Supplementary Materials for The Democracy-Support Nexus: Accounting for Measurement Error and Simultaneous Effects

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1. Conceptualization of Democratic Mood and Democratic Satisfaction

Democratic mood captures the extent to which a public offers explicit support for a democratic system and rejects any autocratic alternatives (Linz and Stepan 1996; Mattes and Bratton 2007; Rose, Mishler, and Haerpfer 1998). It is principled or diffuse support for democracy itself, rather than instrumental support for the outputs of government or the incumbent office-holders. Consequently, mood is measured using existing survey questions which ask respondents to evaluate the appropriateness or desirability of democracy; compare democracy to some undemocratic alternative; or evaluate one of these undemocratic forms of government (see next section). Such items are widely used to measure democratic support (e.g., Dalton 2004; Klingemann 1999; Mattes and Bratton 2007; Magalhães 2014; Norris 2011). Questions focusing on related concepts such as satisfaction with the performance of democracy and trust in national political institutions were not included because neither is a valid measure of principled support for democracy (e.g., Bratton, Mattes, and Gyimah-Boadi 2005; Canache, Mondak, and Seligson 2001; Linde and Ekman 2003).

There is less consensus regarding the meaning and interpretation of the concept of satisfaction with democracy (e.g., Canache, Mondak, and Seligson 2001; Linde and Ekman 2003). Some authors treat it as a measure of democratic support (e.g., Armingeon and Guthmann 2014). Others argue that it captures an instrumental or performance-based appraisal of democracy (e.g., Norris 1999). Yet others use it as an overall measure of system support (e.g., Anderson and Guillory 1997). Despite this ambiguity, the measure is employed in numerous survey projects and therefore appears in numerous research articles. Judging from its treatment in the scientific literature, it would seem that satisfaction with democracy is both (1) correlated with democratic mood, with some conceptual overlap, but also (2) somewhat distinct from mood, being more instrumental than principled in nature.

A dataset of 4,411 nationally-aggregated measures of public support for democracy were collected to measure mood. These survey responses were gathered by 14 survey projects between the years of 1988 and 2020, using 1,596 nationally-representative surveys that tapped the opinions of 2.1 million respondents. We then compiled measures of satisfaction with democracy that were obtained using cross-national survey projects. There were 2,330 nationally-aggregated measures of democratic satisfaction, gathered by 14 survey projects between the years of 1973 and 2020 using 2,309 national surveys, representing the opinions of 3.8 million respondents.

Although mood survey data are available for 162 countries and satisfaction data for 153, we produce estimates only for countries which (1) are independent states; (2) have at least two years' worth of survey measures of either mood or satisfaction; (3) have populations of a million or more at the time of the survey (due to limited covariate availability for microstates). There are 144 such countries.

2. Survey Questions Used to Measure Democratic Mood

1. Three statements items

   (a) Which of these three statements is closest to your own opinion? (AfroBarometer)
   - Democracy is preferable to any other kind of government
   - Under some circumstances, an authoritarian government can be preferable to a democratic one

- For someone like me, it does not matter what kind of government we have.

(b) Which of the following statements comes closest to your own opinion? (AsianBarometer)
- For people like me, it does not matter whether we have a democracy
- Under some circumstances, an authoritarian government can be preferable
- Democracy is always preferable to any other kind of government

(c) Which of these three statements is closest to your own opinion? (ArabBarometer)
- Democracy is preferable to any other kind of government
- Under some circumstances, an nondemocratic government can be preferable
- For people like me, it does not matter what kind of government we have

(d) Here are three opinions about political systems. Which one comes closest to your own way of thinking? (EuroBarometer)
- Democracy is the best political system in all circumstances
- In certain circumstances a dictatorship could be a good thing
- Whether we live in a democracy or under a dictatorship makes no difference to people like me

(e) With which of the following phrases are you in most agreement? (Latin American Public Opinion Project)
- For people like me, it doesn't matter whether a regime is democratic or non-democratic
- Democracy is preferable to any other type of government
- Under some circumstances an authoritarian government can be preferable to a democratic one

(f) Which of the following statements do you agree with most? (LatinoBarometer)
- Democracy is preferable to any other kind of government
- In certain situations, an authoritarian government can be preferable to a democratic one
- To people like me it doesn't matter whether we have a democratic government or a non-democratic government

(g) With which of the following statements do you agree most? (New Democracies Barometer)
- Democracy is preferable to any other kind of government
- Under some circumstances, an authoritarian government can be preferable to a democratic one
- For people like me, it does not matter whether we have a democratic or a non- democratic regime

(h) Which of these three statements is closest to your own opinion? (Pew Global Attitudes)
- Democracy is preferable to any other kind of government
- Under some circumstances, an authoritarian government can be preferable to a democratic one
- For someone like me, it does not matter what kind of government we have

(i) Which one of the following three statements do you agree with most? (South Asian Barometer)
- Democracy is preferable to any other kind of government
- In certain situations, a dictatorial government can be preferable to a democratic one
- It doesn't matter to people like me whether we have democratic or non-democratic governance

2. "Churchill" items

(a) Democracy may have its problems, but it is better than any other form of government. To what extent do you agree or disagree? (ArabBarometer)

(b) Do you agree or disagree with the following statement: Democracy may have its problems, but it is still the best form of government (AsianBarometer).

