Polarization Measurement through Ordered Latent Class Analysis

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The Basic Idea

- A two-stage approach to polarization measurement
- First Stage: Latent Class Analysis. Test for ordinality of latent variable.
- Second stage: measuring polarization for class proportions in different clusters.

Why polarization?

- Attitudinal polarization is an evidence of cultural cleavage
- Polarization may be used as a second-level predictor for analyses of many social processes, especially related to politics and ethnic relations.
- Polarization (and the related cleavage) may be interesting to model as well.

Measurement of Polarization Previous developments

- Variance (or Standard Deviation)
- Kurtosis
- Foster-Wolfson Index
- Duclos-Esteban-Ray family of indices
- Ethno-Linguistic Fractionalization Index
- Reynal-Querol Index of polarization
- Various measures of ordinal variation
- Visual distribution comparisons
- *Ad hoc* methods (like Mouw and Sobel 2001)

Polarization in Survey Data

- The main objects of interest are latent constructs (measured through multiple manifest variables).
- Information about distributional parameters of latent variables provided by relevant statistical software is limited, therefore complex methods for measurement of polarization are non-applicable.
- Latent Variance and measuring polarization for aggregated factor scores seems to be insufficiently accurate approaches due to possible non-normality of the latent variable

Why (Ordinal) Latent Classes?

- **Non-normality** of latent variable distribution
- **Possible multidimensionality**: when the latent categorical variable is nominal rather than ordinal, it is impossible to order all individuals on all items in the same direction.
- Allows for testing **scale of the latent variable** and **measurement Invariance**
- **Classification of individuals** according to their value patterns, to which ordinal measures of polarization are easily applicable

Latent Class Model

- X1, X2, X3, and X4 are observed variables
- Y a latent categorical variable which accounts for the relationships among these four observed variables
-
- is a probability that a randomly selected individual will be in latent class of latent variable
- is a probability that a member of latent class will provide a response of for observed variable
- is a probability that a member of latent class will provide a response of for observed variable 2
- is a probability that a member of latent class will provide a response of for observed variable 3
- is a probability that a member of latent class will provide a response of for observed variable 4

Ordinal Latent Classes

- Ordering of the categories of the latent variable is provided by imposing inequality constraints on model parameters: means for continuous manifest variables and thresholds for binary and ordinal manifest variables.
- Thresholds is used instead probabilities
- Large positive thresholds indicate the probability of a specific response value is relatively low, whereas large negative values suggest that the probability of the response is relatively high.
- Inequality constraint assumes the following ordering of classes for threshold for variable : Class 1 > Class 2 > Class 3 > Class4

Approach to Measurement of Polarization

- Testing for unidimensionality: comparing unconstrained and strictly ordered models.
- Applying relevant index of nominal or ordinal polarization to class proportions for each country obtained at the first stage.
- Bonus: exploring measurement invariance cross-country differences in value distributions

Assessment of Model Fit

- Bayesian Information Criterion adjusted to sample size (aBIC):

  $$BIC = -2 * logL + p * \ln((n+2)/24)$$

- Lo-Mendell-Rubin Test and Bootstrapped Likelihood Ratio Test (are not appropriate for comparisons between models with the same number of classes)

- Interpretability of the model: we do not need many senseless classes with perfect fit

Data

- Survival/Self-Expression Values. WVS, Fifth Wave
- Manifest variables: Happiness, Tolerance for Homosexuality, Trust, Four-Item Postmaterialism Index (as a single variable), Signing Petition
- 29 European Countries: 27 EU members, Norway, and Switzerland
- 42817 respondents
- Data were not weighted
- Data were not imputed

Fit Statistics for Competing Models

	aBIC	LMR Test p-value	BLRT p-value	Free Parameters	Violations of Ordering
Three Classes	471413.682	0.000	0.000	30	0
Four Classes	463097.672	0.000	0.000	40	1
Five Classes	448977.323	0.000	0.000	50	1
Five Classes_Ord	448977.441	***	***	50	0
Six Classes	446572.609	0.000	0.000	60	3
Six Classes_Ord	469077.511	***	***	55	0
Seven Classes	444052.829	0.000	0.000	70	6
Seven_Classes_Ord	***	***	***	64	0

