Measuring Tolerance of Homosexuality in the Mass Public Across Countries and Over Time

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Abstract

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Public attitudes toward homosexuality have been changing toward greater tolerance in many countries over the past several decades, and these often-rapid shifts have attracted sustained interest from researchers. The resulting scholarship has been hampered, however, by the limited available data on these trends in public opinion. Mirroring the coverage of the survey projects on which they were based, these works have either investigated the causes or consequences of dynamics in public opinion over time in only one country or region (see, e.g., Abou-Chadi and Finnigan 2019; Dotti Sani and Quaranta 2022), on the one hand, or differences in public opinion across a broad cross-regional sample of countries but in just a small number of years, on the other (see, e.g., Ayoub and Garretson 2017; Adamczyk 2017). Indeed, given the severe contraint of data availability on this topic, it is not at all surprising that there are also important contributions, even recently, that have been limited in *both* space *and* time (see, e.g., Lax and Phillips 2009; Zhou and Hu 2020; Winkler 2021; Paradela-López, Antón, and Jima-González 2023). The paucity of comparable data that has shaped this literature undermines our confidence in our understanding not only because the data are scant in general but also because they are biased geographically. Naturally, the narrower the evidentiary base upon which conclusions are built, the more susceptible these conclusions will be to collapse (see King, Keohane, and Verba 2021, 23). However, this is especially true where, as here, what suitable data exist are geographically concentrated. There is much more data, and hence research, on public opinion regarding homosexuality in the countries of Europe and North America than elsewhere (Adamczyk and Liao 2019, 406); this geographic bias makes scope conditions difficult to discern and so potentially leaves even theories that find empirical support less generally applicable than perhaps often assumed (see Wilson and Knutsen 2022, 1037).

This article presents the Tolerance of Homosexuality (TOL-H) dataset. The TOL-H dataset combines a comprehensive collection of responses to national and cross-national surveys with recent developments in latent-variable modeling of public opinion to provide estimates of public attitudes toward homosexuality that are comparable across countries and over time. These latent-variable estimates perform well in validation tests: they are

very strongly correlated with single survey items tapping views of homosexuality, and they also relate strongly to other concepts thought causally connected to public opinion on homosexuality. The TOL-H dataset provides a much firmer basis for testing the implications of theories by providing many more observations across a wider scope of countries and time than previously available sources. We demonstrate its potential in this regard by replicating the foundational but recently questioned finding of Andersen and Fetner (2008) that more income inequality yields less tolerance. The TOL-H data will, we expect, become an invaluable source for broadly cross-national and longitudinal research on the sources and consequences of tolerance of homosexuality.

Reviewing Existing Research on Attitudes Toward Homosexuality

Changes in attitudes over time and determinants of opinion shifts are key questions in public opinion studies. To assess these questions, it is important to have longitudinal data. United States is one of a few data rich countries in this regard, having been asked LGBTQ-related issue questions dated back more than 50 years (e.g., General Social Survey (GSS) in 1973). Based upon data availability, many initial studies have examined United States to understand what shapes the attitudes toward homosexuality.

For example, Lee and Mutz (2019) evaluated changes of attitudes toward same-sex marriage between 2008 and 2016 by using three waves of national online panel survey. Thy found that increase in level of education and interpersonal contact with LGBTQ+ community as well as decrease in religiosity increase the support for same-sex marriage. Daniels (2019) also examined the same rights but using data from the Pew Research Center and the National Opinion Research Center with temporal range between 1998 and 2014. This study found that ideology, partisanship, personnel connection, religion, and generation have impacts on forming attitudes toward homosexuality. Looking at different LGBTQ+ rights (namely, conversion therapy and denials of service based on religious beliefs), Flores, Mallory, and Conron (2020) illustrated that some of individual features—such as age, race, party affiliation, education level, and interpersonal contact—could be occasionally inconsistent with

previous findings.

More recent studies opinion towards homosexuality in different countries such as Chile (Paradela-López, Antón, and Jima-González 2023), Japan (Naka 2022), South Korea (Rich and Eliassen 2020), and Taiwan (Cheng, Wu, and Adamczyk 2016). Overall, these studies echo with the previous studies especially from US, which emphasizes the importance of socioeconomic features in forming tolerance toward homosexuality; these studies, however, also presented contextual differences between Western and non-Western countries in terms of opinion toward homosexuality.

Collectively, studies focused on single country over time contribute our understanding in attitudes toward homosexuality in two ways. First, they enable us to understand the over time changes in attitudes. Second, studies illustrate individual-level features that shape opinions toward homosexuality. That said, single-country-focused studies are less interested in country-level factors.

In comparison to single-country studies, a relatively small portion of studies examine cross-national over time. These studies have used regional (e.g., Eurobarometer, European Values Study, Latinobarometer) or global surveys (e.g., International Social Survey Programme, Pew Global Attitudes Project, or World Values Survey) as primary data sources and are more engaged with finding country-level characteristics that shape opinions toward homosexuality. Both poll data and studies have found that public opinion have been changed toward more liberal direction across the world (Corrales et al. 2017; Hadler 2012), although some conservative shifts have been found (Strand 2011). In addition, previous studies have illustrated that features such as economic development (Hooghe and Meeusen 2013), historical legacy (Asal, Sommer, and Harwood 2013), political context (Zhang and Brym 2019), and religious context (Van den Akker, Van der Ploeg, and Scheepers 2013) have shape opinion toward homosexuality.

The issue, however, is that some of the previous findings conflict with each other.

For example, many cross-national studies as well as a few single-country studies have examined the postmaterialist thesis that more developed societies will have higher levels of

social tolerance (Inglehart 1990; Inglehart and Baker 2000). Using the same data source (WVS) with differences in spatial and temporal coverage, Andersen and Fetner (2008) and Zhang and Brym (2019) reach different conclusions. Focusing on 35 democracies between 1990 and 2002, Andersen and Fetner (2008) found that national economic context is important factor of shaping public opinion toward homosexuality. Increasing both geographical and temporal coverage (88 countries between 1981 and 2014), however, Zhang and Brym (2019) showed that economic development is not as substantial as previous studies found. Moreover, they found that economic inequality does not affect attitudes on homosexuality.

On top of conflicting findings, two limitations further stand out from previous studies. First, from our knowledge, there is no comprehensive cross-national longitudinal data available to researchers. As discussed earlier, a few countries are rich on single country over time data, but most countries do not have that benefits. Obtaining cross-country over time data is much harder, and therefore, many cross-country studies have examined a handful of countries with a small time span. More recent studies take the advantage of survey data across the world (e.g., Zhang and Brym 2019), although these are exceptional cases.

In addition, most of available cross-national survey data have a regional focus. This leads to researchers focusing more on data-rich regions such as North America and Europe. This is concerning because it will only grants a partial picture of attitudes toward homosexuality. For example, the phases of tolerance toward homosexuality and developing legal rights of same sex couples vary across countries as well as regions such as Asian vs. Western European countries or even Eastern and Central European countries vs. Western European countries (Štulhofer and Rimac 2009). With regionally focused data, it is difficult to see broader change in attitudes cross-nationally. In other words, limitations in data, in terms of both temporal and spatial scope, hampers comprehensive understanding of attitudes toward homosexuality.

Second, it is difficult to properly address the impact of phrases used in the survey. Even when researchers acknowledge the limitations of relying on one data source (e.g, WVS) for cross-national studies, it is difficult or even potentially erroneous to simply utilize different survey data in one study. Studies and polls have used different terms—such as gay, lesbian,

same-sex, or homosexuality—to indicate LGBTQ-related issues (Adamczyk and Liao 2019). Putting aside whether the public can distinguish the terms, certain phrases—namely gay and homosexuality—are more exposed to and used by the public than the others. Given that question wording can have an impact on the responses (Clifford, Sheagley, and Piston 2021; Zaller et al. 1992), not dealing with question difficulty that stems from wordings is concerning. Smith et al. (2018), for instance, examined the wording impact between "homosexual" and "gay and lesbian". The study found that the survey participants respond differently about their attitudes toward "homosexual rights" and "gay and lesbian rights" based on the group identity and social attitude. Other studies also echo the impacts of phrasing on public support (Hill and Willoughby 2005; Husser and Fernandez 2016; Lewis et al. 2017). Therefore, dealing with question wordings is another hurdle that needs to be properly addressed.

