SUPPLEMENTARY MATERIALS to the article

"Exploring the performance of multilevel modeling and poststratification with Eurobarometer data"

Dimiter Toshkov, last update 20 March 2015

CONTENTS

Table 1. European populations and sample sizes

State	Abbrev.	Eurobarometer sample	Population (mill.)	Population share	Sample size (weighted)	Sample size (equal)
Austria	AT	1015	8,41	0,017	25	55
Belgium	BE	983	11,01	0,022	33	55
Bulgaria	BG	1023	7,35	0,015	22	55
Cyprus	CY	505	0,85	0,002	3	55
Czech Republic	CZ	1094	10,50	0,021	31	55
Denmark	DK	1012	5,57	0,011	17	55
Estonia	EE	1006	1,33	0,003	4	55
Finland	FI	1012	5,39	0,011	16	55
France	FR	1038	65,13	0,130	195	55
Germany	DE	1458	81,80	0,163	245	55
Greece	GR	1000	11,12	0,022	33	55
Hungary	HU	1004	9,97	0,020	30	55
Ireland	IE	1006	4,58	0,009	14	55
Italy	IT	1036	59,38	0,118	178	55
Latvia	LV	1008	2,60	0,004	6	55
Lithuania	LT	1016	3,03	0,006	9	55
Luxembourg	LU	530	0,52	0,001	2	55
Malta	MT	500	0,42	0,001	1	55
The Netherlands	NL	1000	16,69	0,033	50	55
Poland	PL	1000	38,53	0,077	115	55
Portugal	PT	1018	10,56	0,021	32	55
Romania	RO	1012	20,15	0,040	60	55
Slovakia	SK	1065	5,40	0,011	16	55
Slovenia	SI	1012	2,05	0,004	6	55
Spain	ES	1002	46,74	0,093	140	55
Sweden	SE	1068	9,45	0,019	28	55
United Kingdom	GB	1452	63,26	0,126	189	55

Table 2. Data sources for the included public opinion items

Number	Item	Survey	Fieldwork
1	Trust in the European Union	Eurobarometer 63.4	May - June 2005
2	Immigration importance	Eurobarometer 63.4	May - June 2005
3	Life satisfaction	Eurobarometer 63.4	May - June 2005
4	Interpersonal trust	Eurobarometer 62.2	November - December 2004
5	Organizational membership	Eurobarometer 62.2	November - December 2004
6	EU membership is a good thing	Eurobarometer 62.2	November - December 2004
7	Belief in God	Eurobarometer 63.1	January - February 2005
8	Gender equality pol. leaders	Eurobarometer 63.1	January - February 2005
9	Unemployment importance	Eurobarometer 62.0	October-November 2004
10	Democracy satisfaction	Eurobarometer 62.0	October-November 2004

Precise formulation of the survey questions

1. Trust in the EU: 'I would like to ask you a question about how much trust you have in certain institutions. For each of the following institutions, please tell me if you tend to trust it or tend not to trust it: ...The European Union'. The possible answers are 'Tend to trust', 'Tend not to trust', and 'Don't know.'

2. Immigration importance: 'What do you think are the two most important issues facing (OUR COUNTRY) at the moment? (SHOW CARD - READ OUT - MAX. 2 ANSWERS) 'Immigration'. Possible answers: '0 Not mentioned', '1 Mentioned'.

3. Life satisfaction: 'On the whole, are you very satisfied, fairly satisfied, not very satisfied or not at all satisfied with the life you lead?' Possible answers: '1 Very satisfied', '2 Fairly satisfied' '3 Not very satisfied', '4 Not at all satisfied', '5 DK'. The first two grouped in 'satisfied', the rest recoded as 'not satisfied'.

4. Interpersonal trust: 'Generally speaking, would you say that most people can be trusted, or that you can't be too careful in dealing with people?' Possible answers are: '1 Most people can be trusted', '2 You can´t be too careful', '3 It depends (SPONTANEOUS)', and '4 Don't know'. I combine the latter three.

5. Organizational membership: 'Now, I would like you to look carefully at the following list of organisations and activities. Please, say in which, if any, you are a member. (SHOW CARD - MULTIPLE ANSWERS POSSIBLE - SELECT ALL THAT APPLIES) Answer: 'None of these (SPONTANEOUS)'.

6. EU membership is a good thing: 'Generally speaking, do you think that (OUR COUNTRY)'s membership of the European Union is...?' Possible answers: '1 Good thing', '2 Neither good nor bad', '3 Bad thing', '4 4 Don't know'. I combine the latter three.

7. Belief in God: 'Which of these statements comes closest to your beliefs?'. Possible answers: '1 I believe there is a God','2 I believe there is some sort of spirit or life force', '3 I don't believe there is any sort of spirit, God or life force', '4 Don't know'. I combine the latter three.

8. Gender equality (political leaders): 'For each of the following statements please tell me to what extent you agree or disagree: On the whole, men make better political leaders than women'. Possible answers: '1 Strongly agree', '2 Tend to agree', '3 Tend to disagree', '4 Strongly disagree', '5 Don't know.' I group the first two and the last three together.

9. Unemployment importance: 'What do you think are the two most important issues facing (OUR COUNTRY) at the moment? (SHOW CARD - READ OUT - MAX. 2 ANSWERS) 'Unemployment'. Possible answers: '0 Not mentioned', '1 Mentioned'.

10. Democracy satisfaction: 'On the whole, are you very satisfied, fairly satisfied, not very satisfied or not at all satisfied with the way democracy works in (OUR COUNTRY)?' Possible answers: '1 Very satisfied', '2 Fairly satisfied', '3 Not very satisfied', '4 Not at all satisfied', '5 Don't know'. I group the first two and the last three together.

Census categories used

The poststratification is based on data from the 2001 EU-wide Census as provided by EUROSTAT. The data covers the 27 member states of the EU as of 2007, with the exception of Belgium, Sweden, and Malta.