(c) Please tell me how strongly you agree or disagree with the following statement: Democracy may have problems but it's better than any other form of government (Comparative Study of Electoral Systems)

(d) Democracy may have its problems, but it is better than any other form of government. To what extent do you agree or disagree? (European Values Survey)

(e) With which of the following phrases do you most agree: in general, despite its problems, democracy is the best form of government, there are other forms of government that can be just as good or even better than democracy, don't know (Latin American Public Opinion Project)

(f) Do you strongly agree, agree, disagree or strongly disagree with the following statements: Democracy may have problems but it is the best system of government (LatinoBarometer)

(g) Democracy may have its problems, but it is better than any other form of government. To what extent do you agree or disagree? (World Values Survey)

3. Strong leader items

(a) There are many ways to govern a country. Would you disapprove or approve of the following alternatives? Elections and Parliament are abolished so that the president can decide everything. (AfroBarometer)

(b) I will describe different political systems to you, and I want to ask you about your opinion of each one of them with regard to the country's governance. For each one would you say it is very good, good, bad, or very bad? – A political system with an authoritarian president (non-democratic) who is indifferent to parliament and elections. (ArabBarometer)

(c) I'm going to describe various types of political systems. Please indicate for each system whether you think it would be very good, fairly good or bad for this country. Governance by a powerful leader without the restriction of parliament or elections (AsiaBarometer)

(d) Best to get rid of Parliament and elections and have a strong leader who can quickly decide everything. What do you think? (AsianBarometer)

(e) I'm going to describe various types of political systems and ask what you think about each as a way of governing this country. For each one, would you say it is a very good, fairly good, fairly bad or very bad way of governing this country? – Having a strong leader who does not have to bother with parliament and elections (European Values Survey)

(f) On some occasions, democracy doesn't work. When that happens there are people that say we need a strong leader who doesn't have to be elected through voting. Others say that even if things don't function, democracy is always the best. What do you think? (Latin American Public Opinion Project)

(g) There are people who say that we need a strong leader that does not have to be elected. Others say that although things may not work, electoral democracy, or the popular vote, is always best. What do you think? (Latin American Public Opinion Project)

(h) Best to get rid of Parliament and elections and have a strong leader who can quickly decide everything. What do you think? (New Democracies Barometer)

(i) Some feel that we should rely on a democratic form of government to solve our country's problems. Others feel that we should rely on a leader with a strong hand to solve our country's problems. Which comes closer to your opinion? (Pew Global Attitudes)

(j) I'm going to describe various types of political systems and ask what you think about each as a way of governing our country. For each one, would it be a very good, somewhat good, somewhat bad or very bad way of governing this country? – A system in which a strong leader can make decisions without interference from parliament or the courts. (Pew Global Attitudes)

(k) There are different ways in which a country may be governed. I will read out some suggestions. For each of these would you say that you strongly agree, agree, disagree or strongly disagree? We should have a strong leader who does not have to bother about elections (South Asian Barometer)

(l) I'm going to describe various types of political systems and ask what you think about each as a way of governing this country. For each one, would you say it is a very good, fairly good, fairly bad or very bad way of governing this country? – Having a strong leader who does not have to bother with parliament and elections (World Values Survey)

4. Military rule items

(a) There are many ways to govern a country. Would you disapprove or approve of the following alternatives? The army comes in to govern the country (AfroBarometer)

(b) I'm going to describe various types of political systems. Please indicate for each system whether you think it would be very good, fairly good or bad for this country – Military government (AsiaBarometer)

(c) The army should govern the country. What do you think? (AsianBarometer)

(d) I'm going to describe various types of political systems and ask what you think about each as a way of governing this country. For each one, would you say it is a very good, fairly good, fairly bad or very bad way of governing this country? Having the army rule (European Values Survey)

(e) The army should govern the country. What do you think? (New Democracies Barometer)

(f) I'm going to describe various types of political systems and ask what you think about each as a way of governing our country. For each one, would it be a very good, somewhat good, somewhat bad or very bad way of governing this country? The military rules the country (Pew Global Attitudes)

(g) There are different ways in which a country may be governed. I will read out some suggestions. For each of these would you say that you strongly agree, agree, disagree or strongly disagree? The country should be governed by the Army (South Asian Barometer)

(h) I'm going to describe various types of political systems and ask what you think about each as a way of governing this country. For each one, would you say it is a very good, fairly good, fairly bad or very bad way of governing this country? – Having the army rule (World Values Survey)

5. One party rule items

(a) There are many ways to govern a country. Would you disapprove or approve of the following alternatives? Only one political party is allowed to stand for election and hold office (Afro-Barometer)

(b) There are many ways to govern a country. Would you disapprove or approve of the following alternatives? Only one political party is allowed to stand for election and hold office (Asian-Barometer)

6. Evaluate democracy items

   (a) I will describe different political systems to you, and I want to ask you about your opinion of each one of them with regard to the country's governance. For each one would you say it is very good, good, bad, or very bad? – A democratic political system (public freedoms, guarantees equality in political and civil rights, alternation of power, and accountability and transparency of the executive authority) (ArabBarometer)