Acknowledging disagreements of previous studies' findings and limitations in terms of data, this paper aims to introduce TOL-H data for those who are interested in attitudes toward homosexuality. We expect to achieve two goals. First, TOL-H data will facilitate more cross-national studies in this field. TOL-H is a cross-national overtime data from available public opinion survey data from various countries across the world; therefore, it opens more opportunity to explore questions that couldn't be answered with a single country data or a longitudinal data with a few countries. Using the IRT adds additional merits because it helps deal with the usage of different terms across surveys. Second, attitudes toward homosexuality are multifaceted. Like other issue areas, LGBTQ-related issues are composed of different topics such as individual comfortability/tolerance (Monto and Supinski 2014), employment (Becker 2014), marriage (Baunach 2012), and parenting (Webb and Chonody 2014); these are primary issues that have been asked by pollsters. Previous studies, however, mostly examined only one dimension. Using our TOL-H data, researchers can easily access to different LGBTQ-related issues at one venue that covers a wide range of temporal and geographical scopes.

Estimating Tolerance of Homosexuality Across Space and Time

To generate estimates of publics' tolerance of homosexuality that are comparable across countries and over time, we first assemble a comprehensive collection of survey questions on the topic. Surveys have often included questions about homosexuality over the past half-century, but these data are sparse, unavailable for many countries and years, and incomparable, generated by many different survey items. In all, we identified 45 items that were asked in no fewer than five country-years in countries surveyed at least three times; these items were drawn from 405 different national and cross-national survey datasets.[1] Together, these items were asked in 119 different countries in at least three time points over the 49 years from 1973 to 2022, yielding a total of 3,467 country-year-item observations. Observations for every year in each country surveyed would total 5,831, and a complete set of country-year-items would include 262,395 observations. Viewed from this complete-data perspective, the available source data can be seen to be very, very sparse. On the other hand, we do have in the source data 1,479 country-years for which we have at least *some* information about the extent of tolerance of homosexuality in the population, that is, very nearly 50% of the 2,976 country-years spanned by the data we collected. Still, the many different survey items employed render these data incomparable and so difficult to use together.

Consider the most frequently asked item in the data we collected, which asks respondents whether they think homosexuality "can always be justified, never be justified, or something in between," using a ten-point scale. Employed by the Asia Barometer, the European Values Survey, the Latinobarómetro, and the World Values Survey, this question was asked in a total of 527 different country-years. Even this question, the *most common* survey item asked, constitutes only 18% of the country-years spanned by our data. The available public opinion data on this topic are very sparse as well as incomparable.

The upper left panel of Figure 1 shows the dozen countries with the highest count of country-year-item observations. The United States, with 190 observations, is far and away the best represented country in the source data, followed by United Kingdom, Germany,

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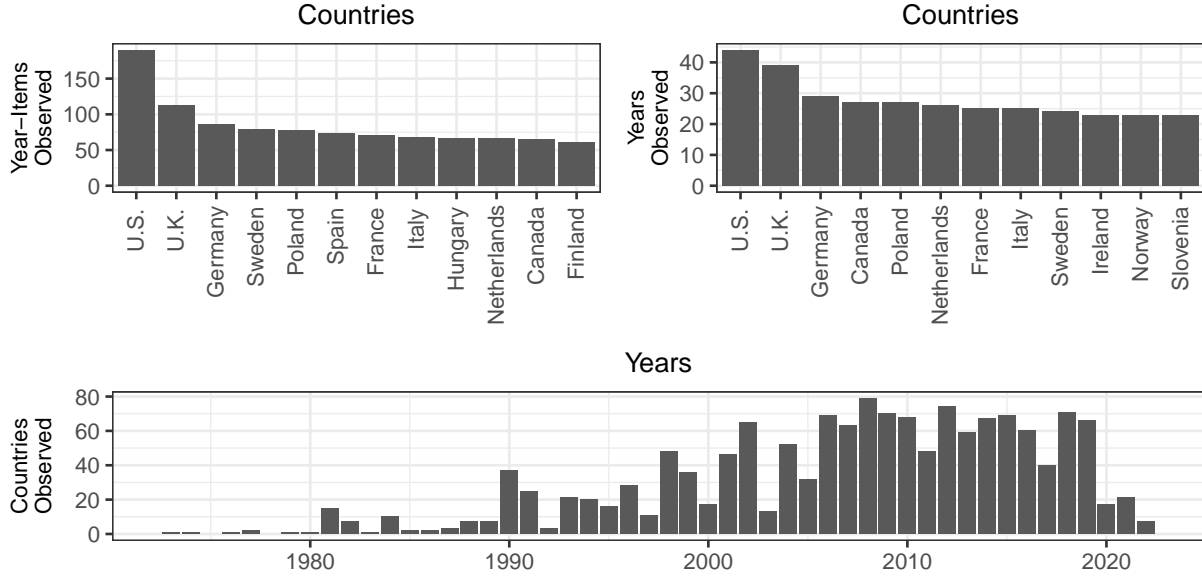[1]The complete list of survey items is included in Appendix A.

Figure 1: Countries and Years with the Most Observations in the Source Data

Sweden, and Poland. As Adamczyk and Liao (2019, 406) notes, more data has been collected in North America and Europe than in the rest of the world. At the other end of the spectrum, four countries—Cambodia, Côte d'Ivoire, Sri Lanka, and Tajikistan—have only the minimum two observations required to be included in the source dataset at all. The upper right panel shows the twelve countries with the most years observed; this group is similar, but with Ireland, Norway, and Slovenia joining the list and Spain, Hungary, and Finland dropping off. The bottom panel counts the countries observed in each year and reveals just how few relevant survey items were asked before 1990. Country coverage reached its peak in 2008, when surveys in 79 countries included items on homosexuality.

Latent variable models of public opinion drawing on cross-national survey data have attracted considerable attention in recent years (see Claassen 2019; Caughey, O'Grady, and Warshaw 2019; McGann, Dellepiane-Avellaneda, and Bartle 2019; Kolczynska et al. 2020). To estimate public gender egalitarianism across countries and over time, we draw on the latest of these methods that is appropriate for data that is both sparse and incomparable, the Dynamic Comparative Public Opinion (DCPO) model (Solt 2020c). In brief, the DCPO model is a population-level two-parameter ordinal logistic item response theory (IRT) model

with country-specific item-bias terms; for a detailed description, see online Appendix B and Solt (2020c, 3–8). Here, we focus on how it deals with the principal issues raised by the survey data described above: incomparability and sparsity.

The DCPO model accounts for the incomparability of different survey questions with two parameters. First, it incorporates the *difficulty* of each question's responses, that is, the amount of tolerance of homosexuality is indicated by a given response. That each response evinces more or less of our latent trait is most easily seen with regard to the ordinal responses to the same question: to strongly agree with the statement "the law should recognise same-sex relationships," evinces more tolerance than responding "agree," which is more tolerant than "neither agree nor disagree," which shows more tolerance than "disagree," and in turn "strongly disagree." The same thing is true across questions. For example, strongly agreeing with the statement "homosexual couples should be able to adopt children" likely expresses even more tolerance than strongly agreeing that same-sex relationships should be recognized by the law. Second, the DCPO model accounts for each question's *dispersion*, its noisiness with regard to our latent trait. A lower dispersion indicates that changes in responses to the question are more faithfully translated to changes in the underlying tolerance of homosexuality. These two parameters, difficulty and dispersion, generate comparable estimates of the latent variable from source data questions that are not directly comparable.

The sparsity in the source data—the interruptions in the time series of each country caused by unobserved country-years, and the fact that even many observed country-years have only one or few observed items—is addressed by the DCPO model using local-level dynamic linear models, also known as random-walk priors. This means that, for each country, each year's value of tolerance is modeled as the previous year's estimate plus a random shock. These dynamic models smooth the estimates of tolerance of homosexuality over time and allow estimation even in years for which little or no survey data is available, albeit at the expense of greater measurement uncertainty.