Sex is coded as a dichotomous variable which maps directly to the Eurobarometer variable. Age is coded as a 4-category variable:"Y15-24", "Y25-34", "Y35-54", and "Y55-74". The analogous Eurobarometer variable has six categories which can be combined in a straightforward way to match the Census levels. Occupation status is coded as 'Unemployed' (mapped to "Unemployed, temporarily not working"), 'Inactive', 'Not applicable', and 'Unknown' which I group together (mapped to "Responsible for ordinary shopping, etc.", "Student", and "Retired, unable to work"), and 'Employed' (mapped to the remaining Eurobarometer categories of the 'current occupation' variable). Education is coded in the Census according to ISCED 1997 standards in terms of levels. I combine some of categories into 'unknown', 'no education', 'primary' (levels 0 and 1), 'lower secondary' (level 2), 'upper secondary I' (levels 3) and 'upper secondary II (level 4) and 'tertiary' (levels 5 and 6). Eurobarometer codes education not in terms of levels but in terms of age of finishing education. I recode the variable into the following categories to match the Census data: "No full-time education", NA, "Up to 14 years", "15 to 17 years", "18 to 19 years", "20 to 21 years", "more than 21 years or still studying".

Table 3. State-level covariates and summary measures of variation

Public opinion Item	Covariate 1	Covariate 2	AdjR2	McFR2	ICC
Trust in the European Union	*Government effectiveness*	*Protestant country*	0.62	0.02	0.03
Immigration importance	*Percentage people in rural*	*Former commun. country*	0.44	0.01	0.09
Life satisfaction	*GDP per capita*	*Government effectiveness*	0.74	0.04	0.17
Interpersonal trust	*Protestant country*	*Control of corruption*	0.75	0.03	0.13
Membership in organizations	*Protestant country*	*Government effectiveness*	0.69	0.05	0.18
EU membership is a good thing	*Percentage people in rural*	*Immigration per capita (2006)*	0.34	0.04	0.06
Belief in God	*Protestant country*	*Orthodox country*	0.32	0.05	0.18
Gender equality (for pol. leaders)	*Post-2004 member state*	*Control of corruption*	0.68	0.02	0.07
Unemployment importance	*Unemployment level*	*Percent social spending*	0.50	0.01	0.14
Satisfaction with democracy	*Government effectiveness*	*Former commun. country*	0.71	0.02	0.16

Table 4. Range of variation of the state means

Public opinion Item	Mean	Median	Min	Max	St.dev
Trust in the European Union	0.49	0.51	0.27	0.67	0.09
Immigration importance	0.10	0.07	0.01	0.30	0.09
Life satisfaction	0.74	0.78	0.29	0.98	0.18
Interpersonal trust	0.29	0.24	0.10	0.75	0.16
Membership in organizations	0.47	0.42	0.18	0.90	0.21
EU membership is a good thing	0.58	0.55	0.41	0.82	0.13
Belief in God	0.54	0.48	0.17	0.91	0.22
Gender equality (for pol. leaders)	0.34	0.38	0.14	0.63	0.13
Unemployment importance	0.44	0.46	0.09	0.75	0.18
Satisfaction with democracy	0.54	0.52	0.22	0.92	0.20

Table 5. Performance indicators for the full MPR model (means with standard deviations in brackets)

Public opinion Item	Weighted sample					Equal sample				
	rho	tau	mae	rmse	cov	rho	tau	mae	rmse	cov
Trust in the European Union	0.84	0.63	0.05	0.06	8.3	0.79	0.59	0.05	0.06	9.0
	(0.05)	(0.06)	(0.01)	(0.01)	(2.9)	(0.06)	(0.08)	(0.01)	(0.01)	(2.3)
Immigration importance	0.89	0.66	0.03	0.04	10.4	0.86	0.68	0.03	0.05	8.2
	(0.05)	(0.08)	(0.01)	(0.01)	(2.5)	(0.07)	(0.07)	(0.01)	(0.01)	(2.7)
Life satisfaction	0.95	0.80	0.05	0.06	7.3	0.93	0.78	0.06	0.07	6.0
	(0.01)	(0.03)	(0.01)	(0.01)	(1.8)	(0.02)	(0.05)	(0.01)	(0.01)	(2.3)
Interpersonal trust	0.94	0.72	0.04	0.06	9.8	0.93	0.70	0.05	0.07	7.6
	(0.02)	(0.04)	(0.01)	(0.01)	(2.2)	(0.02)	(0.02)	(0.01)	(0.01)	(2.2)
Membership in organizations	0.89	0.71	0.07	0.10	6.8	0.93	0.76	0.07	0.08	6.5
	(0.02)	(0.04)	(0.01)	(0.01)	(2.0)	(0.02)	(0.04)	(0.01)	(0.01)	(2.3)
EU member. is a good thing	0.80	0.58	0.06	0.08	7.5	0.76	0.53	0.07	0.0	6.8
	(0.07)	(0.08)	(0.01)	(0.01)	(2.2)	(0.09)	(0.12)	(0.01)	(0.01)	(2.2)
Belief in God	0.92	0.74	0.06	0.09	7.8	0.93	0.75	0.07	0.08	6.7
	(0.02)	(0.04)	(0.01)	(0.01)	(2.0)	(0.03)	(0.05)	(0.01)	(0.01)	(2.0)
Gender equality	0.89	0.68	0.05	0.06	10.4	0.87	0.66	0.05	0.05	8.0
	(0.03)	(0.06)	(0.01)	(0.01)	(2.7)	(0.04)	(0.06)	(0.01)	(0.01)	(2.5)
Unemployment importance	0.92	0.76	0.06	0.08	7.9	0.90	0.74	0.07	0.08	5.8
	(0.02)	(0.04)	(0.01)	(0.01)	(2.2)	(0.03)	(0.06)	(0.01)	(0.01)	(2.1)
Satisfaction with democracy	0.92	0.78	0.06	0.06	7.7	0.93	0.79	0.06	0.08	6.6
	(0.02)	(0.04)	(0.01)	(0.01)	(2.2)	(0.03)	(0.04)	(0.01)	(0.01)	(2.0)

Table 6a. Performance indicators for four models of increasing complexity. Pearson's correlation (rho). (means with standard deviations in brackets)

