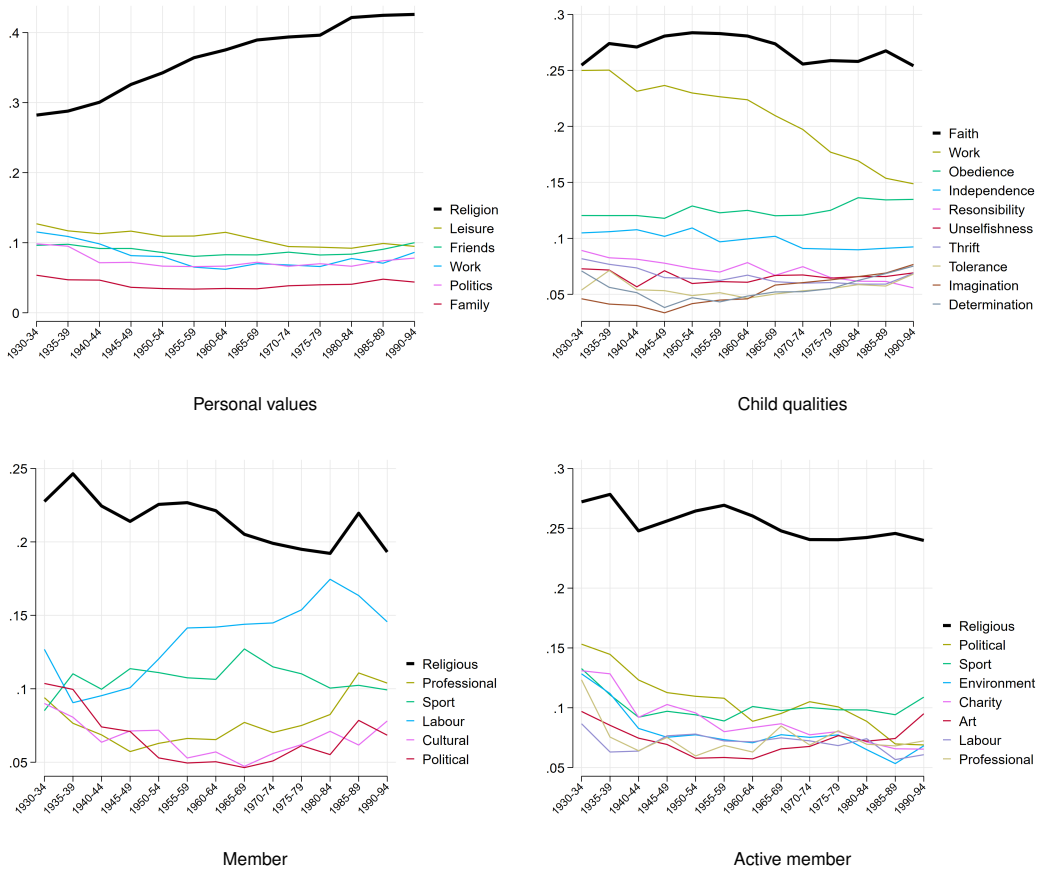

Fig. S5. CF_{st} **over time, controlling for age and gender fixed effects**. *Note*: The samples used are the same as in the right panels of Fig. 1.
Result: Patterns over time in CF_{st} remain consistent when controlling for age and gender, indicating that the temporal trends are robust to these demographic factors.