   (b) I'm going to describe various types of political systems. Please indicate for each system whether you think it would be very good, fairly good or bad for this country – A democratic political system (AsiaBarometer)

   (c) I'm going to describe various types of political systems and ask what you think about each as a way of governing this country. For each one, would you say it is a very good, fairly good, fairly bad or very bad way of governing this country? – Having a democratic political system (European Values Survey)

   (d) I'm going to describe various types of political systems and ask what you think about each as a way of governing our country. For each one, would it be a very good, somewhat good, somewhat bad or very bad way of governing this country? – A democratic system where representatives elected by citizens decide what becomes law (Pew Global Attitudes)

   (e) I'm going to describe various types of political systems and ask what you think about each as a way of governing this country. For each one, would you say it is a very good, fairly good, fairly bad or very bad way of governing this country? – Having a democratic political system (World Values Survey)

7. Elections items

   (a) There are different ways in which a country may be governed. I will read out some suggestions. For each of these would you say that you strongly agree, agree, disagree or strongly disagree? The country should be governed by those chosen by the people in a fair election (South Asian Barometer)

8. Suitability items

   (a) Suppose there was a scale from 0-10 measuring the extent to which democracy is suitable for your country, with 0 meaning that democracy is absolutely inappropriate for your country and 10 meaning that democracy is completely appropriate for your country. To what extent do you think democracy is appropriate for your country? (ArabBarometer)

   (b) Here is a similar scale of 1 to 10 measuring the extent to which people think democracy is suitable for our country. If 1 means that democracy is completely unsuitable for [name of country] today and 10 means that it is completely suitable, where would you place our country today? (AsianBarometer)

   (c) How suitable is democracy for our country - very suitable, suitable, not suitable or not at all suitable? (South Asian Barometer)

9. Importance items

(a) How important for you to live in democratically governed country? (European Social Survey)

(b) How important is it to you to live in a country where honest elections are held regularly with a choice of at least two political parties? Is it very important, somewhat important, not too important or not important at all? (Pew Global Attitudes)

(c) How important is it to have honest elections held regularly with a choice of at least two political parties in our country? Is it very important, somewhat important, not too important or not important at all? (Pew Global Attitudes)

(d) How important is it for you to live in a country that is governed democratically? On this scale where 1 means it is "not at all important" and 10 means "absolutely important" what position would you choose? (World Values Survey)

10. Desire for democracy items

    (a) To what extent do you want our country to be democratic now? (AsianBarometer)

3. Survey Questions Used to Measure Satisfaction

Unlike mood, democratic satisfaction is measured using a question which varies little across cross-national survey projects. The basic form of the question is: "how satisfied or dissatisfied are you with the way democracy works in [country]?"

We include satisfaction with democracy measures from the following cross-national survey projects:

- AfroBarometer
- Asia Barometer
- AsianBarometer
- Comparative Study of Electoral Systems
- EuroBarometer
- European Social Survey
- European Values Study
- Latin American Public Opinion Project
- LatinoBarometer
- Pew Global Attitudes
- South Asian Barometer
- World Values Survey
- Central and Eastern EuroBarometer

4. Excluded Survey Items

Kurzman (2014) notes that there appears to be serious translation errors in some of the questions relating to democracy in the 3rd and 4th waves of the World Values Survey. For example, as he describes, the Indonesian survey of 2001 asked respondents their opinion on having military *rules*, rather than military rule. The vast majority of Indonesians unsurprisingly favored having rules. Survey responses from the following items-year-country combinations from the World Values Survey were therefore excluded from the analysis due to evidence of, or suspicion of, poor translations and severe bias:

- Vietnam: Military rule 2001; Strong leader 2001
- Albania: Military rule 1998
- Indonesia: Military rule 2001 & 2006
- Iran: Military rule 2000; Strong leader 2000 & 2005
- India: Strong leader, all years.
- Pakistan: Military rule 1996 & 2001; Strong leader 1996 & 2001
- Kyrgyzstan: Strong leader 2003 & 2011
- Romania: Strong leader 1998, 2005 & 2012
- Egypt: Strong leader 2012

Responses to the following sets of items were not included as measures of either mood or satisfaction:

- Items tapping evaluations of the political and economic performance of democracy (e.g., "Which of the following statements comes closer to your own view? Democracy is capable of solving the problems of our society; democracy can not solve our society's problems.")
- Items measuring respondents' understandings of the term "democracy" (e.g., "For each of the following things, how essential do you think it is as a characteristic of democracy? – Governments tax the rich and subsidize the poor.").
- Items gauging trust in national political institutions (e.g., "I'm going to name a number of institutions. For each one, please tell me how much trust you have in them. – Parliament").

5. Microlevel Coding of Survey Responses

The latent trait measurement model takes a binomial response, which requires two pieces of information: the number of "trials" and the number of these that were "successful." Two quantities were therefore gathered for each survey question. First, the number of respondents asked each relevant survey question (this was usually, but not always, the full sample size). Second, the number of respondents providing a response that was supportive of / satisfied with democracy. This may include the response "democracy is preferable to any other kind of government" in the three statements question, disagreeing that the military should rule, or offering a response above the median on a 0-10 scale for the question regarding the importance of democracy to the respondent. It follows that all other possible responses (i.e., the difference between the sample size and the number of supportive respondents) were treated, similarly, as not supportive of democracy. These non-supportive respondents may have actively opposed democracy, (e.g., "an authoritarian government can be preferable to a democratic one"), chosen an intermediate response (e.g., "for someone like me, it does not matter what kind of government we have"), responded with "don't know," or refused to provide any response.