Thresholds and Means Estimates for the Five-Class Unconstrained Model

	Happy1	Happy2	Happy3	Pmat1	Pmat2	Trust	Petition 1	Petition 2	Homosex	Order
Class1	-3.84	-1.692	1.348	-0.836	2.365	0.859	-0.798	0.735	3.452	2
Class2	-3.495	-1.278	1.357	-0.598	2.631	1.174	-0.231	1.068	1.118	1
Class3	***-4.492***	-2.433	0.604	-1.706	1.291	-0.208	-2.322	-0.723	9.819	5
Class4	-4.3	-1.931	0.998	-1.038	1.991	0.69	-1.189	0.263	5.256	3
Class5	***-4.555***	-2.084	0.865	-1.294	1.661	0.394	-1.637	-0.134	7.557	4

Thresholds and Means Estimates for the Six-Class Unconstrained Model

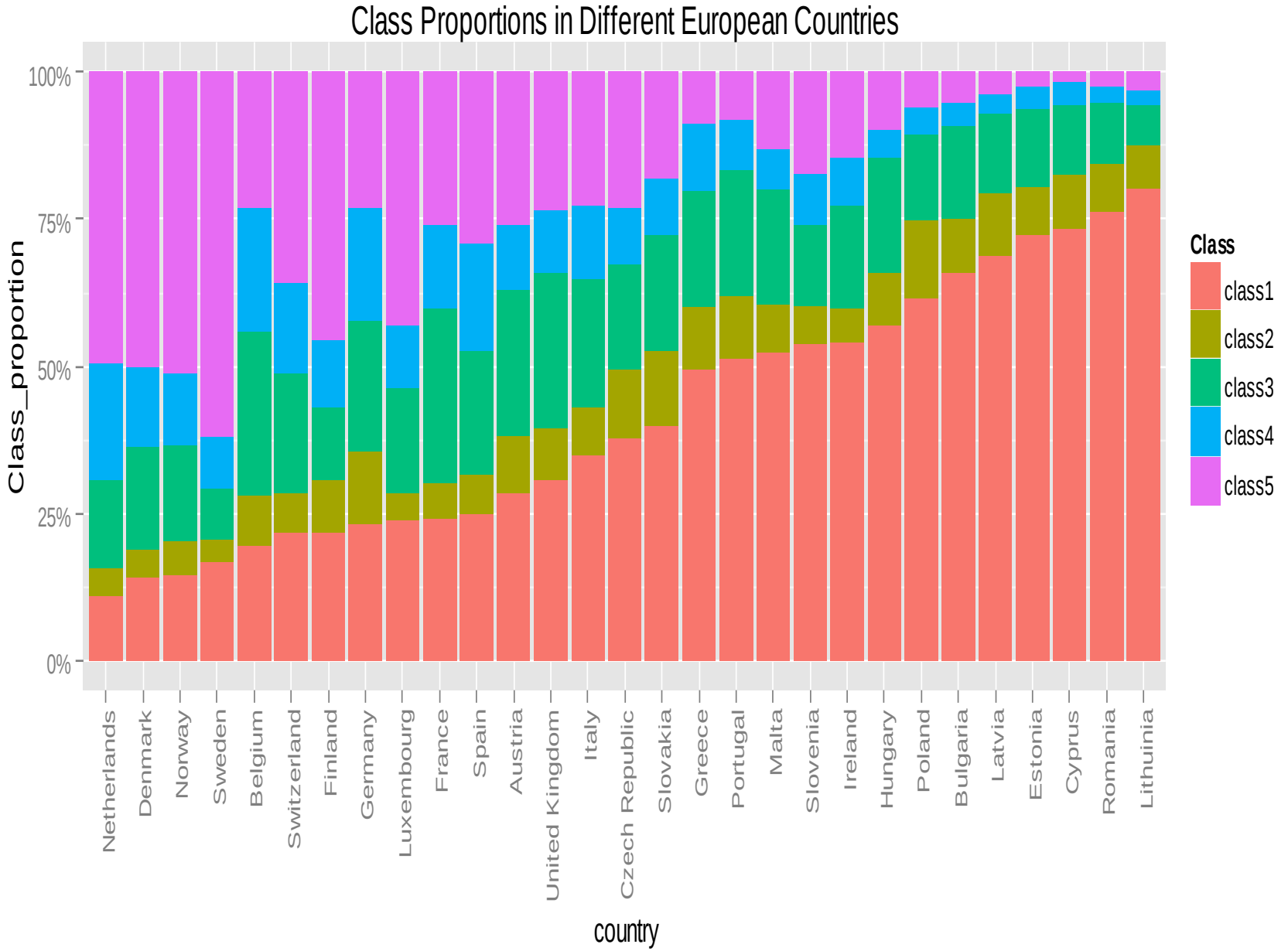
	Happy1	Happy2	Happy3	pmat1	pmat2	trust	petition 1	petition 2	homosex	Order
Class1	-3.83	-1.682	1.375	-0.825	2.393	0.865	-0.778	0.763	3.426	2
Class2	***-4.492***	-2.43	0.605	-1.705	1.292	-0.207	-2.321	-0.722	9.819	6
Class3	-4.57	-1.969	***1.038***	-1.082	1.847	0.519	-1.216	0.228	6.023	4
Class4	***-3.495***	-1.278	1.357	-0.598	2.631	1.174	-0.232	1.067	1.118	1
Class5	***-4.556***	-2.092	0.86	-1.303	1.652	0.387	-1.655	-0.147	7.567	5
Class6	-4.215	-1.915	***0.982***	-1.022	2.044	0.754	-1.178	0.277	4.978	3

