**STAT 684\_601**

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**Project name: Measurement invariance of democracy variables**

**Summary**

In this semester, I collaborated with Dr. Kirby Goidel[[1]](#footnote-1) from the Department of Communication and Dr. Nick Davis[[2]](#footnote-2) from Public Policy Research Institute on a study investigating the measurements of democracy variables in the World Value Survey (<http://www.worldvaluessurvey.org/wvs.jsp)>. I was responsible to conduct a measurement invariance (MI) analysis on the variables listed below:

1.       Government taxes rich to subsidize poor                                               V152, W5

2.       Religious authorities interpret laws                                                         V153, W5

3.       People choose leaders in free elections                                                  V154, W5

4.       People receive state aid for unemployment                                         V155, W5

5.       Army takes over when government is incompetent                           V156, W5

6.       Civil rights protect people’s liberties from state oppression           V157, W5

7.       Women have same rights as men                                                              V161, W5

I have thoroughly investigated data and conducted data-exploratory analysis. The questions are in 10-point Likert scale with 10 meaning “strongly agree” and 1 meaning “strongly disagree.” A distribution of question “Government taxes rich to subsidize poor” is shown in table 1 as an example.

In the following report, I will manly explain what does MI mean and finally compile the MI results from the democracy variables in the World Value Survey Wave 5.

I attached the results of exploratory analysis in a rmarkdown file at the end.

**Litrature of MI and the results of this study**

In comparative studies, researchers aim to compare the level of a certain construct across countries or regions. How can they make such comparisons across very different national or regional contexts? In the parlance of psychometrics, we would describe a measure that is similarly understood and reported as invariant (or equivalent), meaning that the latent construct is the same (or nearly the same) across countries. Achieving measurement invariance (MI) gives us greater confidence that comparisons across groups, contexts, or time points are substantively meaningful.

Assessments of MI focus on four levels of invariance (Van de Schoot, Lugtig, and Hox, 2012). First, configural invariance indicates whether the latent variable is a function of the same set of observed variables. If so, this suggest that the structure behind the latent variable is the same across countries. Second, metric invariance indicates whether or not the factor loadings on the latent variable are the same across countries (Kim et al., 2017). Satisfying metric invariance indicates that the unit and the interval of the latent variable are equal across contexts, while failure to meet this level suggests that the construct does not have the same meaning across countries. In other words, a one unit increase in the latent variable would have a noticeably different effect across countries.

Third, scalar invariance is examined to evaluate the intercepts of each item variable across groups. Satisfying scalar invariance allows researchers to compare latent factor means, latent factor variances, and relevant covariance between groups (Kim et al., 2017). Failure to meet the scalar invariance indicates certain groups tend to systematically give higher or lower item responses. Fourth, strict invariance investigates if the residual variance of each item is consistent across groups after satisfying the assumptions of metric and scalar invariance. Strict invariance provides evidence that the mean differences across groups are driven by real group differences and not by error variance. While researchers prefer strict invariance as the ideal threshold for construct validity, they consider scalar invariance empirically appropriate to compare factor or observed means because of the rigidness required to meet the strict invariance requirements (Davidov et al., 2008; Jang et al., 2017; Meredith, 1993).

We used multigroup confirmatory factor analysis (MG-CFA) to test for configural, metric, and scalar invariance of the democracy variables from the World Value Survey (WVS) wave 5.

MG-CFA starts with specifying a confirmatory factor analysis (CFA) model that reflects the theoretically operationalization of the construct. Separate CFA models are then fitted for each group, allowing comparisons across individual countries.

The model fit is interpreted based on three indices: chi-square, comparative fit index (CFI), and root mean squared error of approximation (RMSEA). Because chi-square values are sensitive to sample size and the number of groups included in the analysis (Bentler and Bonett, 1980; Jang et al., 2017), we primarily rely on CFI and RMSEA. By convention, the CFI >= 0.95 and the RMSEA <= 0.05 indicate acceptable model fits (Hu and Bentler, 1999). Within the MG-CFA context, however, previous research advocates for a more liberal RMSEA cutoff based on simulation results showing the number of groups affects the RMSEA cutoff (Rutkowski and Svetina, 2014).

We conducted a preliminary MI test on democracy variables and compiled the results in the following table. Firstly, we conducted MI on all 6 variables of democracy on ALL of countries which yield poor model fit. Thus, we further devide countries into western and the rest of the world assuming that western countries are more homogenous which might yield MI among them. However, the model fit is still not satisfying for neither metric nor scalar invariance. And the model fits do not suggest MI for the rest of the countries either.

We further extracted 4 items out the original 6 variables because these 4 represent a civil aspect of democracy. We configure these 4 items a factor called “civil.” The MI results about civil variables are not optimistic either neither in western countries not in the rest of the world. These poor model fits suggest that those question items about democracy are not understood and interpreted similarly. We should be cautious when making comparisons between countries when using those democracy variables.

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|  |  | Western countries | Rest of world |
| All six variables  (V152, V153, V154, V155,  V157, V161) | Metric Invariance | = 2291.20  df = 121  CFI = 0.77  RMSEA = 0.13 | = 2506.50  df = 177  CFI = 0.81  RMSEA = 0.12 |
| Scalar Invariance | = 4058.80  df = 161  CFI = 0.59  RMSEA = 0.15 | = 5532.20  df = 237  CFI = 0.58  RMSEA = 0.15 |
| Civil  Variables  (V153, V154, V157, V161) | Metric Invariance | = 390.25  df = 42  CFI = 0.95  RMSEA = 0.08 | = 258.00  df = 62  CFI = 0.81  RMSEA = 0.12 |
| Scalar Invariance | = 1158.38  df = 66  CFI = 0.83  RMSEA = 0.12 | = 1095.62  df = 98  CFI = 0.97  RMSEA = 0.06 |

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1. For more information: <https://comm.tamu.edu/kirby-goidel/> [↑](#footnote-ref-1)
2. For more information: <https://ppri.tamu.edu/nick-davis/> [↑](#footnote-ref-2)