6. The Multivariate Latent Variable Model

We develop a multidimensional version of the dynamic Bayesian latent variable model proposed by Claassen (2019). This allows for several correlated opinion series to be estimated, and is applied here to estimate democratic support and satisfaction jointly. The benefit of this simultaneous

estimation is that information on common shocks is shared between the two opinion estimates to the extent that they are correlated, thereby improving estimates.

Claassen's model uses a beta-binomial link function between observed, nationally-aggregated survey responses y_{ikt} for each country i, year t and survey questions k, and the probabilities of offering a supportive response π_{ikt}:

$$y_{ikt} \sim \text{Beta-Binomial}(s_{ikt},\ \pi_{ikt},\ \phi). \tag{1}$$

These probabilities are modeled as a function of the latent country-year opinion estimates of interest θ_{it}, item slopes γ_k, item bias intercepts λ_k and item-country bias parameters δ_{ik}. These sets of parameters jointly adjust the latent estimates for the effects of particular survey questions, interactions between survey questions and national contexts, and the differing importance of each survey question for the overall latent scale:

$$\pi_{ikt} = \text{logit}^{-1}(\delta_{ik} + \lambda_k + \gamma_k\theta_{it}) \tag{2}$$

These parameters are further modeled using a bivariate normal distribution :

$$\begin{pmatrix}\lambda_k \\ \gamma_k\end{pmatrix} \sim \text{MVN}\left[\begin{pmatrix}\mu_\lambda \\ \mu_\gamma\end{pmatrix}, \begin{pmatrix}\sigma^2_\lambda & \rho\sigma_\lambda\sigma_\gamma \\ \rho\sigma_\lambda\sigma_\gamma & \sigma^2_\gamma\end{pmatrix}\right]$$
$$\delta_{ik} \sim \text{N}(0,\ \sigma^2_\delta)$$

Finally, the latent estimates are modeled as evolving via a random walk dynamic process:

$$\theta_{it} \sim \text{N}(\theta_{i,t-1},\ \sigma^2_\theta) \tag{3}$$

This single-variable latent variable model is extended to the multivariate case by generalizing the final step (above). For two latent opinion series, satisfaction $y^{(s)}_{ikt}$ and democratic mood $y^{(m)}_{ikt}$, the final step is modeled as a multivariate normal in which the series have correlated errors. This permits shocks in one variable to influence the errors, and thus the trajectory, of the other. This is appropriate for two opinion series which are likely to not only shared common causes, but also suffer from common measurement errors.

$$\begin{pmatrix}\theta^{(s)}_{it} \\ \theta^{(m)}_{it}\end{pmatrix} \sim \text{MVN}\left[\begin{pmatrix}\theta^{(s)}_{i,t-1} \\ \theta^{(m)}_{i,t-1}\end{pmatrix}, \begin{pmatrix}\sigma^2_{\theta^{(s)}} & \rho_\theta\sigma_{\theta^{(m)}}\sigma_{\theta^{(s)}} \\ \rho_\theta\sigma_{\theta^{(s)}}\sigma_{\theta^{(m)}} & \sigma^2_{\theta^{(m)}}\end{pmatrix}\right] \tag{4}$$

7. Model Specification and Estimation

We fit six models using Bayesian MCMC methods: (1) the univariate latent variable model proposed and used by Claassen (2019; 2020*a*;*b*) (this is used twice - to estimate satisfaction and mood); (2) the multivariate latent variable model (described above); (3) the simultaneous equation model which takes the point estimates of (1) as input data; (4) the simultaneous equation model which takes the point estimates of (2) as input data; (5) the joint model which estimates (2) and (4) in a single step; and (6) the joint / one-step model which adds a measurement model for democracy to (5). The estimation of these models is described here.

7.1. Specifying the univariate latent variable models

We begin by using Claassen's full dynamic latent variable (model 6) to separately estimate mood and satisfaction. In contrast to Claassen (2019), we allow for ragged country-by-year arrays to accommodate the varying length of national latent opinion time-series (due to the varying years in which survey measurement commenced). We also make use of non-centered parameterizations for all variance terms, e.g., $\sigma_{\theta^{(m)}}$, $\sigma_{\gamma^{(m)}}$, and $\sigma_{\delta^{(m)}}$. Non-centered parameterizations include standard-normally distributed redundant parameters, e.g., $\nu_{ik}^{\delta^{(m)}}$ which shift variance and covariance terms away from zero, making MCMC sampling more efficient:

$$\delta_{ik}^{(m)} = \sigma_{\delta^{(m)}}^{2} \times \nu_{ik}^{\delta^{(m)}} \tag{5}$$

The item-country variances are given weakly-informative half-Normal priors, e.g., $\sigma_{\delta}^{(m)} \sim \mathrm{N}^{+}(0,\ 1)$. Variance-covariance matrices (for the opinion series θ and the item intercepts λ and slopes γ are split into variance terms and correlation matrices, with the former receiving a half-Normal $(0, 0.5)$ prior and the latter an LKJ (1) prior. Item intercepts and slopes are identified by setting their expectations: the former at the log of the mean proportion expressing support / satisfaction with democracy, and the latter at 1. The beta-binomial dispersion parameter ϕ receives a gamma(3, 0.04) prior. The initial value of each country's latent opinion θ_{i1} receives a N(0, 1) prior.