Thresholds and Means Estimates for the Seven-Class Unconstrained Model

	Happy1	Happy2	Happy3	pmat1	pmat2	Trust	petition1	petition2	Homosex	Order
Class1	***-4.164***	-1.46	***1.490***	-0.711	***2.696***	1.028	-0.53	0.803	2.003	2
Class2	***-3.844***	-2.698	1.335	-0.841	2.349	0.854	-0.808	0.722	3.466	3
Class3	***-4.555***	-2.083	0.865	-1.294	1.661	0.394	-1.637	-0.133	7.553	5
Class4	***4.476***	***-2.424***	0.573	-1.759	1.249	-0.26	-2.401	-0.789	9.996	7
Class5	***-4.566***	***-2.454***	0.752	-1.482	1.501	0.044	-2.003	-0.428	8.997	6
Class6	-3.433	-1.256	***1.341***	-0.583	***2.623***	1.193	-0.194	1.104	1.004	1
Class7	-4.301	-1.931	1	-1.038	1.993	0.69	-1.188	0.265	5.267	4

Thresholds and Means Estimates for the Five-Class Model with Inequality Constraints

	Happy1	Happy2	Happy3	Pmat1	Pmat2	Trust	Petition 1	Petition 2	Homosex	Order
Class1	-3.84	-1.692	1.348	-0.836	2.365	0.859	-0.798	0.735	3.452	2
Class2	-3.495	-1.278	1.357	-0.598	2.631	1.174	-0.231	1.068	1.118	1
Class3	***-4.513***	-2.433	0.604	-1.706	1.291	-0.208	-2.322	-0.723	9.819	5
Class4	-4.3	-1.931	0.998	-1.038	1.991	0.69	-1.189	0.263	5.256	3
Class5	***-4.512***	-2.084	0.865	-1.294	1.661	0.394	-1.637	-0.134	7.557	4