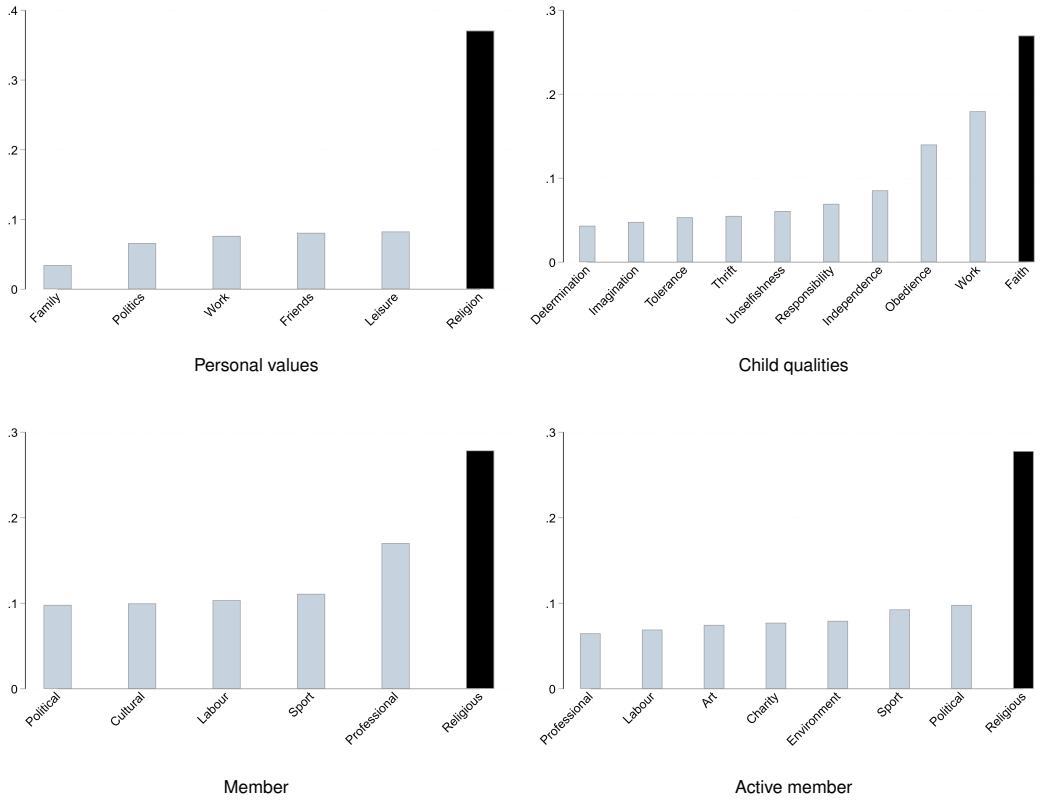

Fig. S6. CF_{st} **across countries, controlling for gender**. *Note*: Each cultural dimension is regressed on a dummy variable for respondents' gender before computing CF_{st} across countries. The samples used are the same as in the left panels of Fig. 1.
Result: Religious values continue to dominate global diversity when comparing individuals of the same gender.