Public opinion Item	Rho (Weighted sample)				Rho (Equal sample)			
	naive	geo	geo+	full	naive	geo	geo+	full
Trust in the European Union	0.47 (0.12)	0.80 (0.07)	0.84 (0.05)	0.84 (0.05)	0.68 (0.11)	0.66 (0.14)	0.80 (0.06)	0.79 (0.06)
Immigration importance	0.73 (0.12)	0.86 (0.06)	0.89 (0.05)	0.89 (0.05)	0.85 (0.07)	0.85 (0.07)	0.86 (0.07)	0.86 (0.07)
Life satisfaction	0.86 (0.08)	0.90 (0.04)	0.95 (0.01)	0.95 (0.01)	0.92 (0.03)	0.92 (0.03)	0.94 (0.02)	0.93 (0.02)
Interpersonal trust	0.76 (0.08)	0.89 (0.04)	0.95 (0.02)	0.94 (0.02)	0.89 (0.03)	0.90 (0.03)	0.93 (0.02)	0.93 (0.02)
Membership in organizations	0.80 (0.10)	0.89 (0.04)	0.91 (0.02)	0.89 (0.02)	0.92 (0.02)	0.92 (0.02)	0.93 (0.02)	0.93 (0.02)
EU membership is a good thing	0.64 (0.21)	0.73 (0.06)	0.84 (0.06)	0.80 (0.07)	0.79 (0.06)	0.79 (0.06)	0.79 (0.08)	0.76 (0.09)
Belief in God	0.82 (0.05)	0.88 (0.03)	0.91 (0.02)	0.92 (0.02)	0.92 (0.03)	0.92 (0.03)	0.92 (0.03)	0.93 (0.03)
Gender equality (for pol. leaders)	0.63 (0.16)	0.83 (0.05)	0.89 (0.03)	0.89 (0.03)	0.81 (0.07)	0.81 (0.07)	0.87 (0.04)	0.87 (0.04)
Unemployment importance	0.77 (0.05)	0.90 (0.03)	0.92 (0.02)	0.92 (0.02)	0.89 (0.03)	0.89 (0.03)	0.90 (0.03)	0.90 (0.03)
Satisfaction with democracy	0.80 (0.13)	0.87 (0.04)	0.92 (0.02)	0.92 (0.02)	0.91 (0.02)	0.91 (0.02)	0.93 (0.03)	0.93 (0.03)

Table 6b. Performance indicators for four models of increasing complexity. Mean absolute error (mae). (means with standard deviations in brackets)

Public opinion Item	Weighted sample (mae)				Equal sample (mae)			
	naive	geo	geo+	full	naive	geo	geo+	full
Trust in the European Union	0.10 (0.02)	0.05 (0.01)	0.05 (0.01)	0.05 (0.01)	0.08 (0.01)	0.06 (0.01)	0.05 (0.01)	0.05 (0.01)
Immigration importance	0.05 (0.01)	0.03 (0.00)	0.03 (0.00)	0.03 (0.01)	0.04 (0.01)	0.04 (0.01)	0.03 (0.01)	0.03 (0.01)
Life satisfaction	0.07 (0.01)	0.06 (0.01)	0.05 (0.01)	0.05 (0.01)	0.06 (0.01)	0.06 (0.01)	0.05 (0.01)	0.06 (0.01)
Interpersonal trust	0.09 (0.01)	0.06 (0.01)	0.04 (0.01)	0.04 (0.01)	0.07 (0.01)	0.06 (0.01)	0.05 (0.01)	0.05 (0.01)
Membership in organizations	0.10 (0.02)	0.07 (0.01)	0.07 (0.01	0.07 (0.01	0.07 (0.01)	0.07 (0.01)	0.06 (0.01)	0.07 (0.01)
EU membership is a good thing	0.09 (0.02)	0.06 (0.01)	0.06 (0.01)	0.06 (0.01)	0.08 (0.01)	0.07 (0.01)	0.06 (0.01)	0.07 (0.01)
Belief in God	0.09 (0.01)	0.07 (0.01)	0.07 (0.01)	0.06 (0.01)	0.07 (0.01)	0.07 (0.01)	0.07 (0.01)	0.07 (0.01)
Gender equality (for pol. leaders)	0.10 (0.02)	0.06 (0.01)	0.05 (0.01)	0.05 (0.01)	0.07 (0.01)	0.06 (0.01)	0.05 (0.01)	0.05 (0.01)
Unemployment importance	0.10 (0.01)	0.06 (0.01)	0.06 (0.01)	0.06 (0.01)	0.07 (0.01)	0.07 (0.01)	0.07 (0.01)	0.07 (0.01)
Satisfaction with democracy	0.09 (0.02)	0.07 (0.01)	0.06 (0.01)	0.06 (0.01)	0.07 (0.01)	0.07 (0.01)	0.06 (0.01)	0.06 (0.01)

Table 6c. Performance indicators for four models of increasing complexity. Coverage (number of countries within the sampling margins of error of the true means at the 95% level). (means with standard deviations in brackets)