We estimated the DCPO model on the source data using the `DCPO` and `cmdstanr` packages for R (Solt 2020a; Gabry and Češnovar 2022), running four chains for 2,000 iterations each
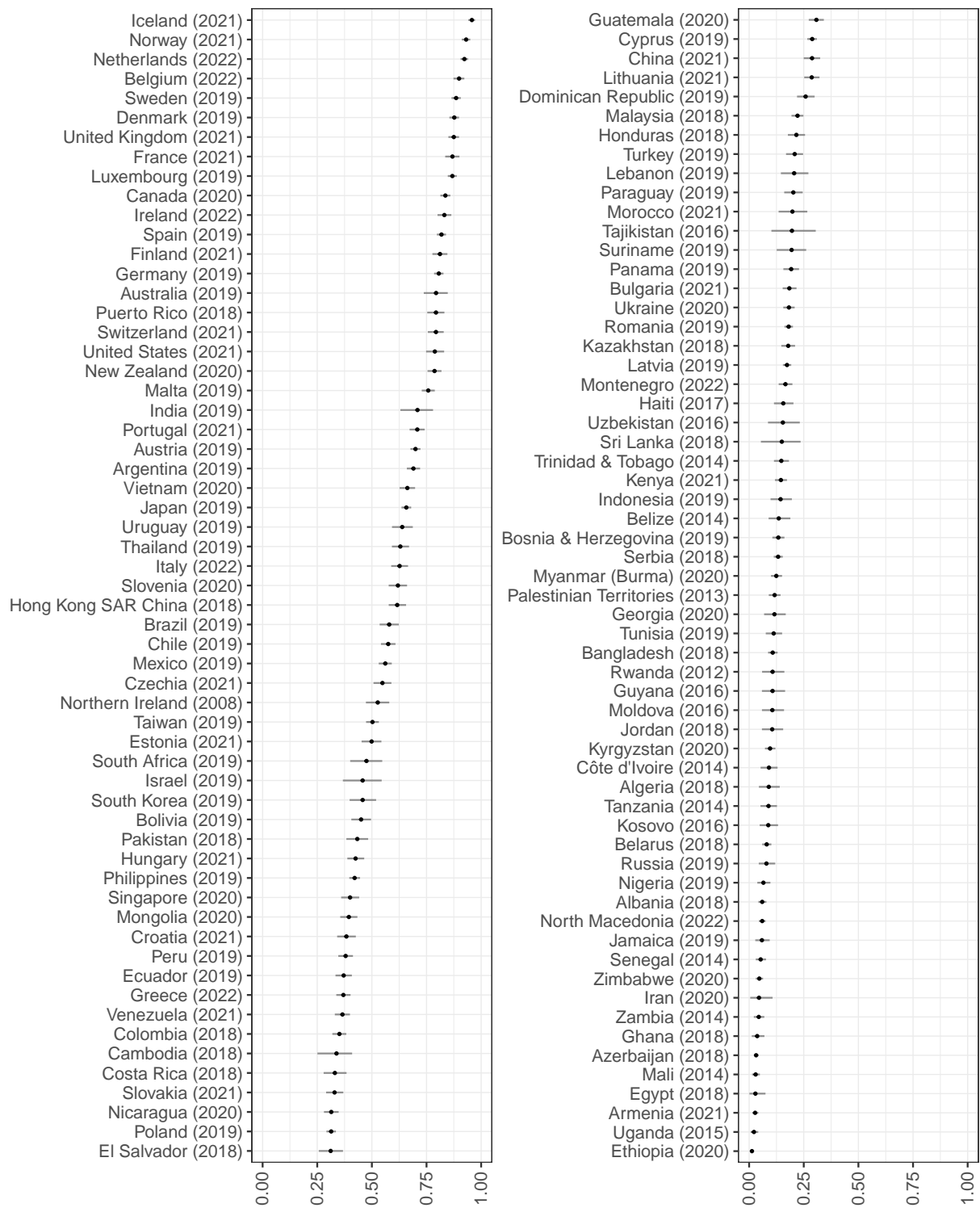
Note: Gray whiskers represent 80% credible intervals.

Figure 2: TOL-H Scores, Most Recent Available Year

and discarding the first half as warmup. All $\hat{R}$ diagnostics were below 1.02, which indicates that the model converged.

Despite the potential for divergences between responses to questions on the morality of homosexuality and those on what civil rights are properly accorded homosexuals, as Adamczyk and Liao (2019, 407) anticipated, "respondents across a range of different countries do not draw major distinctions between these two dimensions": the dispersion parameters indicate that all of the survey items load well on the single latent variable of tolerance for homosexuality (see Table A1 in Appendix A). The result is estimates for each of the 2,976 country-years spanned by the source data of mean tolerance of homosexuality, which together comprise the TOL-H dataset.

Figure 2 displays the most recent available TOL-H score for each of the 119 countries and territories in the dataset. Iceland, the Netherlands, Belgium, and the Scandinavian countries are the places where the public is most accepting of homosexuality. The latest scores for Ethiopia, Uganda, Armenia, Egypt, and Mali indicate there is very little tolerance in those countries.

Note: Countries are ordered by their TOL–H scores in their most recent available year; gray shading represents 80% credible intervals.
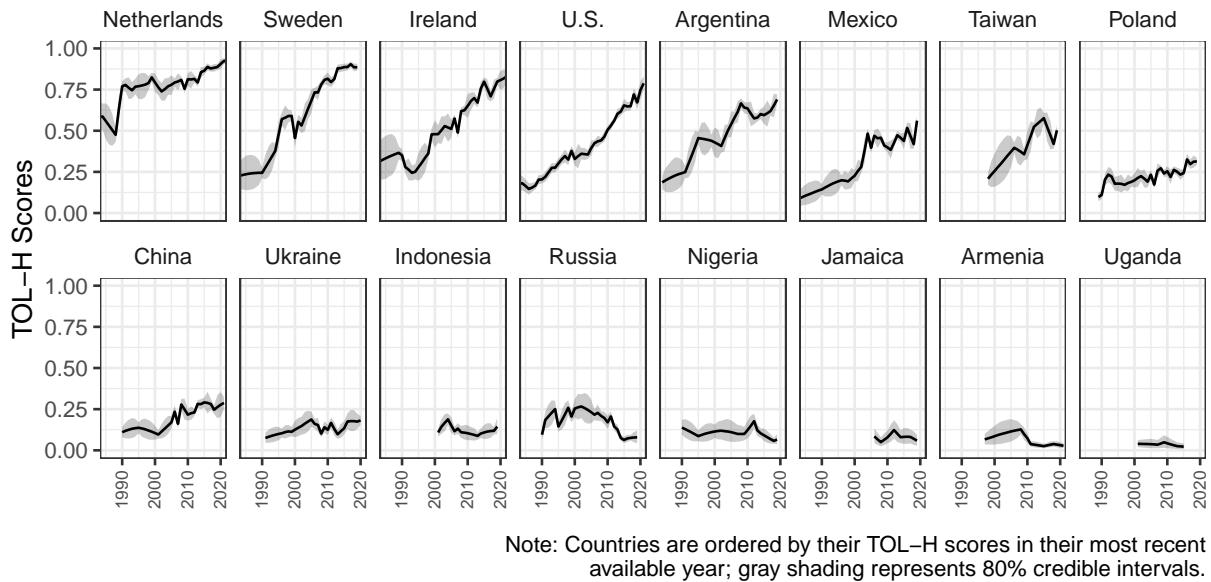
Figure 3: Tolerance Over Time Within Selected Countries

Figure 3 displays how TOL-H scores have changed over time in sixteen countries. It fur-

ther underscores what is already evident in Figure 2: the cross-regional scope of the TOL-H dataset allows comparison of countries too often neglected in political science analyses (see Wilson and Knutsen 2022). The figure also shows that while public opinion toward homosexuality has grown rapidly more tolerant in some countries, such as Sweden and the United States, attitudes have changed much more gradually over time in others, like Poland and China. Tolerance has advanced and retreated somewhat as in Taiwan and more completely as in Russia. And in countries such as Nigeria and Uganda, the extent of tolerance of homosexuality in the public has been steadily scant. The breadth of these differences stand as a challenge to our explanations for the causes and consequences of public tolerance of homosexuality.