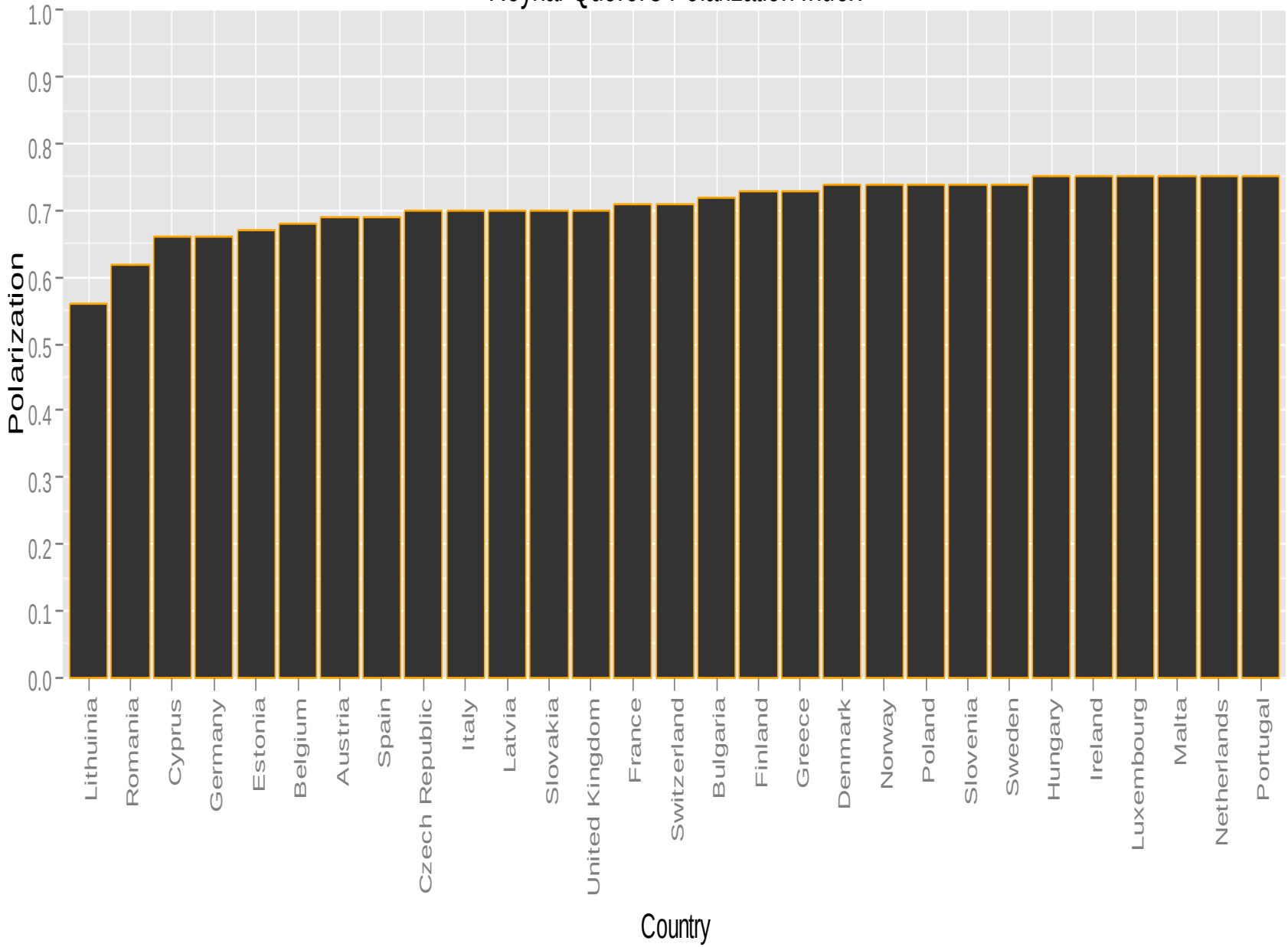

Class Proportions in Different European Countries
Class_proportion
100%
75%
50%
25%
0%
Netherlands
Denmark
Norway
Sweden
Belgium
Switzerland
Finland
Germany
Luxembourg
France
Spain
Austria
United Kingdom
Italy
Czech Republic
Slovakia
Greece
Portugal
Malta
Slovenia
Ireland
Hungary
Poland
Bulgaria
Latvia
Estonia
Cyprus
Romania
Lithuinia
country
Class
class1
class2
class3
class4
class5