7.2. Specifying the multivariate latent variable model

Non-centered parameterizations are again used for all variance terms. The item-country variances are given weakly-informative half-Normal priors, e.g., $\sigma_{\delta}^{(m)} \sim \mathrm{N}^{+}(0,\ 1)$. Variance-covariance matrices (for both latent opinion series θ and each set of item intercepts and slopes, e.g., $\lambda^{(m)}, \gamma^{(m)}$) are split into variance term and a correlation matrix, with the former receiving a half-Normal $(0, 0.5)$ prior and the latter an LKJ (1) prior. The item intercepts and slopes are identified by setting their expectations: the former at the log of the mean proportion expressing support / satisfaction with democracy, and the latter at 1. The beta-binomial dispersion parameters $\phi^{(m)}$ and $\phi^{(s)}$, receive gamma(3, 0.04) priors. The initial value of each country's latent opinion, e.g., $\theta_{i1}^{(m)}$, receives a N(0, 1) prior.

7.3. Specifying the simultaneous equation models without measurement uncertainty

As described in the paper, the simultaneous equation models (SEM) incorporates separate models for mood, satisfaction and democracy, which are linked via certain cross-lagged effects as well as correlations between the mood and satisfaction residuals. Two SEMs are used, one assuming correlated mood and satisfaction residuals; the other assuming orthogonal residuals. The mood and satisfaction error variance-covariance matrix is, like the item parameter variance-covariance matrix (above), split into variance term and a correlation matrix, with the former receiving a half-Normal $(0, 0.5)$ prior and the latter an LKJ (1) prior. The democracy model variance term receives a half-Normal $(0, 1)$ prior. Regression parameters and model intercepts receive standard normal priors, which are weakly informative because all observed variables are centered and rescaled to have variances of 1. The range of lag parameters are restricted to ensure stationarity of each time series: the second lag is restricted to lie between -1 and +1 and is given a Uniform $(-1, 1)$ prior;

with the sum of first and second lags restricted to lie between 0 and 1, and receives a weakly informative Beta $(3, 1)$ prior. The first lag is then defined as the difference between the lag sum and the second lag.

7.4. Specifying the one step model with measurement models for mood and satisfaction

The one-step models combine the above two models: the multidimensional latent variable model and the simultaneous equation model. In contrast to the above, the residuals of the latent opinion models (now both measuring and estimating links between structural covariates) are given a non-centered parameterization. As above, the first year for each of the latent opinion series are given $N(0, 1)$ priors; the second years are modeled as a simple random walk process with a single lag and error term. With two lag parameters, the full model of each opinion series commences in year three.

7.5. Specifying the one step model with measurement model also for democracy

Our most complex model adds an errors-in-variables measurement model for democracy. The residuals for the democracy equation are now also given a non-centered parameterization. As with the other two latent variables in the above model, the initial year of democracy latent estimates is given a $N(0, 1)$ prior, with the second year receiving a simple random walk model with lag and error term.

7.6. Estimation

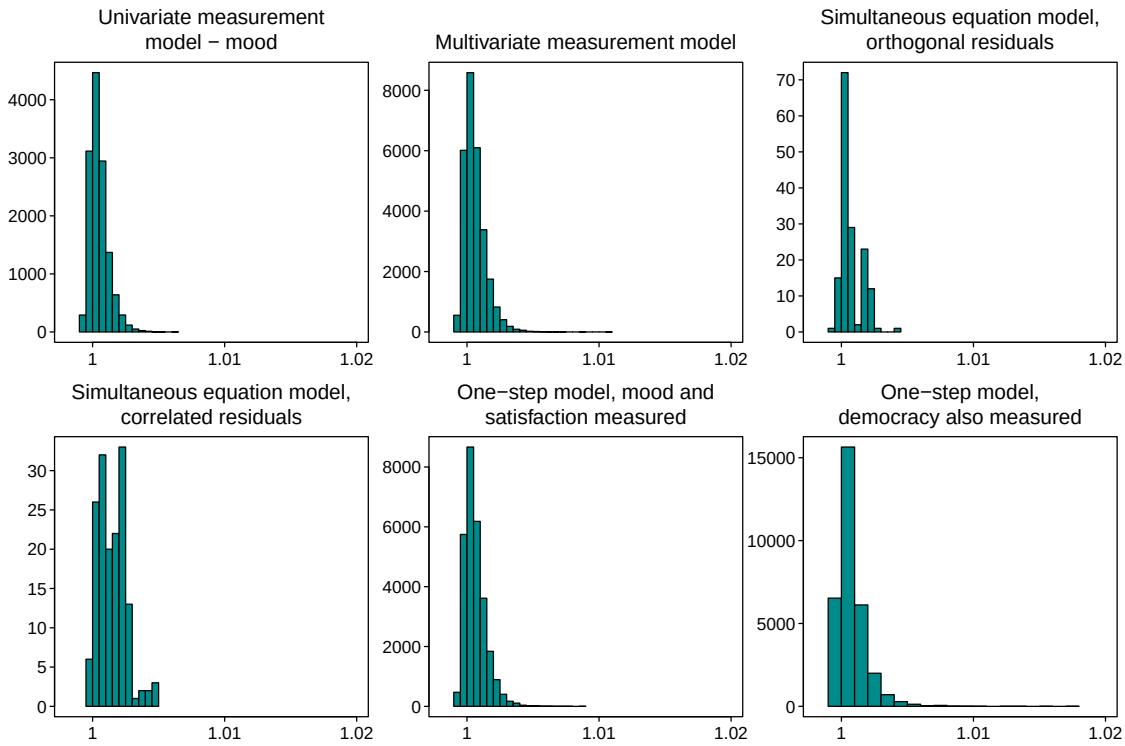
All four models are estimated using Bayesian Markov-Chain Monte Carlo (MCMC) methods via Stan software, which implements Hamiltonian Monte Carlo sampling (Carpenter et al. 2017). Four parallel chains, with randomly selected starting values, are run, with 500 warmup and 1,500 post-warmup samples each. The 4,000 post-warmup samples are saved and analyzed further.