Validating the Tolerance of Homosexuality Scores

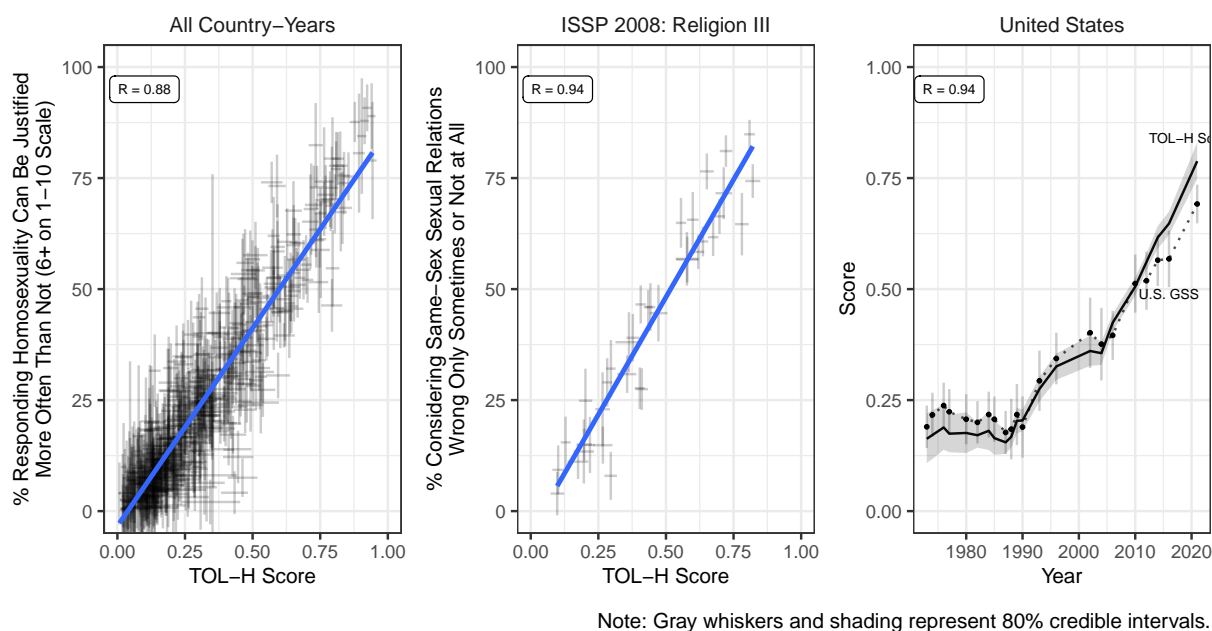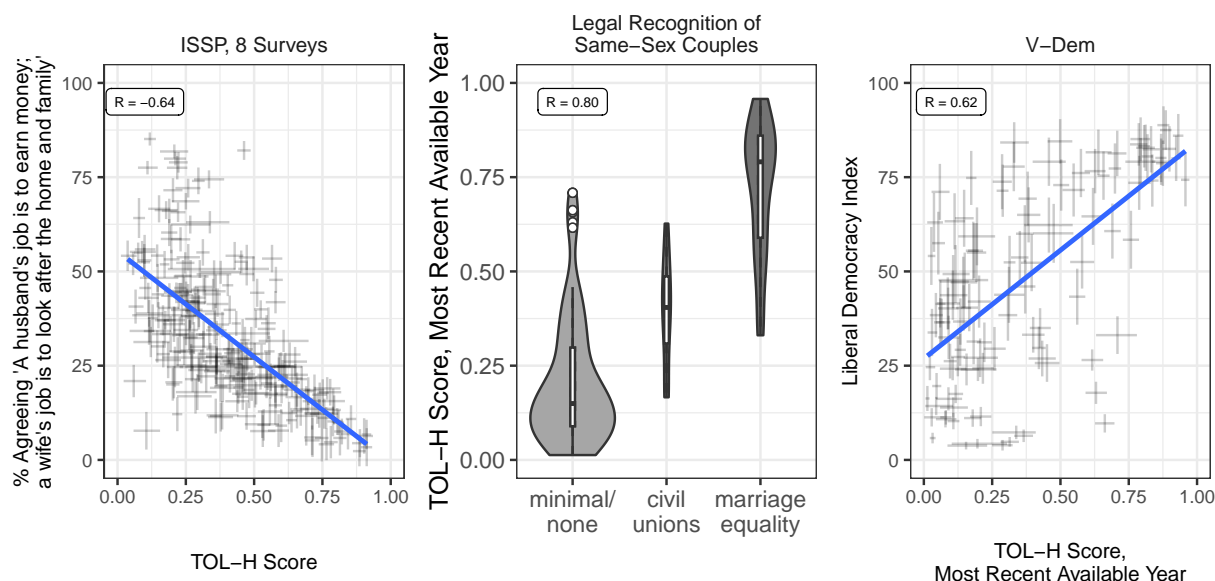Note: Gray whiskers and shading represent 80% credible intervals.

Figure 4: Convergent Validation: Correlations Between TOL-H Scores and Individual Source-Data Survey Items

Before these estimates can be used, however, they must be validated: the mere fact that we can generate estimates for tolerance of homosexuality does not automatically mean

that they are suitable for analysis. Just as with any other new measure, validation tests of cross-national latent variables are crucially important (see, e.g., Hu et al. 2023). Figure 4 and Figure 5 provide evidence of this measure's validity with tests of convergent validation and construct validation. Convergent validation refers to tests of whether a measure is empirically associated with alternative indicators of the same concept (Adcock and Collier 2001, 540). In Figure 4, the TOL-H scores are compared to responses to individual source-data survey items that were used to generate them; this provides an 'internal' convergent validation test (see, e.g., Caughey, O'Grady, and Warshaw 2019, 689; Solt 2020c, 10). The left panel is a scatterplot of country-years in which the TOL-H scores are plotted against the percentage of respondents who gave an accepting response to the most commonly asked item in the source data: whether homosexuality can always be justified, scored ten, never be justified, scored zero, or something in between. For this plot, responses six or greater are considered as indicating that whether respondents consider homosexuality justified more often than not. The middle panel shows responses to the question with the most data-rich cross-section, "And what about sexual relations between two adults of the same sex, is it always wrong, almost always wrong, wrong only sometimes, or not wrong at all?" in the International Social Survey Program's 2008 module on Religion, plotting our latent variable of tolerance against the percentage who responded "wrong only sometimes" or "not at all." Finally, in the right panel, the U.S. General Social Survey's series on this same item—the longest of any item in any single country in the source data—was used to evaluate how well the TOL-H scores capture change over time. The correlations, estimated taking into account the uncertainty in the measures, are very strong in all three cases.

Figure 5 moves on, then, to construct validation. Construct validation refers to demonstrating, for some *other* concept believed causally related to the concept a measure seeks to represent, that the measure being tested is empirically associated with measures of that other concept (Adcock and Collier 2001, 542). More traditional attitudes toward gender roles are often argued to yield more intolerance of homosexuals (see, e.g., Brown and Henriquez 2008). The left panel compares traditional gender attitudes, measured as the percentage of

Figure 5: Construct Validation: Correlations Between TOL-H Scores and tolerance of Homosexuality Survey Items

those agreeing or strongly agreeing with the statement, "A husband's job is to earn money; a wife's job is to look after the home and family," in eight ISSP surveys (Family and Changing Gender Roles in 1988, 1994, 2002, and 2012; and Religion in 1991, 1998, 2008, and 2018), with the TOL-H scores.

As a result of policy responsiveness, that is, the influence of public opinion on policy (see, e.g., Lax and Phillips 2009), and policy feedback, the influence of policy on public opinion (see, e.g., Abou-Chadi and Finnigan 2019; Earle et al. 2021), public tolerance of homosexuality is expected to be closely related to policies recognizing same-sex relationships. The figure's center panel presents violin plots of the distribution of TOL-H scores in the most recent available year across three groups of countries: those that currently have no or minimal legal recognition of same-sex relationships, those that recognize civil unions, and those with marriage equality. The gray-shaded 'violins' depict mirrored kernal density plots of the observations in each group; their areas are proportional to the number of observations. The violins are inset with box-and-whisker plots showing the 25th percentile, median, and

75th percentile as horizontal lines in a box; the dashed vertical whiskers then extend to the farthest observation within 1.5 times the interquartile range, that is, the height of the box; and all observations beyond that distance are shown individually as white circles (see Tukey 1977).

A third oft-theorized relationship is that liberal democracies promote generally more tolerant attitudes that lead to greater tolerance of homosexuality (see, e.g., Adamczyk 2017). The right panel of Figure 5 plots the TOL-H score of the most recent available year for each country against the V-Dem Liberal Democracy Index for that country-year. In each of these three cases, the relationship is in the expected direction and strong to very strong. The evidence of convergent validation in Figure 5, together with the evidence of construct validation in Figure 4, demonstrates the validity of the TOL-H scores as measures of the public's tolerance of homosexuality.