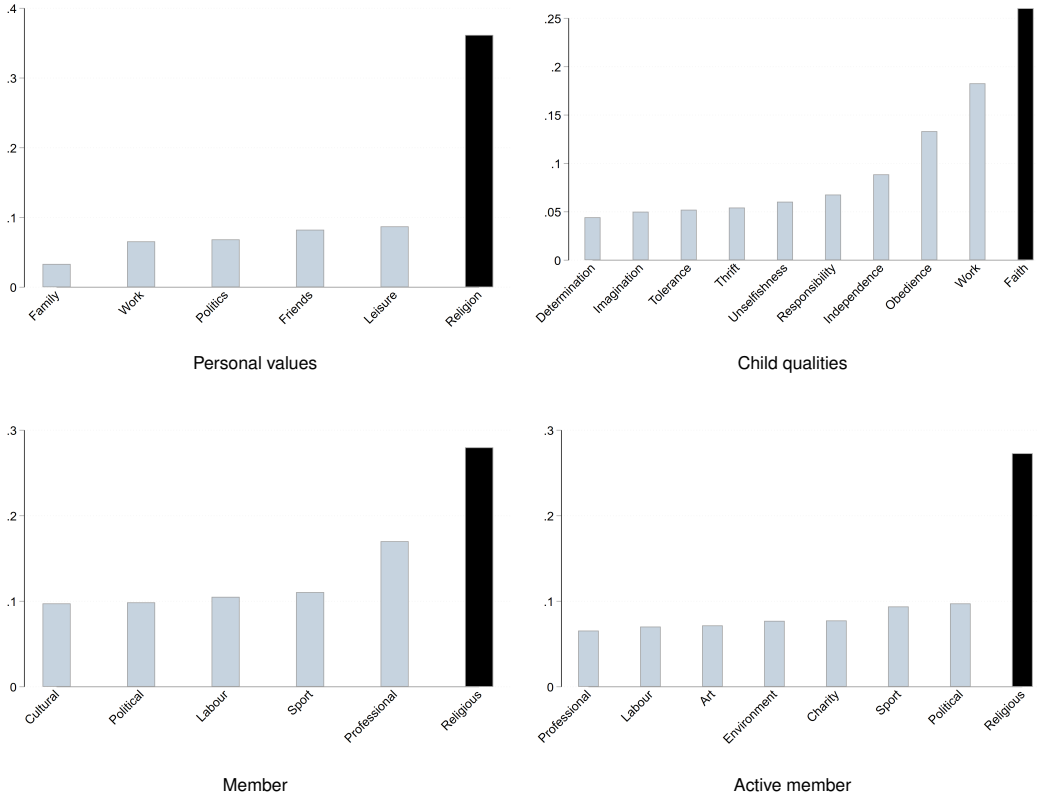

Fig. S7. CF_{st} **across countries, controlling for age**. *Note*: Each cultural dimension is regressed on 92 dummies for respondents' age before computing CF_{st} across countries. The samples used are the same as in the left panels of Fig. 1.
Result: Religious values continue to dominate global diversity when comparing individuals of the same age.

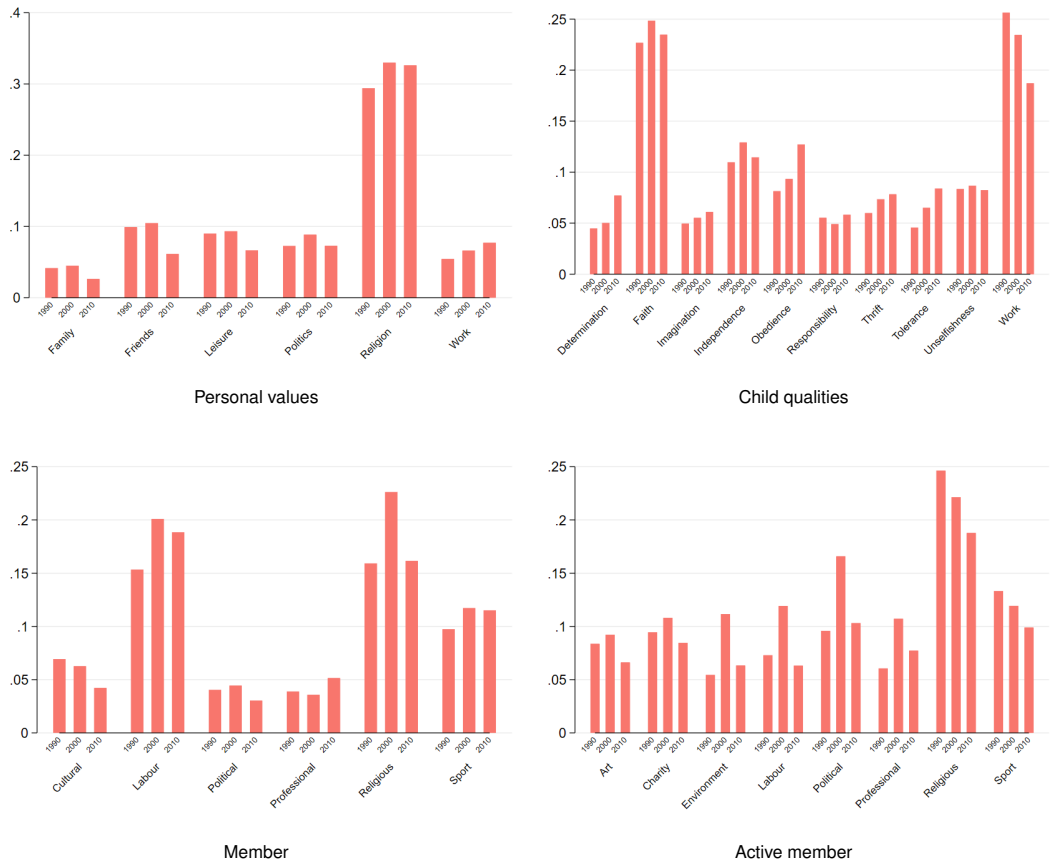

Fig. S8. CF_{st} **across survey decades**. *Note*: The sample includes 432,023 respondents across 61 countries for *Personal values*, 464,906 across 61 countries for *Child qualities*, 197,222 across 35 countries for *Membership*, and 141,345 across 25 countries for *Active membership*.
Result: Religious values continue to generally dominate global diversity in these smaller samples balanced based on survey decade.