8. Model Checking

Convergence is assessed using a variety of diagnostics, including traceplots of multiple parameters and Gelman-Rubin R-hat statistics. The latter were close to one for all models (Figure S1).

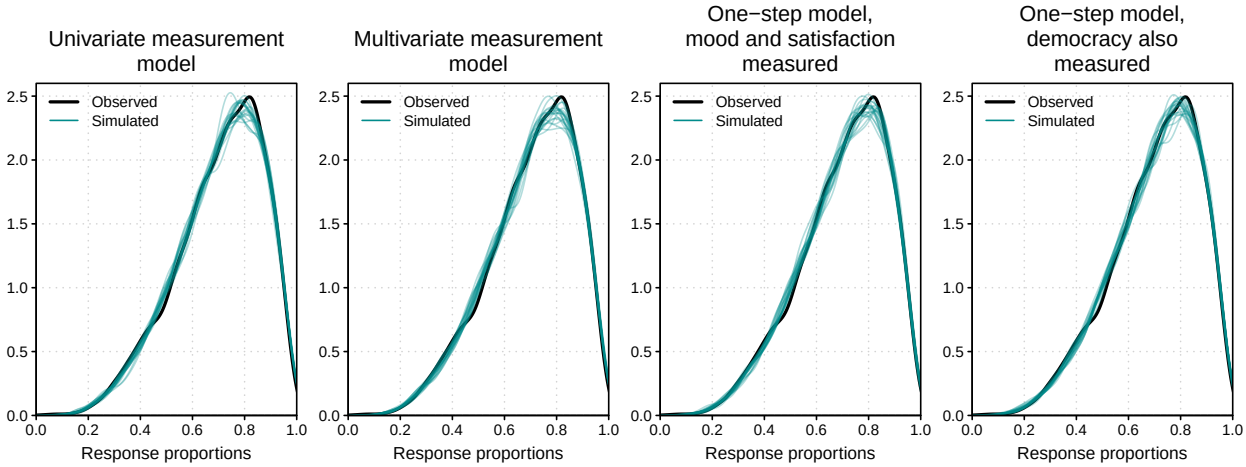
The models can be further checked using the method of posterior predictive checking: simulating data conditional on the estimated parameters and comparing the former these against the actual survey responses. As Figure S2 shows, there is a close correspondence between the aggregated survey responses for each of the national mood items in our dataset $y_{ikt}^{(m)}$ (we show these here as proportions, i.e., $y_{ikt}^{(m)}/s_{ikt}^{(m)}$, for ease of presentation) and those we simulate $\tilde{y}_{ikt}^{(m)}$ in each of the three Bayesian models which estimate latent mood. These posterior predictive checks suggest that each model fits the observed survey responses.

Figure S1. Model convergence as shown by the Gelman-Rubin diagnostic



Distribution of the Gelman-Rubin R-hat statistic for all parameters, one plot for each model.

Figure S2. Posterior predictive plots



Each plot compares the distributions of response proportions in the observed survey measures of mood (heavy black line) against 20 draws from the posterior distributions of the response proportions π_{ikt} estimated by the particular model (thin teal lines).

9. Testing Measurement Accuracy

Does including structural links between covariates and our endogenous latent variables improve measurement accuracy? Does it create bias? The two-step method of composition assumes that the latent estimates θ depend only on the observed indicators of this construct z and not on the covariates X which are linked with θ in the subsequent structural model, i.e., the assumption is $p(\theta \mid z) = p(\theta \mid z, X)$. The one step methods used here make no such assumption.

To test the measurement accuracy of our various models, we split the dataset of national support for democracy opinions into an 80% training set, leaving the remaining 20% of observations as a test set.[1] We fit five models using the training set: (1) a simple univariate measurement model which uses a binomial rather than a beta-binomial link and excludes the item-country and item slope / discrimination parameters (this is "model 1" from (Claassen 2019)); (2) the univariate measurement model without covariates (this model is described in equations 1 through 3 in this appendix and corresponds to "model 6" in Claassen (2019)); (4) the multivariate version of this measurement model which simultaneously estimates democratic support and satisfaction but does not include covariates and structural parameters (the model described in section 6 above); (5) the multivariate model which also adds covariates and structural parameters (the fourth approach in Table 1 in the main paper); (5) the multivariate model which adds covariates and structural parameters and treats democracy as measured with error (the fifth approach in Table 1 in the main paper).