Testing Theories on the Tolerance of Homosexuality: Revisiting 'Economic Inequality and Intolerance'

As an example of the utility of the TOL-H data, we revisit Andersen and Fetner's (2008) foundational work on economic inequality and intolerance. The piece argues that postmaterialist theory (see, e.g., Inglehart and Welzel 2005) implies that greater inequality should be expected to yield greater intolerance of homosexuality: if economic prosperity is what provides societies with the security needed to leave such traditional biases behind, then when a society's prosperity (and security) is not broadly shared, more tolerant attitudes will not be broadly shared either.[2] Supporting this view, its analysis found that more economic inequality leads to more intolerance of homosexuality. Despite the article's influence, it was flagged in a recent review of the literature as a study for which "more research is needed to replicate and confirm [its] findings" (Adamczyk and Liao 2019, 415). Indeed, one recent work finds no support at all for the hypothesized relationship between inequality and tolerance of

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[2]An alternate, possibly complementary, theory would be that greater inequality gives wealthier individuals both greater means and enhanced motive to promote religiosity among their fellow citizens (see, e.g., Solt, Habel, and Grant 2011; Solt 2014), and more religiosity in turn works to decrease tolerance (see, e.g., Adamczyk and Pitt 2009). We leave distinguishing between these two theories to future research.

homosexuality (Zhang and Brym 2019, 515).

One difference between these two works, Andersen and Fetner (2008) and Zhang and Brym (2019), that is potentially important to their diverging conclusions is the sample employed. Both works draw on World Values Survey data, but the group of countries each examines differs in size and in kind. Noting the particular importance to democracies of tolerance of social and political difference, Andersen and Fetner (2008) examined only democratic countries. Its analyses included 35 countries, observed in just one to four years each, for a total of 63 country-years, that is, a mean of 1.8 years observed per country. The sample analyzed in Zhang and Brym (2019), on the other hand, incorporated a wider range of cases including non-democracies. This broader scope—along with the additional WVS survey waves conducted in the time between the two pieces' writing—yielded 88 countries and 214 country-year observations for an increased mean number of years observed of 2.4 per country. So although the different conclusion reached in Zhang and Brym (2019, 517) may, as the piece suggests, reflect the larger sample of countries that study included, it may have also resulted from the inclusion of non-democratic countries, revealing a scope condition to the theory presented in Andersen and Fetner (2008).

The TOL-H data allow us to revisit the Andersen and Fetner (2008) hypothesis with many, many more observations of economic inequality and tolerance from a broader sample of countries than either of these two previous works and also to assess whether tolerance in the advanced democratic countries is distinctively sensitive to income inequality. Our sample of democracies includes the 36 democratic countries of the OECD, each observed in 21 (Costa Rica) to 49 (the United States) consecutive years (mean: 33.4 years, median: 31.5 years), a total of 1203 country-year observations. The broader sample of all countries includes 114 countries, observed in 2 to 49 consecutive years each, for a total of 2623 country-year observations. That is, the TOL-H dataset provides a number of country-years observations for our sample of democracies that is some 19 times greater than that considered in Andersen and Fetner (2008), and it gives us a number of country-years in our sample of all countries that is about 12 times greater than that in the sample employed in Zhang and Brym (2019). This

much larger evidentiary base provides us with a much firmer basis for drawing conclusions regarding both the theory and its potential scope conditions (see, e.g., King, Keohane, and Verba 2021, 23).

The independent variable, economic inequality, is measured using the Gini index of disposable income inequality. The Gini index ranges from 0, indicating perfect equality in the distribution, in this case, of income after taxes and government transfers, to 100, indicating a perfectly unequal distribution in which a single household receives all such income. The data are drawn from the Standardized World Income Inequality Database (Solt 2020b).

We also include the country-year- and country-level control variables included in the analysis in Andersen and Fetner (2008). Data on GDP per capita (in thousands of constant 2015 U.S. dollars) are provided by the World Bank's World Development Indicators (World Bank 2023). A series of dichotomous country-level variables identify a country's religious heritage—countries are coded as having alternately a Catholic, Orthodox, Eastern, or Islamic heritage, with those with a Protestant heritage treated as the reference category—and countries with a Communist history are also identified with such a variable (see Inglehart and Welzel 2005). Finally, although its presence does not impact the conclusions drawn below, we add a dichotomously-coded variable for the presence of marriage equality, which takes on a value one in country-years where same-sex marriage was legal and zero otherwise (at the time of publication of Andersen and Fetner (2008), only five countries had legalized same-sex marriage, and the data analyzed in that piece ended before any of those policy adoptions).

Shor et al. (2007) shows that the best way to analyze such pooled time series is by using a Bayesian multilevel model that includes varying intercepts for each country and for each year. Varying intercepts for each country account for heteroskedasticity across space due to, e.g., omitted variable bias, while permitting the inclusion of time-invariant predictors such as religious heritage and communist past. Varying intercepts for each year take into account 'time shocks' that operate on all countries simultaneously (Shor et al. 2007, 171–72). We further employ the 'within-between random effects' specification, meaning each of the

time-varying predictors is decomposed into its time-invariant country mean and the time-varying difference between each country-year value and this country mean. The time-varying difference variables capture the short-term effects of the predictors, while the time-invariant country-mean variables reflect their—often different—long-run, "historical" effects (Bell and Jones 2015, 137). This specification has been shown superior for addressing omitted variable bias and endogeneity to fixed effects and other commonly used specifications for time-series cross-sectional data like these (see Bell and Jones 2015). The measurement uncertainty in the data for both tolerance of homosexuality and income inequality was incorporated into the analysis as well (see Tai, Hu, and Solt 2022). The model was estimated using the `brms` R package (Bürkner 2017).

The results are presented in Figure 6. Greater income inequality is associated with less tolerance of homosexuality, both in the long run and in the short term, in both samples of countries. Looking at the 'historical,' long-run effect of income inequality, we see that in the democratic sample, a two-standard deviation increase in a country's mean inequality is associated with 14.2 points less tolerance (95% credible interval: -22.4 to -5.1 points), while across all countries this estimated difference was -6.1 (95% c.i.: -10.6 to -1.6) points. In the short run, a two-standard-deviation year-to-year change was found to decrease tolerance 1.3 points (95% c.i.:-2.3 to -0.3) among democracies. If anything, the estimated decline in tolerance was even larger when all countries are considered: 2.2 (95% c.i.: -2.8 to -1.6) points. Having much more data provides strong evidence that income inequality decreases tolerance of homosexuality and that democracies are not particularly sensitive to this effect.