Public opinion Item	Weighted sample (mae)				Equal sample (mae)			
	naive	geo	geo+	full	naive	geo	geo+	full
Trust in the European Union	8.2 (2.0)	9.5 (2.5)	8.4 (2.9)	8.3 (2.9)	4.8 (1.9)	8.2 (2.3)	9.2 (2.6)	9.0 (2.2)
Immigration importance	6.5 (1.8)	7.6 (2.2)	10.4 (2.4)	10.4 (2.5)	3.3 (1.6)	7.0 (2.3)	8.3 (2.5)	8.2 (2.6)
Life satisfaction	6.8 (2.0)	7.5 (2.3)	7.3 (2.4)	7.3 (1.8)	5.2 (1.9)	6.0 (2.0)	6.0 (2.0)	6.0 (2.3)
Interpersonal trust	7.2 (1.9)	8.6 (2.3)	10.5 (2.2)	9.8 (2.2)	6.2 (2.4)	7.3 (2.5)	8.0 (2.3)	7.6 (2.2)
Membership in organizations	7.2 (2.0)	7.4 (2.0)	7.7 (2.0)	6.8 (2.1)	5.9 (2.0)	5.8 (2.2)	6.7 (2.2)	6.5 (2.3)
EU membership is a good thing	8.1 (2.0)	8.4 (2.3)	8.9 (2.1)	7.5 (2.2)	5.5 (1.7)	7.0 (2.3)	7.4 (2.1)	6.8 (2.2)
Belief in God	7.4 (2.0)	8.0 (2.0)	7.8 (2.0)	7.8 (2.0)	6.3 (2.3)	6.6 (2.2)	6.8 (2.4)	6.7 (2.0)
Gender equality (for pol. leaders)	6.5 (1.7)	7.9 (2.1)	10.3 (2.9)	10.4 (2.7)	5.6 (1.8)	6.5 (2.2)	8.2 (2.6)	8.0 (2.6)
Unemployment importance	7.4 (1.9)	8.3 (2.0)	7.8 (2.1)	7.9 (2.2)	5.8 (2.0)	6.4 (2.3)	5.7 (2.1)	5.8 (2.1)
Satisfaction with democracy	7.4 (1.8)	7,4 (2.0)	7.7 (2.2)	7.7 (2.2)	5.2 (2.1)	5.8 (2.0)	6.5 (1.9)	6.6 (2.0)

Tables 7 [1:10]. Summaries of the multi-level models of the ten public opinion items.
The models are estimated on the full universe of available cases in the Eurobarometer survey. In the actual MRP implementation, the model is estimated from each drawn sample, but the selection of variables remains the same.

Fixed effects	Coef.est	Coef.st. err.
(Intercept)	0.32	0.18
Government effectiveness	-0.34	0.08
Protestant country	-0.29	0.11
Random effects	**Std.dev**	
State	0.20	
Age	0.16	
Sex	0.07	
Occupation status	0.07	
Education	0.31	
Output variable: Trust in EU. 24,789 observations		

Fixed effects	Coef.est	Coef.st. err.
(Intercept)	-1.67	0.27
Former communist country	-1.44	0.27
Percentage rural population	-1.05	0.62
Random effects	**Std.dev**	
State	0.61	
Age	0.09	
Sex	0.02	
Occupation status	0.08	
Education	0.09	

Output variable: Immigration most important problem. 24,789 observations.

Fixed effects	Coef.est	Coef.st. err.
(Intercept)	-0.17	0.46
GDP per capita	0.47	0.14
Government effectiveness	1.05	0.22
Random effects	**Std.dev**	
State	0.49	
Age	0.33	
Sex	0.00	
Occupation status	0.51	
Education	0.38	

Output variable: Life satisfaction. 24,789 observations.

Fixed effects	Coef.est	Coef.st. err.
(Intercept)	-2.02	0.19
Protestant country	0.36	0.17
Control of corruption	0.69	0.10
Random effects	**Std.dev**	
State	0.32	
Age	0.15	
Sex	0.03	
Occupation status	0.13	
Education	0.26	

Output variable: Interpersonal trust. 24477 observations.

Fixed effects	Coef.est	Coef.st. err.
(Intercept)	-1.68	0.34
Protestant country	0.50	0.25
Government effectiveness	1.08	0.18
Random effects	**Std.dev**	
State	0.47	
Age	0.12	
Sex	0.12	
Occupation status	0.36	
Education	0.36	

Output variable: Organizational membership. 24,477 observations.

Fixed effects	Coef.est	Coef.st. err.
(Intercept)	0.22	0.30
Percentage rural population	-1.02	0.41
Immigration per capita (2006)	0.39	0.10
Random effects	**Std.dev**	
State	0.42	
Age	0.06	
Sex	0.17	
Occupation status	0.16	
Education	0.46	

Output variable: EU membership is a good thing. 24,344 observations.

Fixed effects	Coef.est	Coef.st. err.
(Intercept)	0.23	0.38
Protestant country	-0.83	0.39
Orthodox country	1.17	0.47
Random effects	**Std.dev**	
State	0.82	
Age	0.21	
Sex	0.32	
Occupation status	0.21	
Education	0.29	

Output variable: Belief in God. 24,344 observations.

Fixed effects	Coef.est	Coef.st. err.
(Intercept)	-0.52	0.32
Post-2004 EU member state	0.51	0.19
Control of corruption	-0.39	0.12
Random effects	**Std.dev**	
State	0.32	
Age	0.10	
Sex	0.32	
Occupation status	0.00	
Education	0.12	

Output variable: Gender equality. 24,344 observations.

Fixed effects	Coef.est	Coef.st. err.
(Intercept)	-0.15	0.20
Unemployment level	0.58	0.13
Percent social spending	0.40	0.13
Random effects	**Std.dev**	
State	0.60	
Age	0.13	
Sex	0.03	
Occupation status	0.25	
Education	0.08	

Output variable: Immigration most important problem. 24,772 observations.

Fixed effects	Coef.est	Coef.st. err.
(Intercept)	-0.47	0.34
Former communist country	-0.72	0.26
Government effectiveness	0.81	0.20
Random effects	**Std.dev**	
State	0.48	
Age	0.06	
Sex	0.05	
Occupation status	0.15	
Education	0.12	

Output variable: Satisfaction with democracy. 24,772 observations.