Table S1. Tests of Measurement Accuracy

Model	Mean Absolute Error (%)	% Improvement in MAE
Country means	11.40	–
Item means	9.78	14.3
Grand mean	13.21	−15.9
1. Basic univariate measurement model, no covariates	7.86	31.1
2. Full univariate measurement model, no covariates	5.91	48.2
3. Multivariate measurement model, no covariates	5.89	48.3
4. Multivariate measurement model, covariates, democracy exogenous	5.87	48.5
5. Multivariate measurement model, covariates, democracy endogenous	5.89	48.4

The "basic univariate model" uses a binomial link and item bias parameters but no item slopes / discrimination parameters or item-country bias parameters, corresponding to "Model 1" in Claassen (2019). The "full univariate model" is described in equations 1 through 3 above. Percent improvement in MAE is a comparison between model MAE and country-mean MAE.

Results are reported in Table S1. The basic univariate measurement model shows an average bias of 7.86 percentage points when fit on the training set and used to predict held-out values on the test set. This is a slight improvement over the same model's test set performance in Claassen

[1]To facilitate comparison, we removed all countries which had less than two years' worth of survey measures of support for democracy, which resulted in training and test sets featuring 141 countries.

(2019). It is also a 31% improvement over a baseline method – using only the country means to predict held out values. The full measurement model shows a marked increase in accuracy, with a MAE of 5.91 percentage points, again a slight improvement over the corresponding result from the earlier dataset (Claassen 2019). The new results here are for models 3 through 5. Each shows an marginal, albeit insignificant improvement over the univariate measurement model used in the two-step approach in the main paper. These results show that including covariates and simultaneous effects does no harm to measurement accuracy, and may even offer slight improvements in some cases.

10. Full Model Results

Table S2. Measurement error omitted, uncorrelated errors

	Democracy			Mood			Satisfaction		
	Posterior mean	95% credible interval		Posterior mean	95% credible interval		Posterior mean	95% credible interval	
Intercept	−.071	−.194	.045	−.758	−1.308	−.338	−.114	−.339	.104
First lag of DV	1.132	1.105	1.159	1.513	1.487	1.539	1.446	1.420	1.472
Second lag of DV	−.161	−.189	−.134	−.521	−.548	−.495	−.466	−.493	−.441
Mood	.006	.002	.010				.003	−.002	.009
Satisfaction	−.006	−.010	−.002	−.003	−.006	.000			
Δ democracy				−.042	−.069	−.015	−.013	−.054	.027
Democracy				−.003	−.009	.002	−.011	−.021	−.002
Δ log GDP per capita	.045	.000	.090	.061	.022	.101	.158	.097	.219
log GDP per capita	−.002	−.006	.003	−.004	−.008	−.001	.003	−.003	.010
Corruption	−.016	−.023	−.009	−.011	−.017	−.006	−.019	−.029	−.010
Δ regional democracy	.448	.394	.504	−.025	−.072	.024	−.111	−.188	−.035
Regional democracy	.011	.006	.016	.007	.003	.011	.001	−.005	.008
Residual standard deviation	.103	.101	.105	.090	.088	.092	.138	.135	.141

Model estimated using Bayesian MCMC methods. Note that the variances of latent variables fluctuate between model specifications. These estimates may therefore differ from those presented in the main paper, where parameter estimates for key structural parameters are standardized based on the empirical distributions of latent variables.

Table S3. Measurement error omitted, correlated mood and satisfaction errors

	Democracy			Mood			Satisfaction		
	Posterior mean	95% credible interval		Posterior mean	95% credible interval		Posterior mean	95% credible interval	
Intercept	−.070	−.193	.044	−.641	−1.301	−.160	−.139	−.377	.081
First lag of DV	1.133	1.105	1.160	1.528	1.508	1.548	1.506	1.486	1.526
Second lag of DV	−.162	−.190	−.134	−.537	−.556	−.517	−.528	−.548	−.508
Mood	.006	.002	.011				−.009	−.015	−.003
Satisfaction	−.006	−.010	−.002	−.014	−.018	−.010			
Δ democracy				−.039	−.072	−.006	−.022	−.068	.021
Democracy				−.006	−.013	.002	−.007	−.018	.003
Δ log GDP per capita	.044	−.002	.091	.091	.040	.139	.141	.073	.210
log GDP per capita	−.002	−.007	.003	−.003	−.008	.002	.001	−.006	.008
Corruption	−.016	−.023	−.009	−.018	−.026	−.011	−.023	−.033	−.013
Δ regional democracy	.448	.396	.501	−.068	−.128	−.008	−.121	−.203	−.042
Regional democracy	.011	.006	.016	.007	.001	.012	.005	−.002	.012
Residual standard deviation	.103	.101	.105	.112	.109	.114	.152	.149	.155
Residual correlation (mood & satis.)				.854	.845	.862			

Model estimated using Bayesian MCMC methods. Note that the variances of latent variables fluctuate between model specifications. These estimates may therefore differ from those presented in the main paper, where parameter estimates for key structural parameters are standardized based on the empirical distributions of latent variables.