Notes: Dots indicate posterior means; whiskers, from thickest to thinnest, describe 80%, 90%, and 95% credible intervals; shading depicts the posterior probability density function.
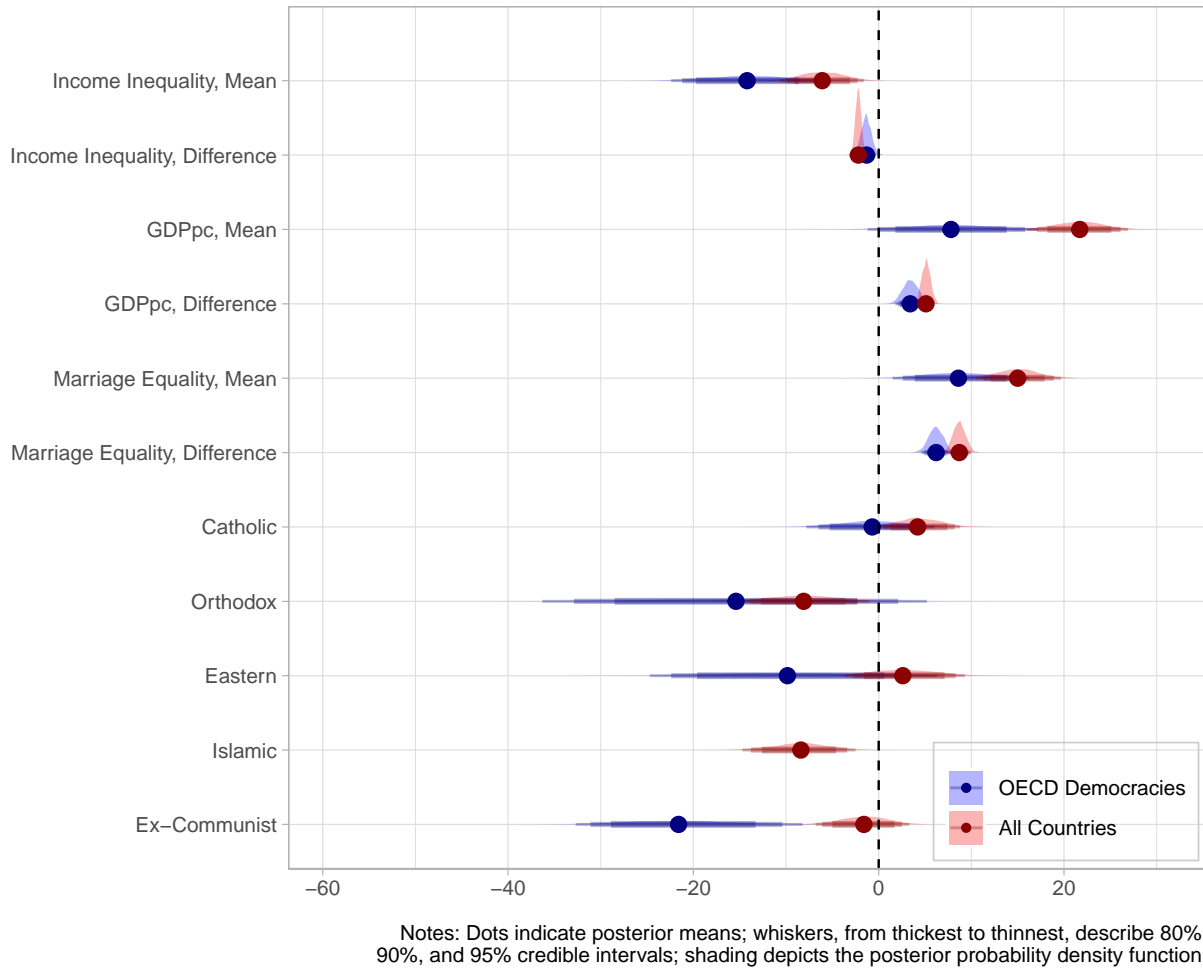
Figure 6: Predicting Tolerance of Homosexuality

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Measuring Tolerance of Homosexuality in the Mass Public Across Countries and Over Time

June 13, 2023

Appendices

Appendix A: Survey Items Used to Estimate tolerance of Homosexuality

National and cross-national surveys have often included questions tapping interest in politics over the past four decades, but the resulting data are both sparse, that is, unavailable for many countries and years, and incomparable, generated by many different survey items. In all, I identified 45 such survey items that were asked in no fewer than five country-years in countries surveyed at least three times; these items were drawn from 405 different survey datasets. These items are listed in the table below, along with the dispersion (α) and difficulty (β) scores estimated for each from the DCPO model. Lower values of dispersion indicate questions that better identify publics with a higher level of trust from those with lower. Items have one less difficulty score than the number of response categories. Survey dataset codes correspond to those used in the `DCPOtools` R package (Solt, Hu, and Tai 2019); they appear in decreasing order of country-years contributed.

Together, the survey items in the source data were asked in 119 different countries in at least two time points over 49 years, from 1973 to 2022, yielding a total of 3,467 country-year-item observations. The number of items observed in the source data for each country-year is plotted in Figure A1 below. The estimates of tolerance in country-years with more observed items are more precise. In country-years with fewer observed items, the estimates rely more heavily on the random-walk prior and are therefore more uncertain, and when there are no observed items, the estimates rely *entirely* on the random-walk prior and so uncertainty increases still further.

Table A1: Indicators Used in the Tolerance of Homosexuality Latent Variable Model

Survey Item Code	Country-Years	Question Text	Response Categories	Dispersion	Difficulties	Survey Dataset Codes
just10	527	Please tell me for each of the following statements whether you think it can always be justified, or something in between, using this card. READ OUT STATESMENTS. COME ONE ANSWEWR FOR EACH[Homosexuality]	[1-10]1 Never Justifiable 10 Always justifiable	0.42	0.01, 0.30, 0.54, 0.75, 1.39, 1.70, 1.98, 2.35, 2.63	evs, wvs, asiab, lb, caucasusb
neigh2	520	Homosexuals. Would you mind having them as neighbors?	0 Do not have a problem with having them as neighbors / 1 Do not want them as neighbors	0.86	-0.33	evs, wvs, lits, cid, lb, fsdreligion, amb
free5	264	Homosexuality is a personal behavior, others should not blame	1 Strongly disagree / 2 disagree / 3 Neither / 4 Agree / 5 Strongly Agree	1.23	-3.08, -1.54, -0.08, 2.69	ess, ress, seessp, cgss
accept2	211	And which one of these comes closer to your opinion?	1 homosexuality is a way of life that should be accepted by society / 2 homosexuality is a way of life that should not be accepted by society	0.62	0.63	uspew, gallup, pew, pewrel
approve4	209	A sexual relationship between two adults of the same sex	1 Very bad 2 Fairly bad 3 Not so bad 4 Definitely not bad	0.21	0.55, 1.00, 1.58	usgss, issp, lat, bsa, allbus, pgss, isshr, chcep, seessp, jgss, nsss, twscs
run10	177	And now, changing the topic and thinking of homosexuals, how strongly do you approve or disapprove of such people being permitted to run for public office?	1 Strongly Disapprove 2 3 4 5 6 7 8 9 10 Strongly Approve	0.56	-0.67, -0.32, -0.05, 0.21, 0.65, 0.95, 1.27, 1.66, 1.99	amb
hioff10	140	Using a scale from 1 to 10, please tell me how you would feel about having a person from each of the following groups in the highest elected political position in	1 Not at all comfortable / 23456789 / 10 Totally comfortable	0.16	-0.83, -0.53, -0.22, 0.02, 0.50, 0.76, 1.06, 1.44, 1.75	eb
approve3	92	Is homosexual behavior morally acceptable, morally wrong, or is it not a moral issue?	1 morally acceptable / 2 morally wrong / 3 not a moral issue	0.44	0.86, 2.00	uspew, pew, pewrel
marry4a	90	Overall, do you support or oppose allowing gays and lesbians to marry legally?	1 Support strongly 2 Support somewhat 3 Oppose somewhat 4 Oppose strongly	0.82	-0.59, 1.06, 3.36	nbcwsj, lat, uspew, prri, abcwapo, pewrel, pew, lb, aes
marry4e	85	For each of the following propositions, tell me if you Homosexual marriages should be allowed throughout Europe?	Totally agree 1 totally disagree 4	0.09	-0.01, 0.84, 2.06	eb
marry10	80	How strongly do you approve or disapprove of same-sex couples having the right to marry?	1 Strongly disapprove / 23456789 / 10 Strongly approve	0.24	0.18, 0.48, 0.68, 0.86, 1.17, 1.36, 1.58, 1.82, 2.07	amb