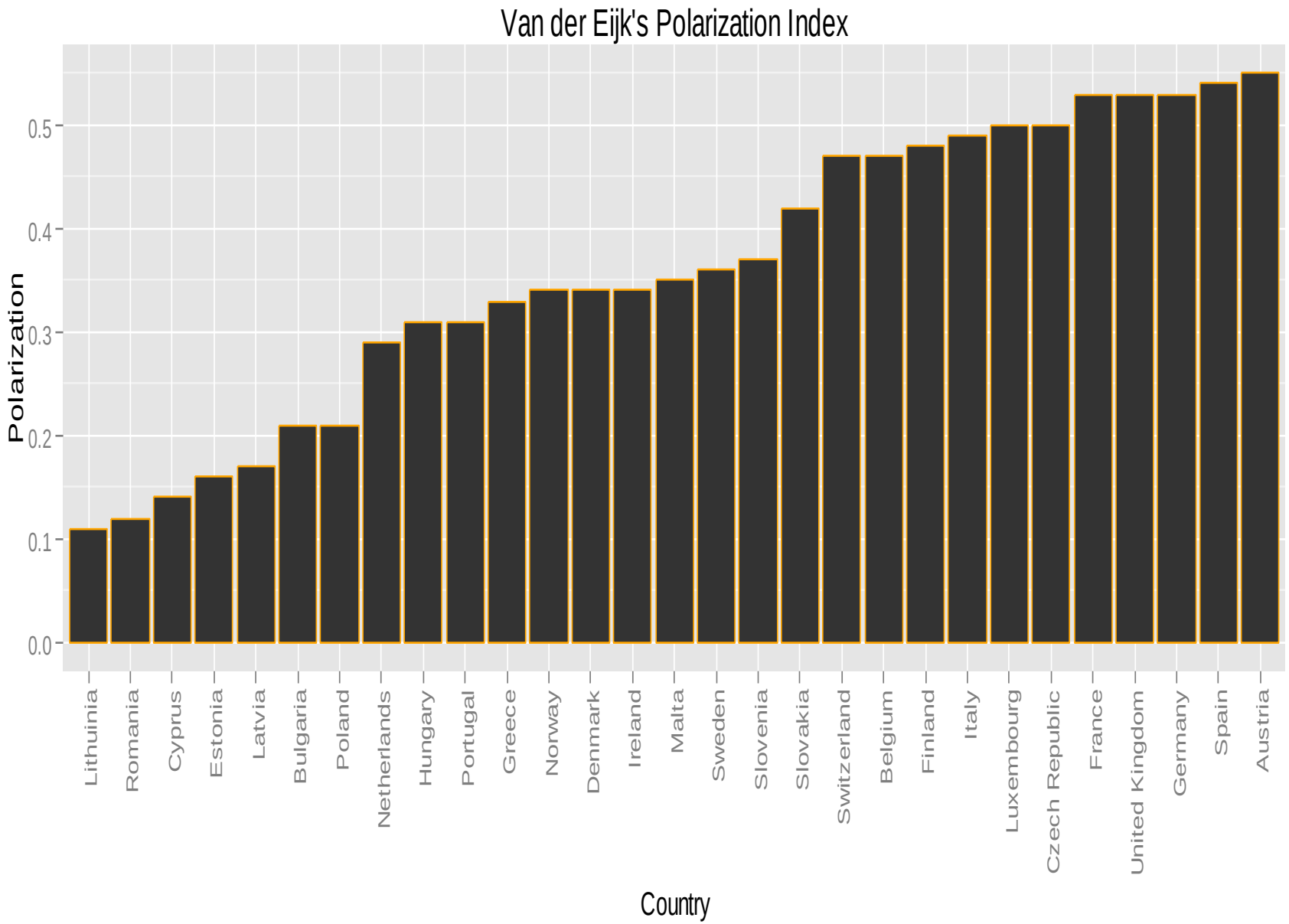
Results of Latent Class Analysis

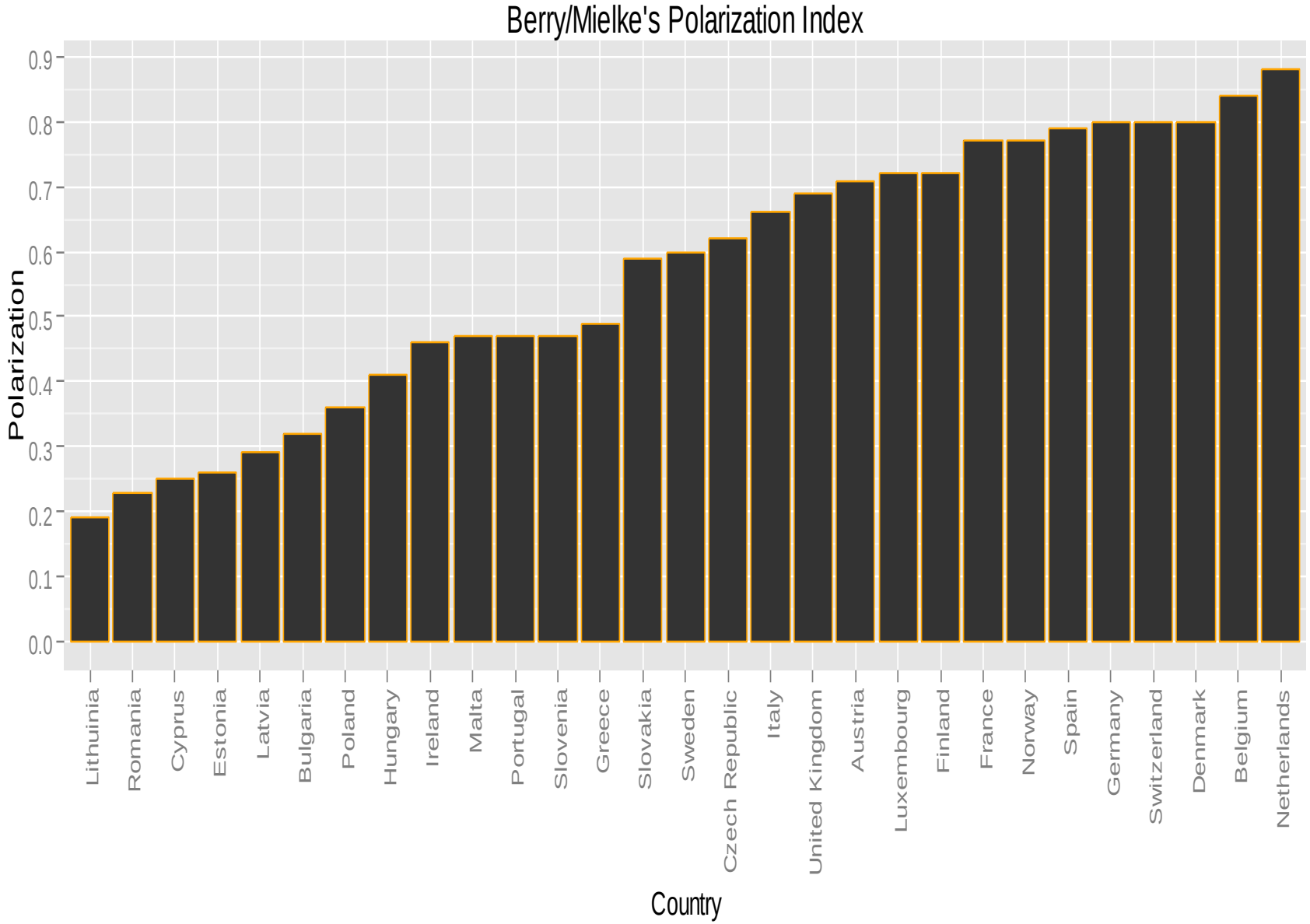
- Strict unidimensionality (ordering) holds only for models with no more than five classes.
- Class proportions vary in a large amount between countries (Non-invariance?)
- There is a clear pattern: Eastern European countries shows larger proportions of lower classes (i.e. less “modernized”)

