

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

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Appendices

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Appendix A: Sample of Published Articles on Public Opinion and Homosexuality

To generate a sample of published articles on public opinion and homosexuality, we combined results from two searches, the first on the Web of Science and the second on Google Scholar. Web of Science topic searches return articles in which the search terms appear in the title or abstract. We executed the following search: TS=("public opinion" AND (homosexual* OR gay OR LGB*)). The fifty most cited empirical research articles returned were retained for our sample. Google Scholar, [according to its about page](#), "aims to rank documents the way researchers do, weighing the full text of each document, where it was published, who it was written by, as well as how often and how recently it has been cited in other scholarly literature." We searched "public opinion" homosexuality and identified the first fifty research articles returned. To ensure comparability of citation counts, we collected the Web of Science records for this second group of articles (Google Scholar, because it includes citations in books, white papers, working papers, some journals not in the Web of Science collection, and other sources, tends to report higher—and sometimes *much* higher—numbers of citations for the same article). Then we added the Web of Science records for the Google Scholar results to our original Web of Science sample and dropped all duplicates, yielding a total of 86 different articles. Each of the articles was then consulted to identify its number of countries and mean years observed per country. This information is listed in Table A1 below.

Table A1: Prominent Research Articles on Public Opinion Toward Homosexuality

| Article | Countries Observed | Mean Years Observed per Country | Country-Years Observed | WoS Citations |
|-------------------------------|--------------------|---------------------------------|------------------------|---------------|
| Loftus 2001 | 1 | 21 | 21 | 490 |
| Herek 2002 | 1 | 1 | 1 | 457 |
| Nelson and Kinder 1996 | 1 | 1 | 1 | 407 |
| Lax and Phillips 2009a | 1 | 9 | 9 | 371 |
| Norton and Herek 2013 | 1 | 1 | 1 | 330 |
| Adamczyk and Pitt 2009 | 40 | 1 | 40 | 318 |
| Olson et al. 2006 | 1 | 1 | 1 | 312 |
| Lax and Phillips 2012 | 1 | 12 | 12 | 276 |
| Lewis 2003 | 1 | 31 | 31 | 274 |
| Lax and Phillips 2009 | 1 | 12 | 12 | 256 |
| Andersen and Fetner 2008a | 2 | 3 | 6 | 241 |
| Andersen and Fetner 2008 | 35 | 1.8 | 63 | 228 |
| Haider-Markel and Joslyn 2008 | 1 | 2 | 2 | 216 |
| Yang 1997 | 1 | 26 | 26 | 201 |
| Baunach 2012 | 1 | 14 | 14 | 192 |
| Sherkat et al. 2011 | 1 | 13 | 13 | 187 |
| Brewer 2003a | 1 | 3 | 3 | 180 |
| Perez-Brumer et al. 2015 | 1 | 1 | 1 | 180 |
| Tankard and Paluck 2017 | 1 | 1 | 1 | 172 |
| Herek et al. 2003 | 1 | 1 | 1 | 172 |
| Brewer 2003 | 1 | 2 | 2 | 159 |
| Hicks and Lee 2006 | 1 | 14 | 14 | 146 |
| Gerhards 2010 | 27 | 1 | 27 | 139 |
| Sherkat et al. 2010 | 1 | 4 | 4 | 139 |
| Brace et al. 2002 | 1 | 16 | 16 | 136 |
| Frost et al. 2016 | 1 | 1 | 1 | 135 |
| Van Den Akker et al. 2013 | 20 | 3.8 | 75 | 135 |
| Oldenburg et al. 2015 | 1 | 1 | 1 | 122 |
| Whitehead 2010 | 1 | 1 | 1 | 103 |
| Avery et al. 2007 | 1 | 15 | 15 | 98 |
| Hooghe and Meeusen 2013 | 29 | 4.2 | 123 | 93 |
| Lewis 2011 | 1 | 22 | 22 | 93 |
| Brewer 2002 | 1 | 1 | 1 | 92 |
| Price et al. 2005 | 1 | 1 | 1 | 91 |
| Lindaman, Haider-Markel 2002 | 1 | 16 | 16 | 88 |
| Doan et al. 2014 | 1 | 1 | 1 | 86 |
| Clements and Field 2014 | 1 | 42 | 42 | 86 |
| Lewis and Gossett 2008 | 1 | 6 | 6 | 86 |
| Flores 2015 | 1 | 1 | 1 | 85 |
| Baiocco et al. 2013 | 1 | 1 | 1 | 79 |
| Flores and Barclay 2016 | 1 | 2 | 2 | 78 |
| Craig et al. 2005 | 1 | 1 | 1 | 76 |
| Hooghe et al. 2010 | 2 | 1 | 2 | 73 |
| Lewis et al. 2017 | 1 | 1 | 1 | 72 |
| Schwartz 2010 | 1 | 1 | 1 | 72 |