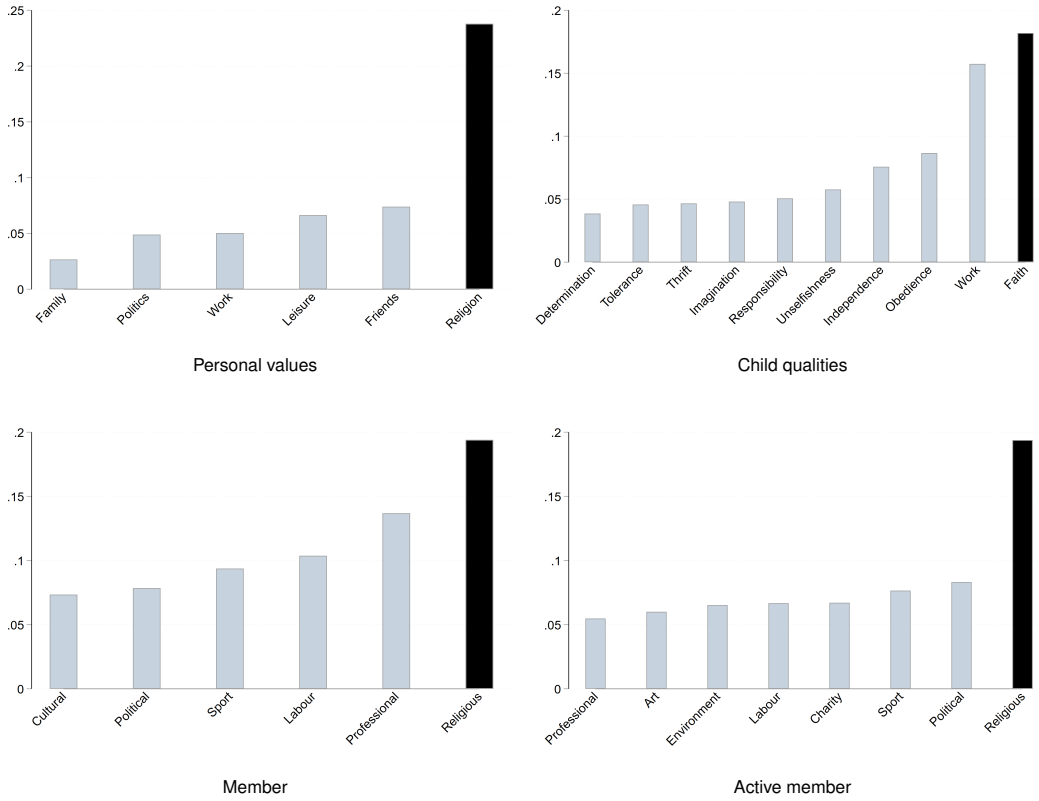

Fig. S9. CF_{st} **across countries, controlling for continent fixed effects**. *Note*: Each cultural dimension is regressed on continent dummies before computing CF_{st} across countries. The samples used are the same as in the left panels of Fig. 1.
Result: Religious values continue to dominate global diversity when comparing countries within the same continent.