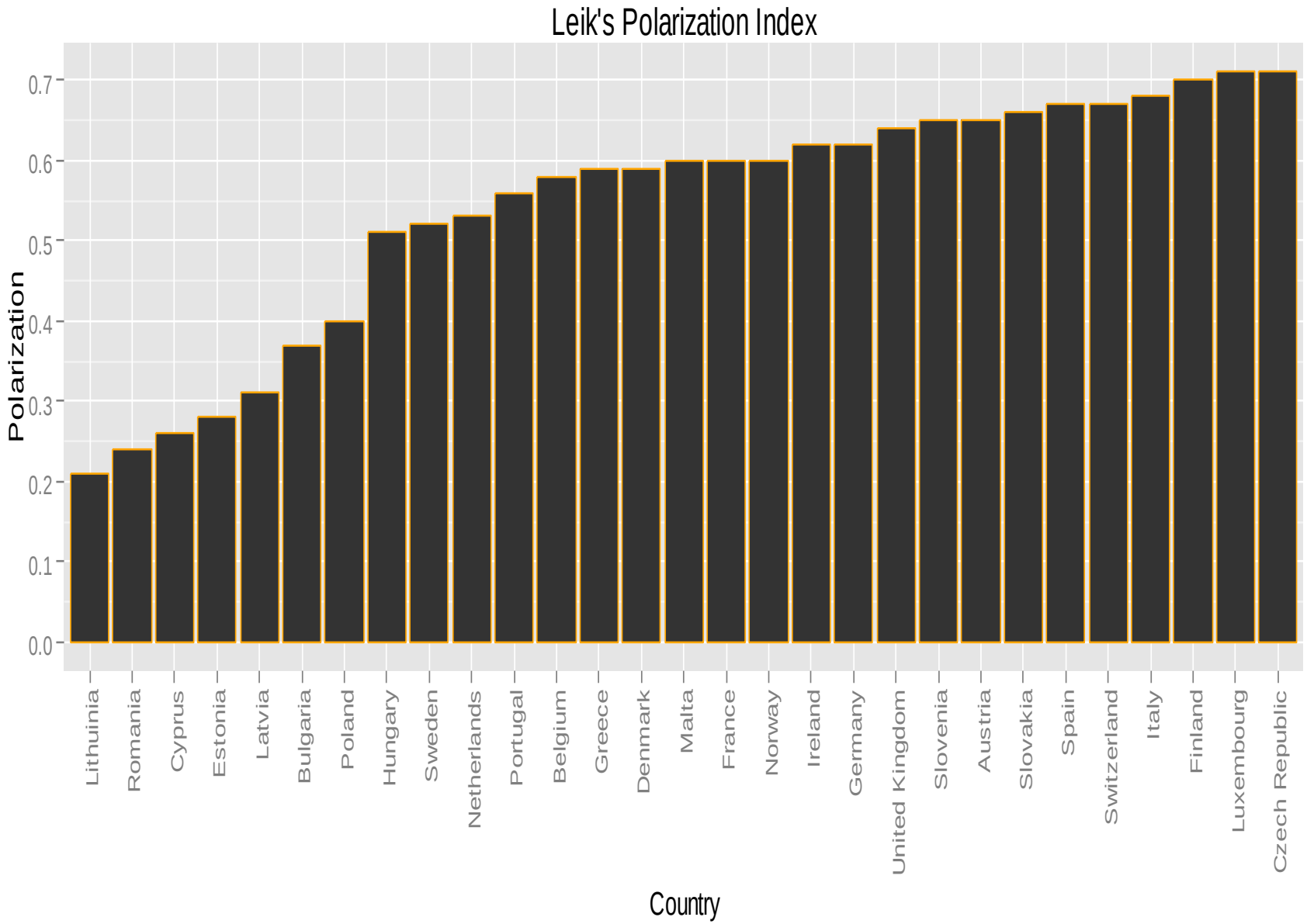
Polarization Indices

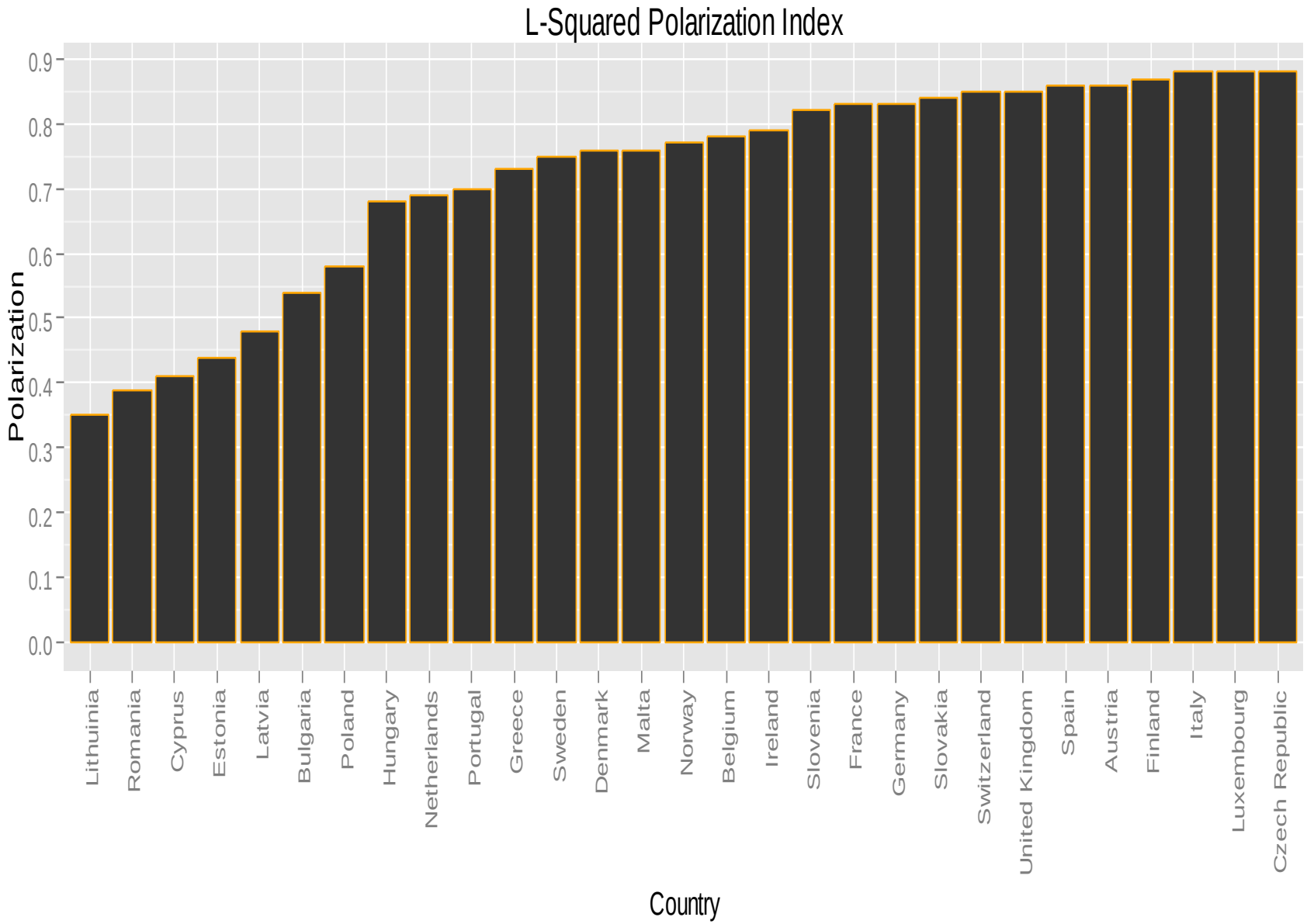
- Reynal-Querol Index (nominal)
- Standardized Van der Eijk's Agreement A measure
- Berry/Mielke Index of Ordinal Variation
- Leik's Ordinal Variation Index
- L-Squared