Table S4. Measurement error included for satisfaction and mood, two-step "method of composition"

	Democracy			Mood			Satisfaction		
	Posterior mean	95% credible interval		Posterior mean	95% credible interval		Posterior mean	95% credible interval	
Intercept	.091	.075	.109	−.013	−.029	.003	−.011	−.028	.005
First lag of DV	1.101	1.076	1.126	.944	.890	.995	.953	.901	1.003
Second lag of DV	−.140	−.167	−.116	.020	−.030	.074	.005	−.041	.055
Mood	.004	−.001	.009				.007	−.011	.024
Satisfaction	−.005	−.010	−.001	.002	−.011	.014			
Δ democracy				−.055	−.183	.063	−.053	−.190	.091
Democracy				−.004	−.028	.021	−.023	−.054	.008
Δ log GDP per capita	.045	−.009	.103	.190	.003	.372	.356	.128	.593
log GDP per capita	−.001	−.007	.004	−.007	−.025	.011	.004	−.019	.025
Corruption	−.018	−.026	−.010	−.027	−.054	−.003	−.040	−.073	−.009
Δ regional democracy	.575	.517	.638	−.088	−.335	.161	−.146	−.419	.103
Regional democracy	.011	.005	.017	.019	.003	.036	.007	−.013	.026

Structural equation model estimated using GLS. Measurement uncertainty is then simulated via the "method of composition" – 1,000 draws of each parameter estimate are simulated using the fitted coefficients and variance-covariance matrix. Note that the variances of latent variables fluctuate between model specifications. These estimates may therefore differ from those presented in the main paper, where parameter estimates for key structural parameters are standardized based on the empirical distributions of latent variables.

Table S5. Measurement error included for satisfaction and mood, one-step / joint model

	Democracy			Mood			Satisfaction		
	Posterior mean	95% credible interval		Posterior mean	95% credible interval		Posterior mean	95% credible interval	
Intercept	−.095	−.251	.050	−.214	−.422	−.011	−.275	−.538	−.026
First lag of DV	1.130	1.101	1.159	.590	.468	.718	.931	.829	1.035
Second lag of DV	−.158	−.187	−.130	.316	.192	.434	−.006	−.105	.090
Mood	.012	.003	.021				.009	−.022	.042
Satisfaction	−.006	−.012	−.001	−.001	−.017	.016			
Δ democracy				−.125	−.263	.014	−.048	−.218	.127
Democracy				.003	−.018	.023	−.032	−.061	−.005
Δ log GDP per capita	.046	−.003	.096	.330	.160	.502	.730	.506	.965
log GDP per capita	−.002	−.007	.003	−.008	−.022	.005	.005	−.014	.025
Corruption	−.014	−.021	−.007	−.032	−.052	−.013	−.060	−.088	−.033
Δ regional democracy	.462	.404	.520	−.273	−.537	−.008	−.462	−.761	−.170
Regional democracy	.012	.007	.017	.027	.013	.041	.008	−.009	.025
Residual standard deviation	.111	.109	.114	.469	.442	.498	.542	.496	.591
Residual correlation (mood & satis.)				.270	.214	.328			

Model estimated using Bayesian MCMC methods. Note that the variances of latent variables fluctuate between model specifications. These estimates may therefore differ from those presented in the main paper, where parameter estimates for key structural parameters are standardized based on the empirical distributions of latent variables.

Table S6. Measurement error included for democracy, satisfaction, and mood, one-step / joint model

	Democracy			Mood			Satisfaction		
	Posterior mean	95% credible interval		Posterior mean	95% credible interval		Posterior mean	95% credible interval	
Intercept	.575	.419	.718	−.259	−.508	−.019	.007	−.372	.363
First lag of DV	1.546	1.488	1.600	.557	.439	.686	.923	.824	1.025
Second lag of DV	−.563	−.617	−.507	.343	.220	.456	.000	−.098	.095
Mood	.009	.004	.014				.012	−.021	.047
Satisfaction	−.005	−.008	−.002	.000	−.017	.019			
Δ democracy				−.322	−.563	−.070	−.277	−.580	.017
Democracy				.008	−.013	.031	−.034	−.065	−.005
Δ log GDP per capita	.027	−.005	.059	.355	.181	.537	.743	.515	.991
log GDP per capita	−.001	−.003	.001	−.009	−.023	.005	.003	−.016	.023
Corruption	−.010	−.014	−.006	−.031	−.051	−.011	−.061	−.088	−.035
Δ regional democracy	.276	.220	.333	−.243	−.525	.040	−.375	−.687	−.069
Regional democracy	.005	.002	.007	.027	.013	.043	.008	−.009	.025
Residual standard deviation	.050	.046	.054	.474	.445	.507	.539	.494	.586
Residual correlation (mood & satis.)				.268	.211	.326			

Model estimated using Bayesian MCMC methods. Note that the variances of latent variables fluctuate between model specifications. These estimates may therefore differ from those presented in the main paper, where parameter estimates for key structural parameters are standardized based on the empirical distributions of latent variables.

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