Figure 1. [1:10] comparing the MRP estimates to the 'true' state means for the ten items. Means (dots) and 95% sampling margins of error for the true state means in black. Means (dots) and 0.05 to 0.95 quintiles of MRP estimates from 100 simulations in red.
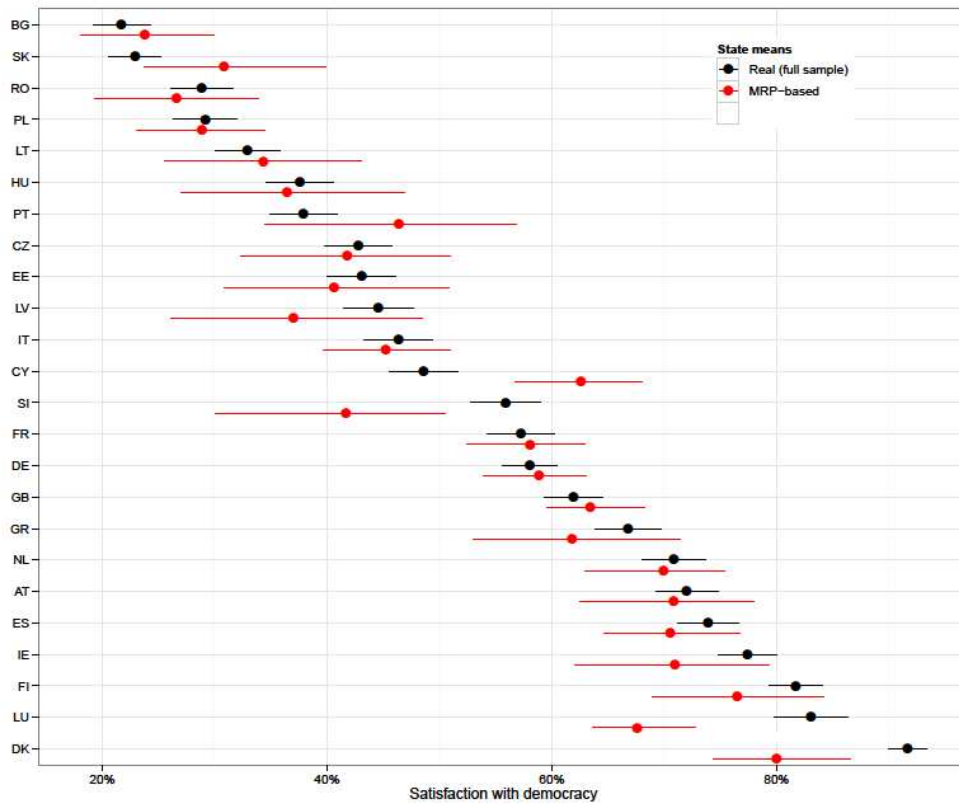
Unemployment most important problem
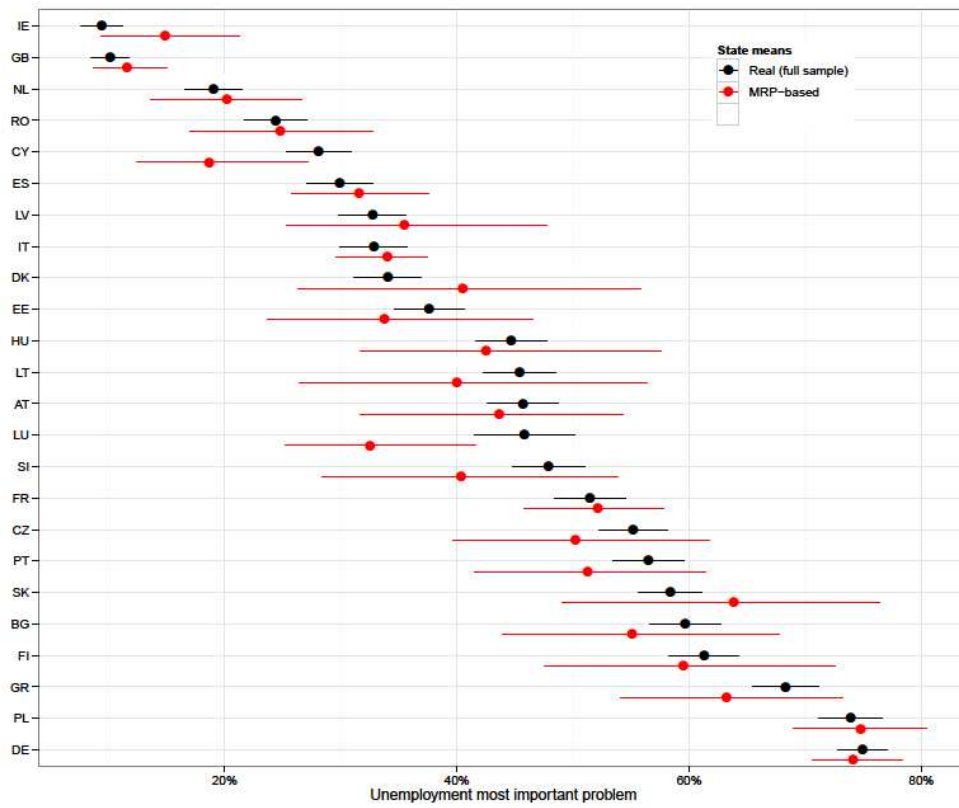