(continued)

| Article | Countries Observed | Mean Years Observed per Country | Country- Years Observed | WoS Citations |
|------------------------------|-----------------------|---------------------------------------|-------------------------------|------------------|
| Bishin et al. 2016 | 1 | 2 | 2 | 71 |
| Reynolds 2013 | 81 | 1.8 | 145 | 71 |
| Kreitzer et al. 2014 | 1 | 3 | 3 | 69 |
| Price and Hsu 1992 | 1 | 2 | 2 | 69 |
| Baunach 2011 | 1 | 3 | 3 | 67 |
| Willnat et al. 2002 | 1 | 1 | 1 | 67 |
| Barth et al. 2009 | 1 | 1 | 1 | 66 |
| Schnabel 2016 | 1 | 25 | 25 | 65 |
| Gearhart and Zhang 2014 | 1 | 1 | 1 | 65 |
| Herek and Glunt 1991 | 1 | 1 | 1 | 65 |
| Whitehead and Perry 2015 | 1 | 1 | 1 | 62 |
| Ayoub and Garretson 2017 | 72 | 2.4 | 173 | 62 |
| Stipp and Kerr 1989 | 1 | 1 | 1 | 60 |
| Detenber et al. 2007 | 1 | 1 | 1 | 55 |
| Stoutenborough et al. 2006 | 1 | 14 | 14 | 54 |
| Jaspers et al. 2007 | 1 | 10 | 10 | 40 |
| Pollock 1994 | 1 | 2 | 2 | 38 |
| Brewer 2014 | 30 | 1 | 30 | 34 |
| Roggemans et al. 2015 | 1 | 1 | 1 | 33 |
| Alston 1974 | 2 | 7 | 14 | 25 |
| Kazyak and Stange 2018 | 1 | 2 | 2 | 23 |
| Redman 2018 | 70 | 2.9 | 203 | 23 |
| Engel 2013 | 1 | 6 | 6 | 21 |
| Perry and Whitehead 2016 | 1 | 1 | 1 | 18 |
| Deboer 1978 | 8 | 2.3 | 18 | 18 |
| Seltzer 1993 | 1 | 2 | 2 | 16 |
| Roder and Lubbers 2016 | 4 | 2 | 8 | 13 |
| Hildebrandt et al. 2017 | 19 | 2.9 | 54 | 12 |
| Lewis 2001 | 1 | 19 | 19 | 12 |
| Kleiner 2018 | 23 | 3 | 68 | 12 |
| Rayside and Bowler 1988 | 3 | 3.7 | 11 | 11 |
| Burke 2008 | 1 | 21 | 21 | 10 |
| Hetzel 2011 | 1 | 1 | 1 | 9 |
| Perry and Snawder 2016 | 1 | 1 | 1 | 8 |
| Tolkachev and Tolordava 2020 | 2 | 3 | 6 | 6 |
| Hildebrandt et al. 2019 | 73 | 1 | 73 | 6 |
| Lau et al. 2017 | 1 | 2 | 2 | 6 |
| Hayes 1997 | 1 | 4 | 4 | 5 |
| Kuyper et al. 2018 | 3 | 1 | 3 | 3 |
| Becker and Todd 2018 | 1 | 2 | 2 | 2 |
| Northcott and Reutter 1991 | 1 | 1 | 1 | 2 |

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Appendix B: Survey Items Used to Estimate Tolerance of Homosexuality

National and cross-national surveys have often included questions tapping attitudes toward homosexuality over the past half century, 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 A2: 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 STATEMENTS. COME ONE ANSWER 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, issr, 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 |

(continued)

| 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 strongly 1 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 strongly 1 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 |

(continued)

| 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 |

(continued)

| 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, fsdim |
| 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 |