Survey Item Code	Country-Years	Question Text	Response Categories	Dispersion	Difficulties	Survey Dataset Codes
adopt5	80	How acceptable or unacceptable do you consider the following issues? That homosexual and lesbian couples have the right to adopt children	1 completely unacceptable 2 unacceptable 3 neither acceptable nor unacceptable 4 acceptable 5 completely acceptable	0.76	-0.61, 0.74, 1.77, 3.37	bsa, ess, belgiumes, dkes, nores, icenes
parent5	79	How much do you agree or disagree with this statement? Homosexual couples are as good parents as other couples	Agree strongly1 strongly disagree 5	0.88	-1.52, 0.30, 1.53, 3.49	wvs, evs
ashamed5	73	If a close family member was a gay man or a lesbian, I would feel ashamed.	Agree strongly 1 Disagree strongly 5	1.01	-2.55, -0.88, 0.39, 2.30	ess
marry3	69	What is your view on same-sex marriage?	1 Favour same-sex marriage / 2 Oppose same-sex marriage, but would accept civil unions / 3 Oppose entirely same-sex marriage	0.97	-0.74, 0.90	ipsos, cgeis
rights4	57	To what extent do you agree or disagree with each of the following statements? Gay, lesbian and bisexual people should have the same rights as heterosexual people	Totally agree 1 totally disagree 4	0.72	-1.31, -0.12, 1.67	eb, itanes
approve4a	56	To what extent do you agree or disagree with each of the following statements?There is nothing wrong in a sexual relationship between two persons of the same sex	Totally agree 1 totally disagree 4	0.71	-0.93, 0.34, 2.00	eb
adopt4a	55	Same-sex couples' right to adopt is a good thing	1 strongly agree / 2 somewhat agree / 3 somewhat disagree / 4 strongly disagree	0.55	0.01, 1.03, 2.31	prri, ipsos, prriatlantic, fsdelection, ptvs
adopt5a	53	How would you feel about the following statement? Do you agree or disagree with them? Homosexual couples should be able to adopt children	Agree strongly1 strongly disagree 5	1.70	-0.90, 1.41, 3.01, 5.61	evs, som, snes, ptvs
adopt2	51	Do you favor or oppose allowing gay or lesbian couples to adopt a child?	1 Favor 2 Oppose 8 DK/No opinion 9 NA/Refused	0.10	1.60	gallup, anes, cnn, psra, abcwapo, bsa, eb, pew, angus
marry4c	47	Same-sex marriage is or could be harmful to society	1 strongly disagree / 2 somewhat disagree / 3 somewhat agree / 4 strongly agree	0.45	-0.77, 0.33, 1.48	ipsos
marry2	39	Do you think homosexuals should or should not have equal rights to marry one another?	1 Should have equal rights to marry 2 Should not have equal rights to marry 8 DK/No opinion 9 NA/Refused	0.88	1.20	cnn, abcwapo, psra, ap, gallup, uspew, cces, eb, angus, aes
ff5	39	same sex female couple can bring up a child as well as a male-female couple	1 Strongly agree / 2 Agree / 3 Neither agree nor disagree / 4 Disagree / 5 Strongly disagree	0.74	-0.73, 0.87, 1.62, 3.67	issp

Survey Item Code	Country-Years	Question Text	Response Categories	Dispersion	Difficulties	Survey Dataset Codes
mm5	39	same sex male couple can bring up a child as well as a male-female couple	1 Strongly agree / 2 Agree / 3 Neither agree nor disagree / 4 Disagree / 5 Strongly disagree	0.72	-0.38, 1.17, 1.94, 3.80	issp
marry5a	33	Here are some statements about general social concerns. Please say whether you strongly agree, agree, disagree or strongly disagree with each of these statements. Same-sex marriages should be prohibited by law	1 Strongly agree / 2 Agree / 3 Neither agree nor disagree / 4 Disagree / 5 Strongly disagree	0.65	-0.71, 0.39, 1.15, 2.56	ees, ptvs, ines, aes
approve5	30	What about sexual relations between two adults of the same sex?	1 Always wrong 2 Mostly wrong 3 Sometimes wrong 4 Rarely wrong 5 Not wrong at all	0.11	0.46, 0.80, 1.32, 1.65	bsa, cgss
adopt4	29	For each of the following propositions, tell me if you Adoption of children should be authorised for homosexual couples throughout Europe	Totally agree 1 totally disagree 4	0.76	0.67, 1.81, 3.31	eb
marry5	28	Agree: The law should recognise same-sex relationships	1 Strongly agree / 2 Agree / 3 Neither agree nor disagree / 4 Disagree / 5 Strongly disagree	0.56	-0.26, 0.69, 1.51, 2.96	issp, usgss, bsa, som, chcep, nsss, aussa, kgss
marry11	28	I would like you to tell me your views on various issues: same-sex marriage	0 fully in favour of same sex marriage / 123456789 / 10 fully opposed to same sex marriage	1.13	-0.41, -0.15, 0.17, 0.46, 0.67, 1.57, 1.82, 2.15, 2.50, 2.91	ees
neigh10	27	Having a homosexual	1 Not at all comfortable / 23456789 / 10 Totally comfortable	0.86	-2.37, -1.94, -1.50, -1.20, -0.55, -0.23, 0.14, 0.68, 1.21	eb
civil2	22	.Allowing homosexual couples to have the same benefits as married heterosexual couples, such as health benefits inheritance rights and Social Security survivor benefits	1 Support 2 Oppose 8 DK/No opinion 9 NA/Refused	0.86	0.61	abcwapo, eb, politbarometer, gallup
accept4	20	Homosexuals are people who should be accepted like anybody else	Agree completely 1 Disagree completely 4	0.90	-2.04, -0.92, 0.91	cdcee
pension4	16	Couples of the same sex should be entitled to a widow's/widower's pension as if they had lived with a partner of the opposite sex	1 strongly agree / 2 agree / 3 disagree / 4 strongly disagree	0.82	-0.75, 0.20, 2.04	eb
marry4d	13	Gays and lesbians should be allowed to get married	1 strongly agree / 3 somewhat agree / 5 somewhat disagree / 7 strongly disagree	0.20	0.44, 1.15, 2.42	uspew, fsdelection, cnes, poc, canadianes, twscs
neigh5	13	For each of the following types of people, please tell me whether you would like having people from this group as neighbors, dislike it, or not care: Homosexuals	1 strongly dislike / 2 somewhat dislike / 3 would not care / 4 somewhat like / 5 strongly like	0.45	-0.38, 0.19, 1.54, 2.20	afrob

| Survey Item Code	Country-Years	Question Text	Response Categories	Dispersion	Difficulties	Survey Dataset Codes
legal2	12	Do you think homosexual relations between consenting adults should or should not be legal	1 should be legal / 2 should not be legal	0.70	-0.21	gallup, abcwapo, cbsnyt, cnn, uswapo, anpas, aes
teacher4	12	School boards ought to have the right to fire teachers who are known homosexuals	1 completely agree / 2 mostly agree / 3 mostly disagree / 4 completely disagree	0.75	-1.56, -0.48, 1.18	uspew
legal2a	9	Do you think gay or lesbian relations between consenting adults should or should not be legal?	1 should be legal / 2 should not be legal	1.68	-0.03	gallup
accept2a	7	Do you feel that homosexuality should be considered an acceptable alternative lifestyle or not?	1 acceptable / 2 not acceptable	1.40	0.43	gallup, usnwr, cbsnyt
accept5	7	Homosexuals are people just like others	1 Disagree completely / 2 Disagree / 3 Neither agree nor disagree / 4 Agree / 5 Completely agree	0.46	-2.18, -1.25, -0.41, 0.79	eb, fsdimm
marry4b	6	Do you think it should be LEGAL or ILLEGAL for homosexual couples to get married?	1 Legal, STRONGLY 2 Legal, SOMEWHAT 3 Illegal, SOMEWHAT 4 Illegal, STRONGLY 8 DK/No opinion 9 NA/Refused	0.84	0.40, 0.91, 1.95	abcwapo
approve5a	6	Homosexual relations are always wrong	1 strongly agree / 2 agree to some extent / 3 hard to say / 4 disagree to some extent / 5 strongly disagree	0.51	-1.24, -0.36, 1.06, 2.43	bsa, nzes
strength5	6	Strengthen the position of homosexuals, bisexuals and transsexuals in society	1 very good suggestion 2 pretty good suggestion 3 neither good nor bad suggestion 4 pretty bad suggestion 5 very bad suggestion	0.80	-0.35, 0.51, 2.70, 4.16	som
legal5	6	Homosexuals are no better than criminals and should be punished in the extreme	1 agree strongly / 2 agree / 3 neither agree nor disagree / 4 disagree / 5 disagree strongly	0.40	-1.95, -1.04, -0.39, 1.06	seessp
marry3a	5	Do you favour or oppose same-sex marriage, or do you have no opinion on this?	1 favor / 3 oppose / 8 no opinion	0.51	0.72, 2.25	canadianes
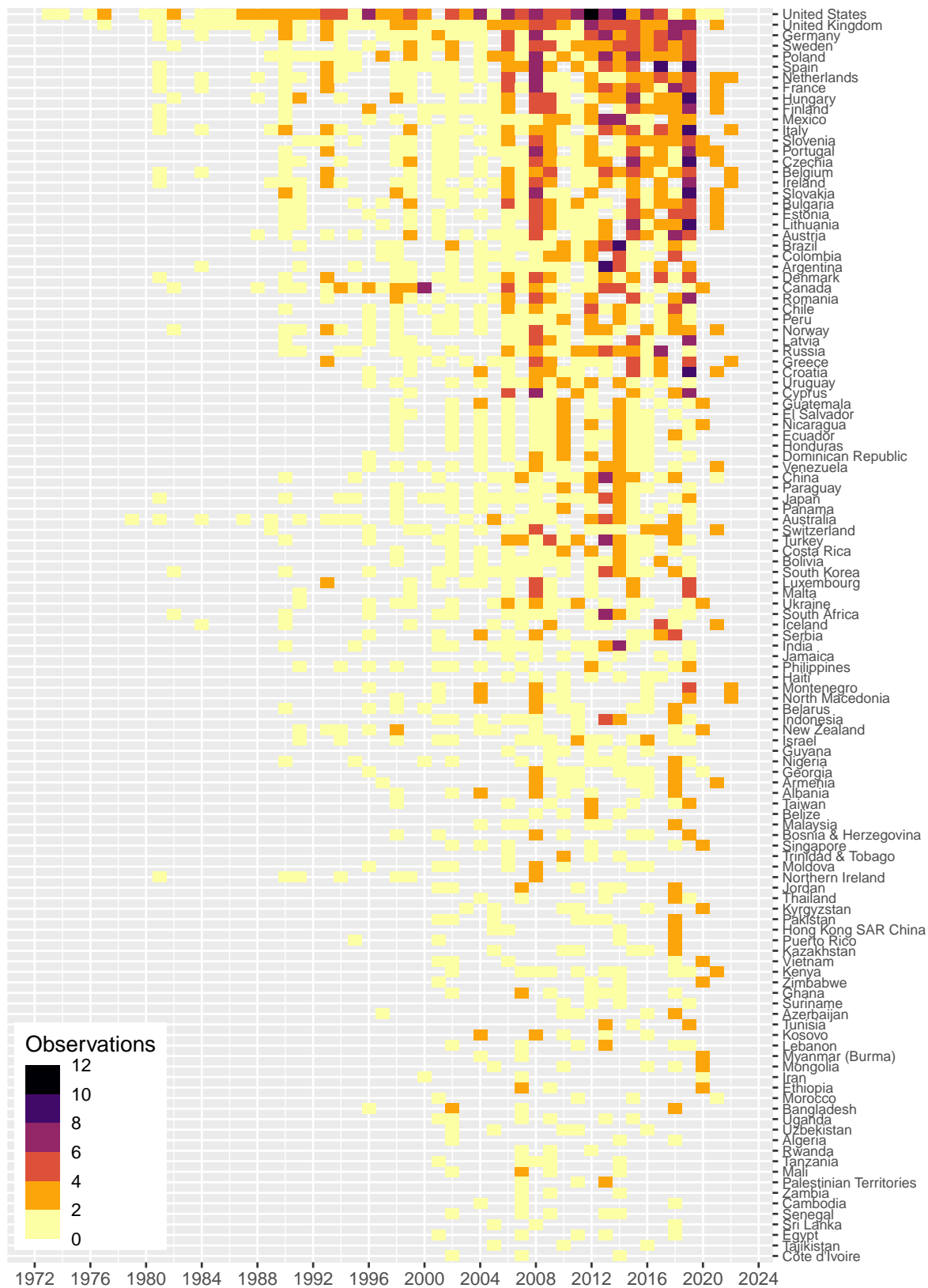
Figure A1: Source Data Observations by Country and Year