Satisfaction with democracy

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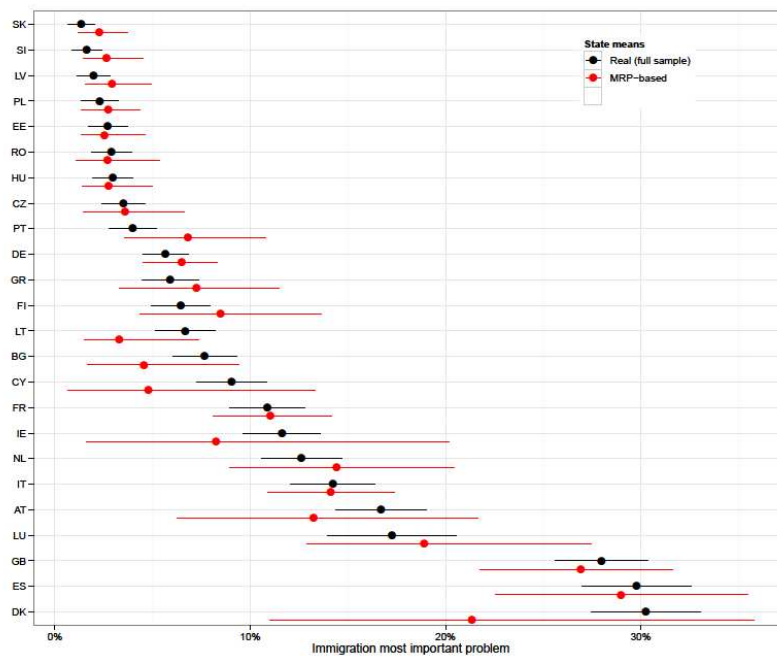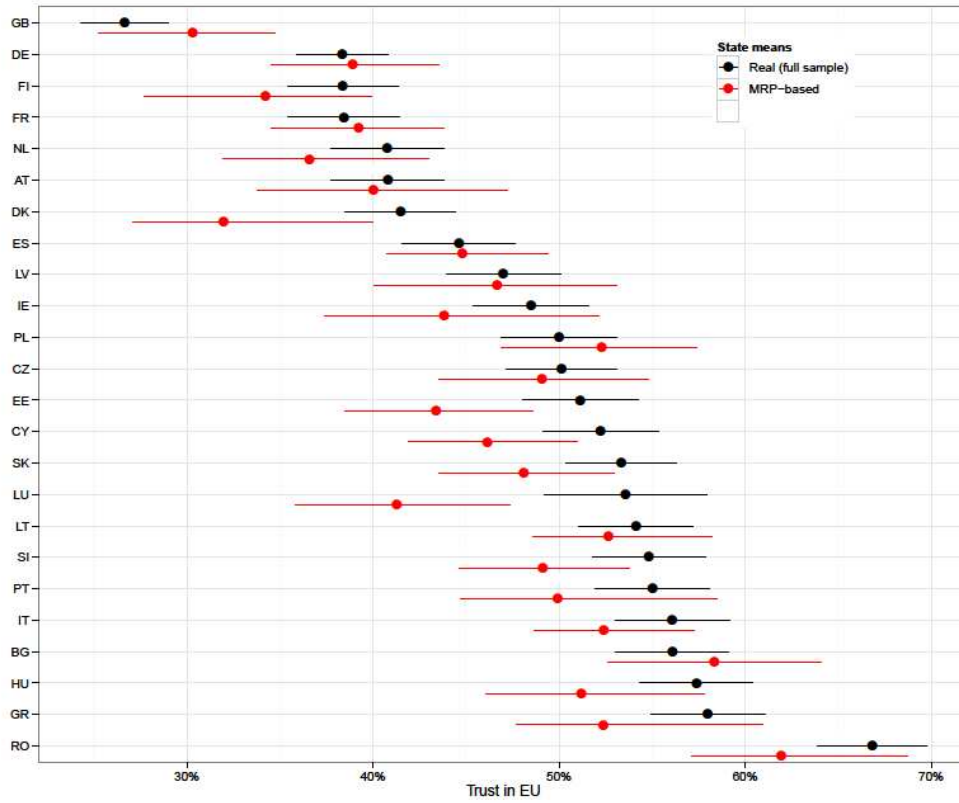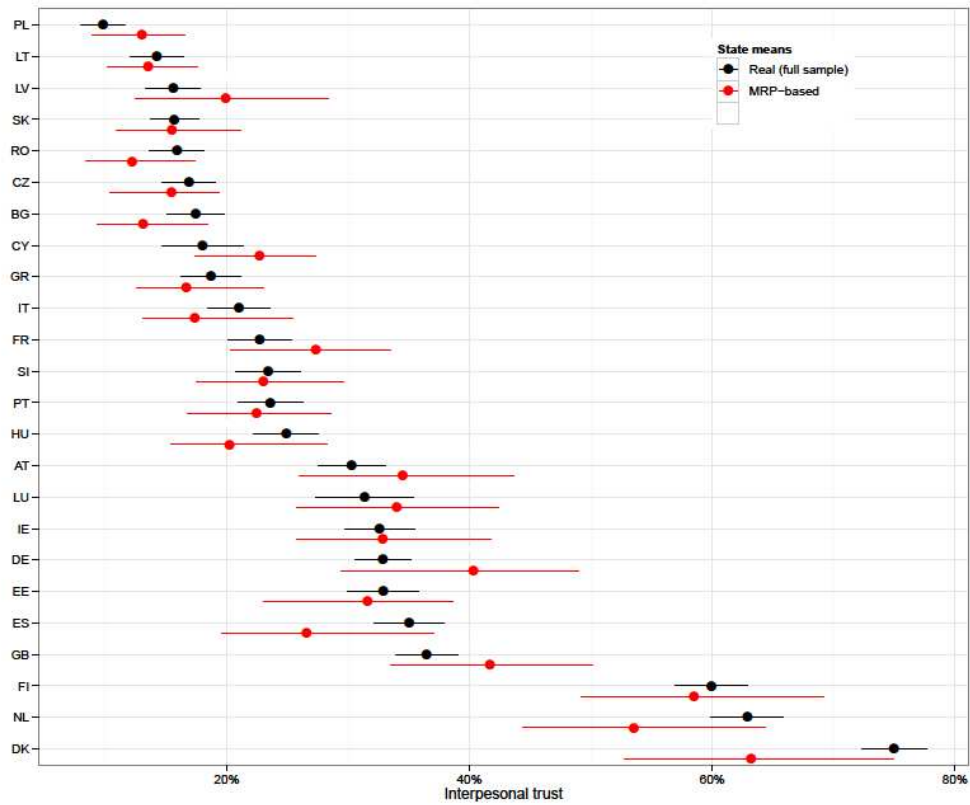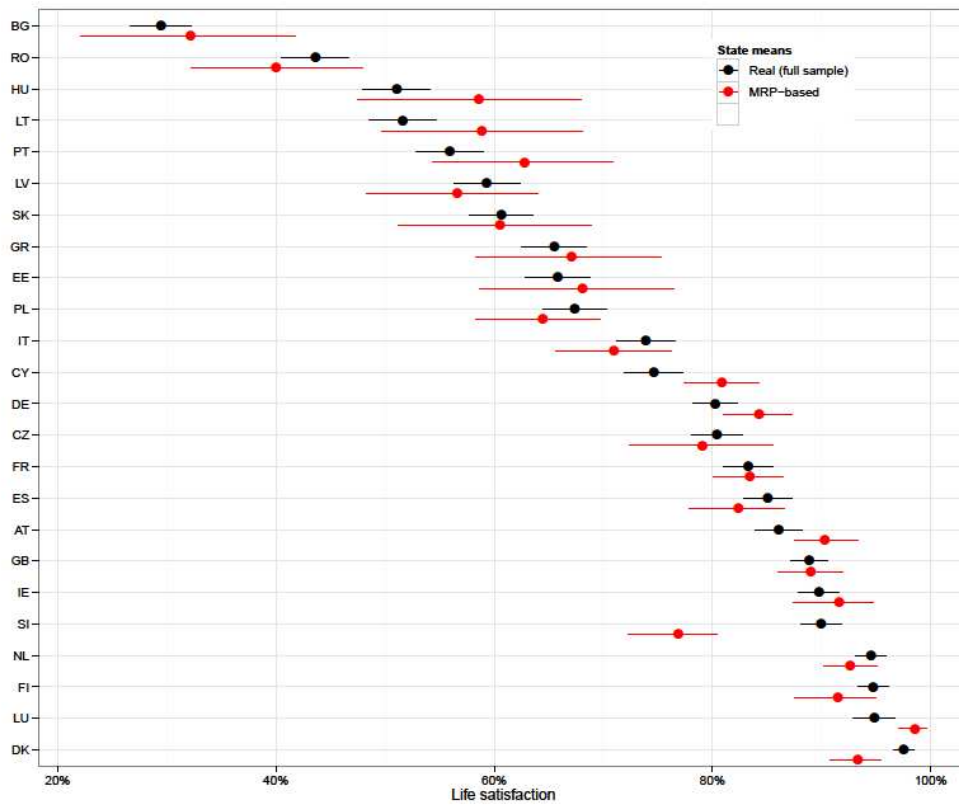