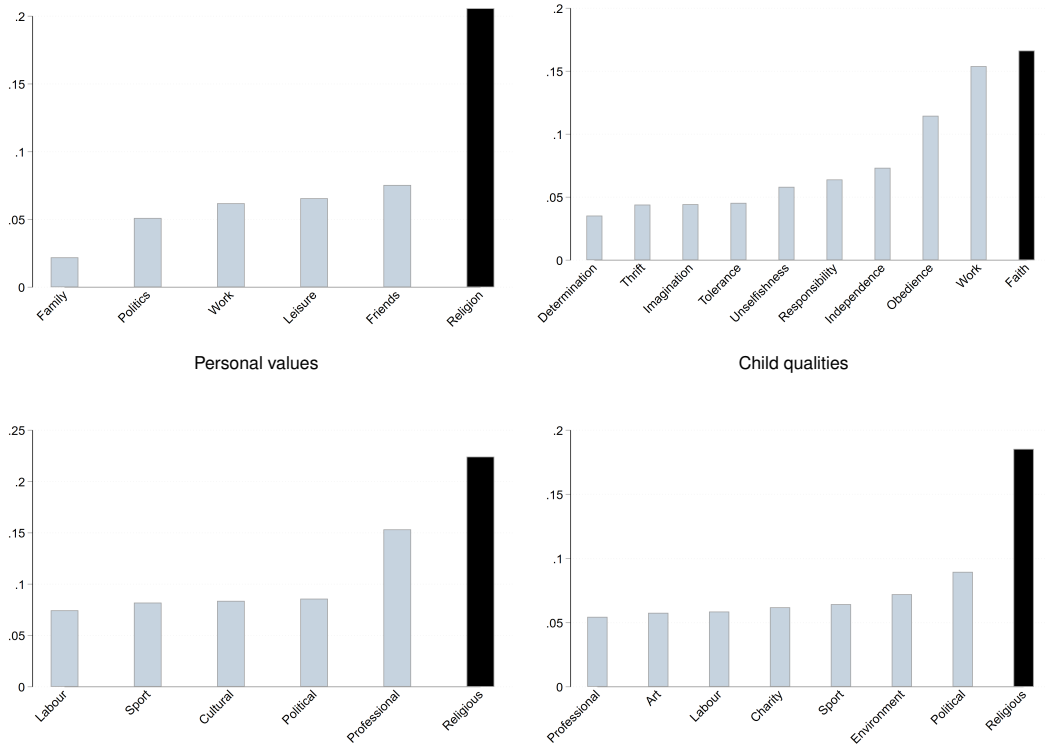

Fig. S10. CF_{st} **across countries, controlling for religious denomination**. *Note*: Each cultural dimension is regressed on 10 dummies for respondents' religious denomination before computing CF_{st} across countries. The samples used are the same as in the left panels of Fig. 1.
Result: Religious values continue to dominate global diversity when comparing individuals within the same religious denomination.