Appendix B: The DCPO Model

Research on latent variable models of public opinion based on cross-national survey data has enjoyed explosive growth in recent years (see Claassen 2019; Caughey, O'Grady, and Warshaw 2019; McGann, Dellepiane-Avellaneda, and Bartle 2019; Kolczynska et al. 2020). To estimate tolerance of homosexuality across countries and over time, we draw on the latest of these methods that is appropriate for data that is not only incomparable but also sparse, the Dynamic Comparative Public Opinion (DCPO) model presented in Solt (2020c).[1] The DCPO model is a population-level two-parameter ordinal logistic item response theory (IRT) model with country-specific item-bias terms.

DCPO models the total number of survey responses expressing at least as much tolerance of homosexuality as response category r to each question q in country k at time t, y_{ktqr}, out of the total number of respondents surveyed, n_{ktqr}, using the beta-binomial distribution:

$$a_{ktqr} = \phi \eta_{ktqr} \tag{1}$$

$$b_{ktqr} = \phi(1 - \eta_{ktqr}) \tag{2}$$

$$y_{ktqr} \sim \text{BetaBinomial}(n_{ktqr}, a_{ktqr}, b_{ktqr}) \tag{3}$$

where ϕ represents an overall dispersion parameter to account for additional sources of survey error beyond sampling error and η_{ktqr} is the expected probability that a random person in country k at time t answers question q with a response at least as positive as response r.[2]

This expected probability, η_{ktqr}, is in turn estimated as follows:

$$\eta_{ktqr} = \text{logit}^{-1}\left(\frac{\bar{\theta}'_{kt} - (\beta_{qr} + \delta_{kq})}{\sqrt{\alpha_q^2 + (1.7 * \sigma_{kt})^2}}\right) \tag{4}$$

In this equation, β_{qr} represents the difficulty of response r to question q, that is, the degree of tolerance the response expresses. The δ_{kq} term represents country-specific item bias: the extent to which all responses to a particular question q may be more (or less) difficult in a given country k due to translation issues, cultural differences in response styles, or other idiosyncrasies that render the same survey item not equivalent across countries.[3]

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[1]Solt (2020c) demonstrates that the DCPO model provides a better fit to survey data than the models put forward by Claassen (2019) or Caughey, O'Grady, and Warshaw (2019). The McGann, Dellepiane-Avellaneda, and Bartle (2019) model depends on dense survey data unlike the sparse data on public gender egalitarianism described in the preceding section. Kolczynska et al. (2020) is the very most recent of the five works and builds on each of the others, but the MRP approach developed in that piece is suitable not only when the available survey data are dense but also when ancillary data on population characteristics are available, so it is similarly inappropriate to this application.

[2]The ordinal responses to question q are coded to range from 1 (expressing the least tolerance of homosexuality) to R (expressing the most tolerance of homosexuality), and r takes on all values greater than 1 and less than or equal to R.

[3]Estimating δ_{kq} requires repeated administrations of question q in country k, so when responses to question q are observed in country k in only a single year, the DCPO model sets δ_{kq} to zero by assumption,

The dispersion of question q, its noisiness in relation to our latent variable, is α_q. The mean and standard deviation of the unbounded latent trait of tolerance of homosexuality are $\bar{\theta}'_{kt}$ and σ_{kt}, respectively.

Random-walk priors are used to account for the dynamics in $\bar{\theta}'_{kt}$ and σ_{kt}, and weakly informative priors are placed on the other parameters.[4] The dispersion parameters α_q are constrained to be positive and all survey responses are coded with high values indicating more tolerance to fix direction. The difficulty β of "not so bad" (on a four-point scale ranging from "very bad" through "fairly bad" and "not so bad" to "not at all bad") of reactions to "a sexual relationship between two adults of the same sex" is set to 1 to identify location, and for each question q the difficulties for increasing response categories r are constrained to be increasing. The sum of δ_{kq} across all countries k is set to zero for each question q:

$$\sum_{k=1}^{K} \delta_{kq} = 0 \tag{5}$$

Finally, the logistic function is used to transform $\bar{\theta}'_{kt}$ to the unit interval and so give the bounded mean of latent tolerance of homosexuality, $\bar{\theta}_{kt}$, which is our parameter of interest here (see Solt 2020c, 3–8).

increasing the error of the model by any country-item bias that is present. Questions that are asked repeatedly over time in only a single country pose no risk of country-specific item bias, so δ_{kq} in such cases are also set to zero.

[4]The dispersion parameters α_q are drawn from standard half-normal prior distributions, that is, the positive half of N(0, 1). The first difficulty parameters for each question, β_{q1}, are drawn from standard normal prior distributions, and the differences between βs for each r for the same question q are drawn from standard half-normal prior distributions. The item-bias parameters δ_{kq} receive normally-distributed hierarchical priors with mean 0 and standard deviations drawn from standard half-normal prior distributions. The initial value of the mean unbounded latent trait for each country, $\bar{\theta}'_{k1}$, is assigned a standard normal prior, as are the transition variances $\sigma^2_{\bar{\theta}'}$ and σ^2_{σ}; the initial value of the standard deviation of the unbounded latent trait for each country, σ_{k1}, is drawn from a standard lognormal prior distribution. The overall dispersion, ϕ, receives a somewhat more informative prior drawn from a gamma(4, 0.1) distribution that yields values that are well scaled for that parameter.