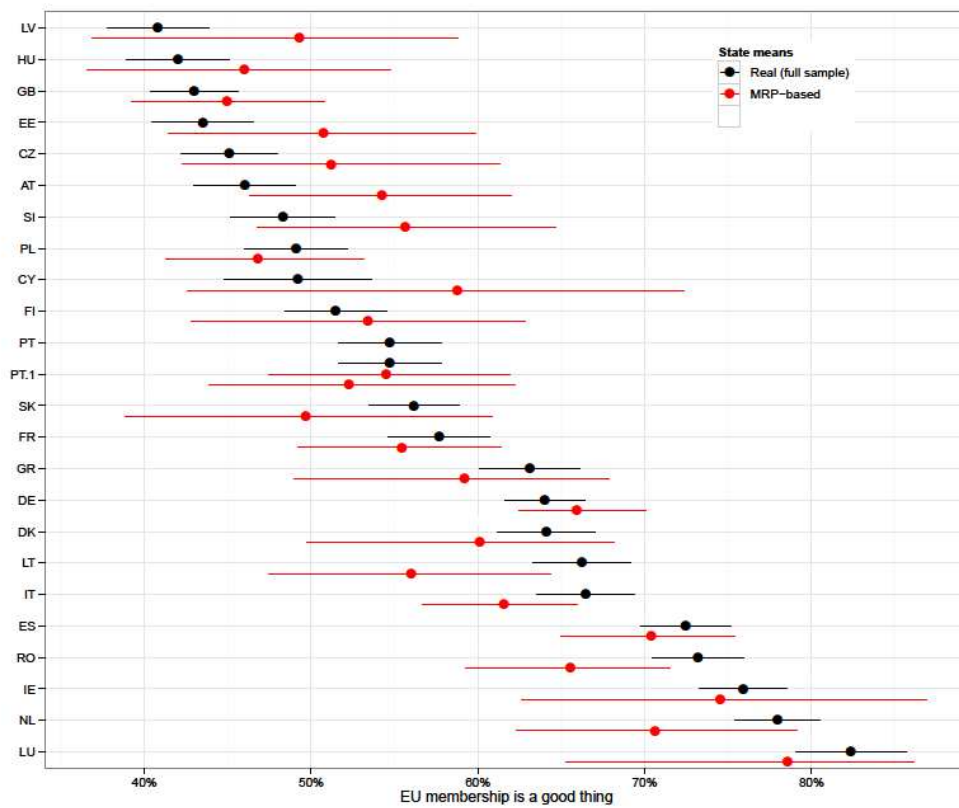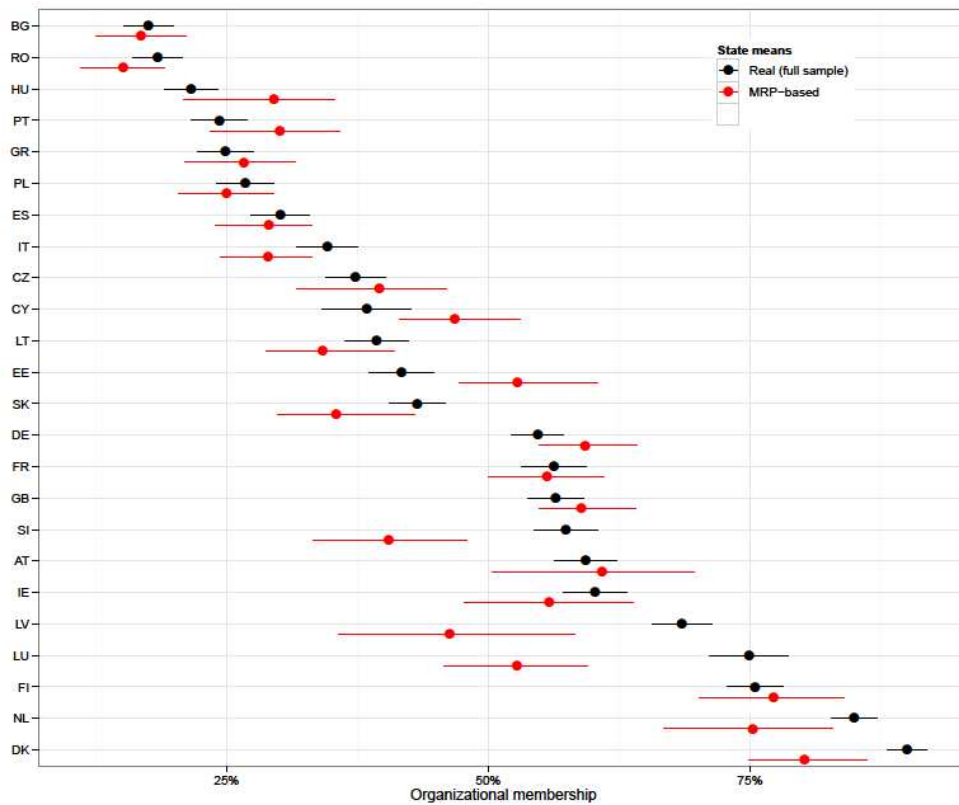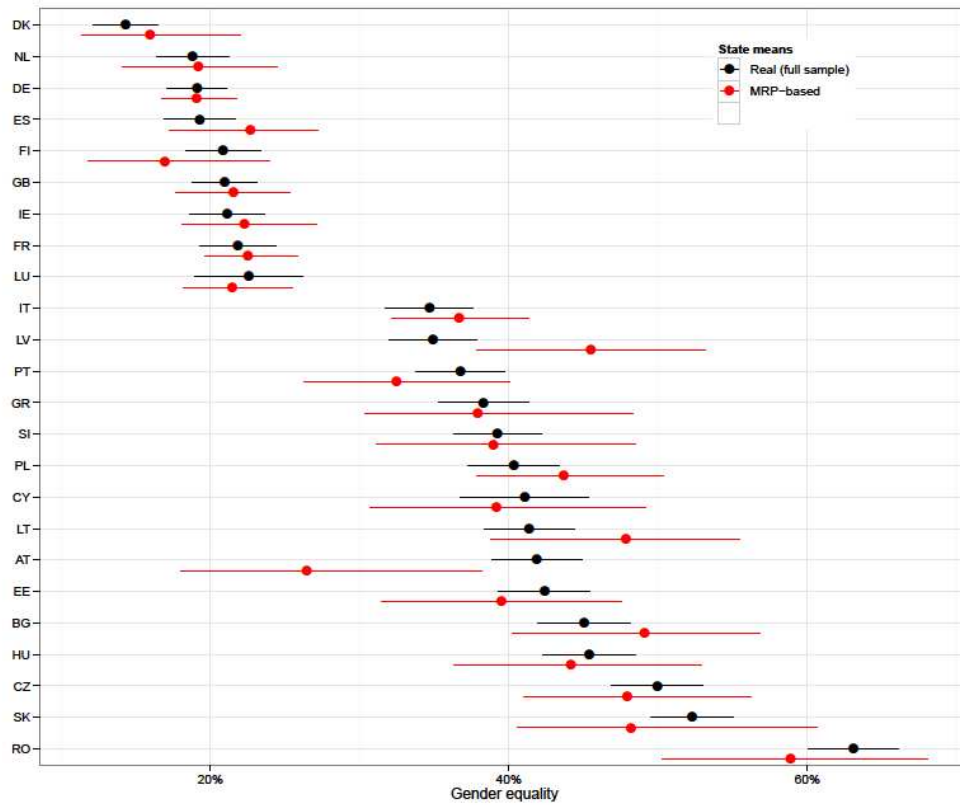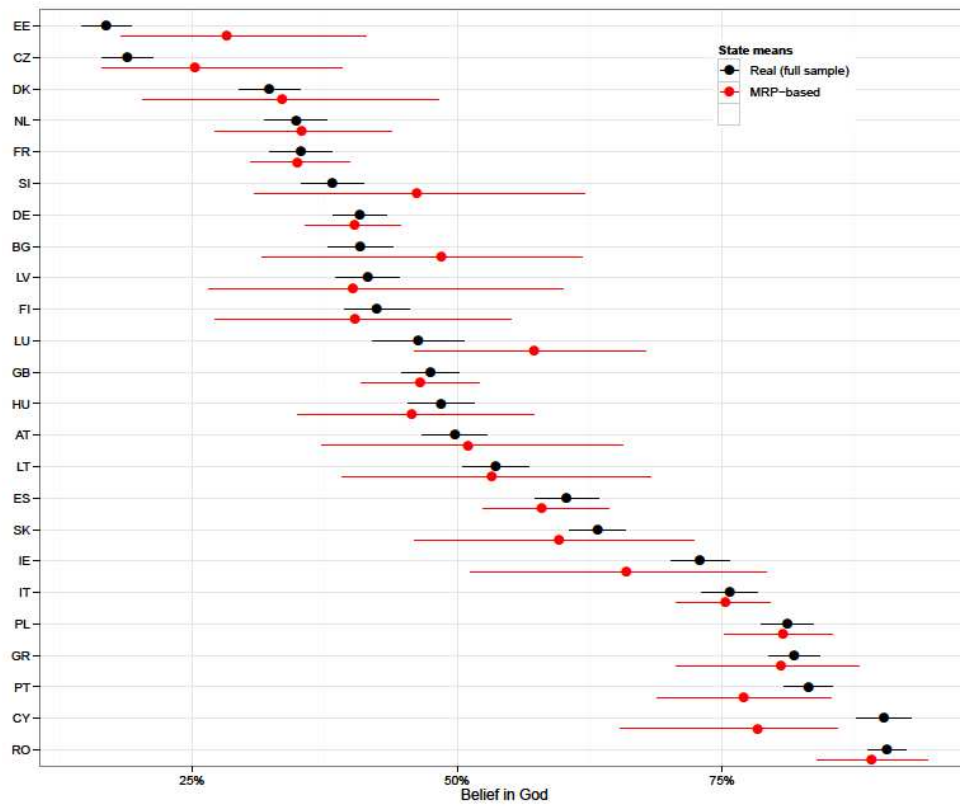
Figure 2. [1:10] Boxplots of the correlations for 100 simulations between the true state means and estimates from four approaches: simple disaggregation (bottom), state indicator random effects, state indicators random effects with state-level predictors, and full MRP adding the individual level predictors (top). Left panels: weighted samples; Right panels: equal-shares samples.