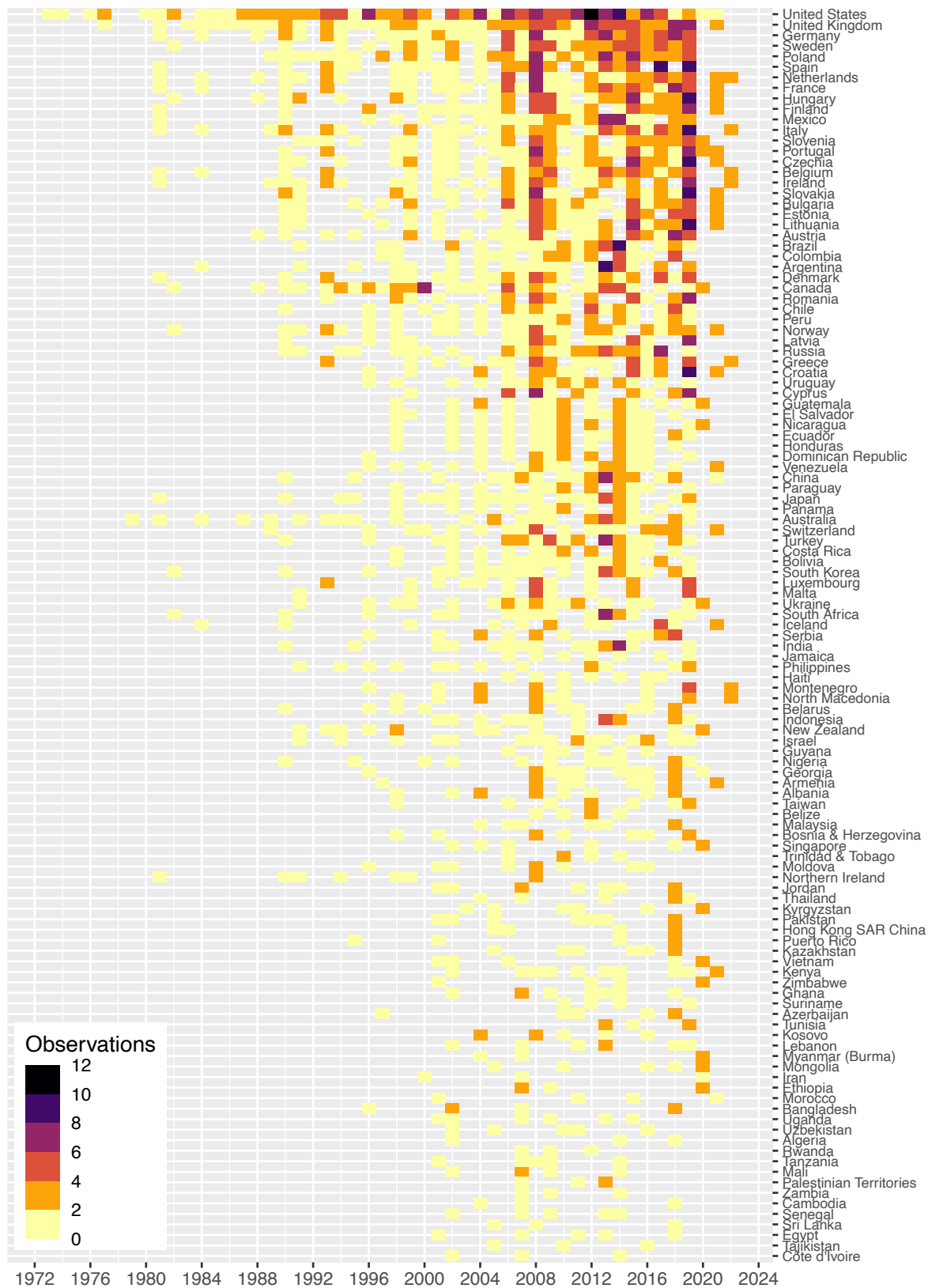


Figure A1: Source Data Observations by Country and Year
A13

Appendix C: 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:

$$a_{ktqr} = \phi \eta_{ktqr} \quad (1)$$

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

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

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:

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

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

¹Solt (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.

²The 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 .

³Estimating 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 :

$$\sum_{k=1}^K \delta_{kq} = 0 \quad (5)$$

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.

⁴The 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 β s 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 $\sigma_{\theta'}^2$ and σ_{σ}^2 ; 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.

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