Reynal-Querol's Polarization Index
Polarization
1.0
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.0
Lithuinia
Romania
Cyprus
Germany
Estonia
Belgium
Austria
Spain
Czech Republic
Italy
Latvia
Slovakia
United Kingdom
France
Switzerland
Bulgaria
Finland
Greece
Denmark
Norway
Poland
Slovenia
Sweden
Hungary
Ireland
Luxembourg
Malta
Netherlands
Portugal
Country


Van der Eijk's Polarization Index
Polarization
0.0
0.1
0.2
0.3
0.4
0.5
Lithuinia
Romania
Cyprus
Estonia
Latvia
Bulgaria
Poland
Netherlands
Hungary
Portugal
Greece
Norway
Denmark
Ireland
Malta
Sweden
Slovenia
Slovakia
Switzerland
Belgium
Finland
Italy
Luxembourg
Czech Republic
France
United Kingdom
Germany
Spain
Austria
Country


Berry/Mielke's Polarization Index
Polarization
0.0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
Lithuinia
Romania
Cyprus
Estonia
Latvia
Bulgaria
Poland
Hungary
Ireland
Malta
Portugal
Slovenia
Greece
Slovakia
Sweden
Czech Republic
Italy
United Kingdom
Austria
Luxembourg
Finland
France
Norway
Spain
Germany
Switzerland
Denmark
Belgium
Netherlands
Country


Leik's Polarization Index
Polarization
0.0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
Lithuinia
Romania
Cyprus
Estonia
Latvia
Bulgaria
Poland
Hungary
Sweden
Netherlands
Portugal
Belgium
Greece
Denmark
Malta
France
Norway
Ireland
Germany
United Kingdom
Slovenia
Austria
Slovakia
Spain
Switzerland
Italy
Finland
Luxembourg
Czech Republic
Country


L-Squared Polarization Index
Polarization
0.0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
Lithuinia
Romania
Cyprus
Estonia
Latvia
Bulgaria
Poland
Hungary
Netherlands
Portugal
Greece
Sweden
Denmark
Malta
Norway
Belgium
Ireland
Slovenia
France
Germany
Slovakia
Switzerland
United Kingdom
Spain
Austria
Finland
Italy
Luxembourg
Czech Republic
Country

Pairwise Correlations between Polarization Measures

	RQ Index	Berry-Mielke	Lsquared	Polarization	Leik
RQ Index	1	0.35	0.52	0.28	0.55
Berry_Mielke	0.35	1	0.82	0.83	0.79
Lsquared	0.52	0.82	1	0.94	0.99
Polarization	0.28	0.83	0.94	1	0.91
Leik	0.55	0.79	0.99	0.91	1

Polarization Patterns

- Nominal Index (RQ) suggests relatively small differences in value polarization across European Countries
- According to ordinal Indices, the less polarized countries are at the same time the less modernized while many modernized countries are highly polarized
- Modernization and spread of self-expression values lead to the growth of value polarization?

Thank you very much
for your attention!