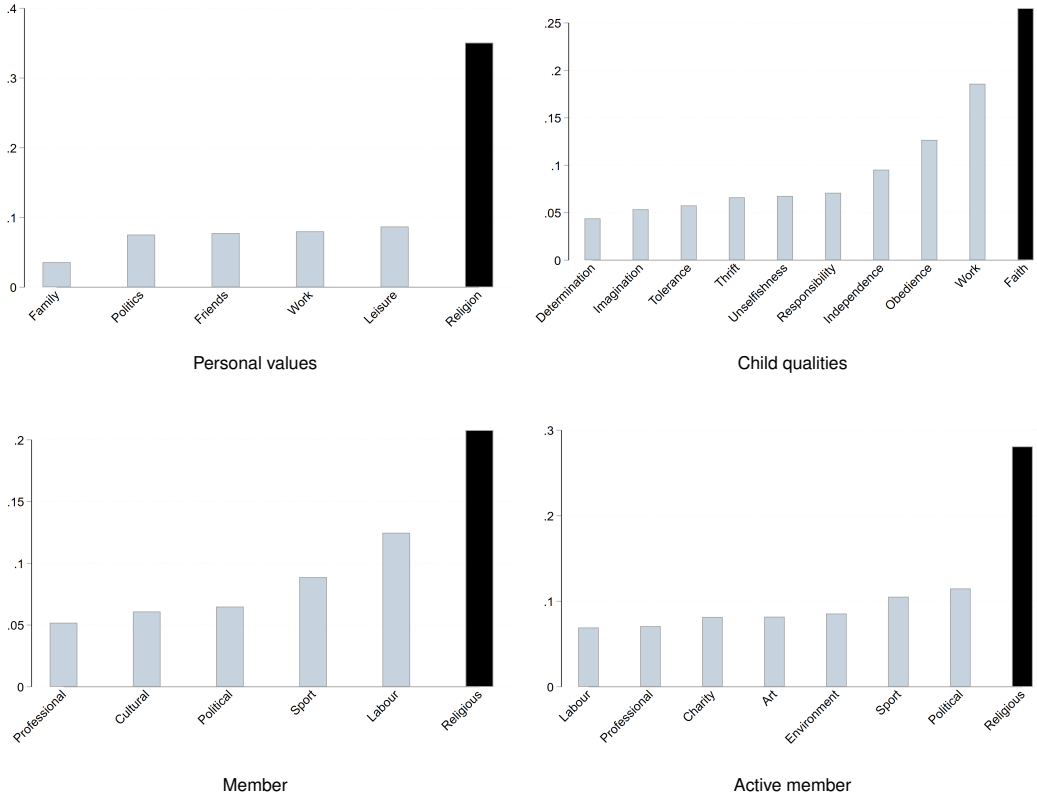

Fig. S11. CF_{st} **across countries, controlling for educational attainment**. *Note*: Each cultural dimension is regressed on 8 dummies for respondents' highest educational attainment before computing CF_{st} across countries. The samples used are the same as in the left panels of Fig. 1.
Result: Religious values continue to dominate global diversity when comparing individuals within the same education group.

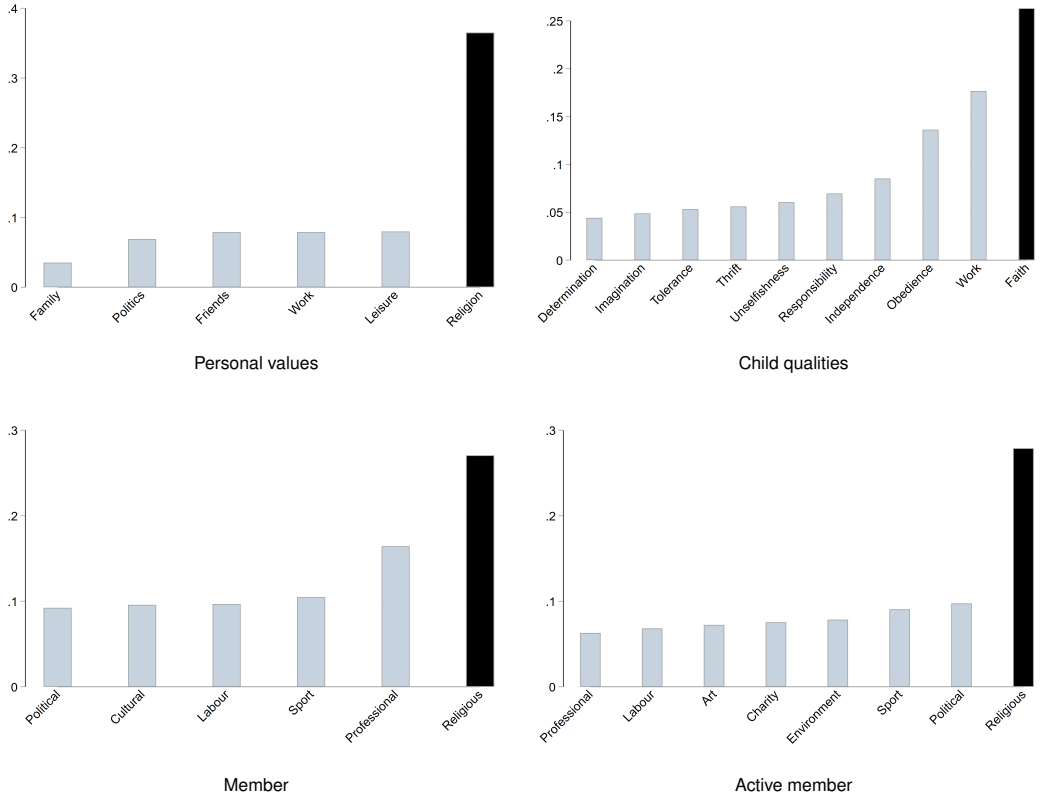

Fig. S12. CF_{st} **across countries, controlling for income levels**. *Note*: Each cultural dimension is regressed on 10 dummies for respondents' income level before computing CF_{st} across countries. The samples used are the same as in the left panels of Fig. 1.
Result: Religious values continue to dominate global diversity when comparing individuals within the same income group.

References

1. M Muthukrishna, et al., Beyond western, educated, industrial, rich, and democratic (weird) psychology: Measuring and mapping scales of cultural and psychological distance. *Psychol. science* **31**, 678–701 (2020).
2. CJ White, M Muthukrishna, A Norenzayan, Cultural similarity among coreligionists within and between countries. *Proc. Natl. Acad. Sci.* **118**, e2109650118 (2021).
3. JC Jackson, D Medvedev, Worldwide divergence of values. *Nat. Commun.* **15**, 2650 (2024).