COVID-19 Policy-Compliance in Europe

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Introduction

The COVID-19-Pandemic is an ongoing challenge for policymakers. Especially, because overcoming it is so dependent on the policy-compliance of each and every individual. However, how is the state of this policy-compliance in Europe? Does it differ across different countries and how does it evolve over time?

To find an answer to these questions, the following analysis will assess the following hypotheses.

$H1_0$: There **is no** difference in compliance with mobility-reducing policies across European countries.

$H1_a$: There **is** a difference in compliance with mobility-reducing policies across European countries.

$H2_0$: There **is no** linear trend in such compliance over time.

$H2_a$: There **is** a linear trend in such compliance over time.

This analysis combines data from the Google COVID-19 Community Mobility Reports ("COVID-19 Community Mobility Report" 2020) and data from the Oxford Policy Tracker (Hale et al. 2020). The Google Mobility Report charts "movement trends over time by geography, across different categories."("COVID-19 Community Mobility Report" 2020) For the sake of this analysis the movement trends of the categories retail and recreation, supermarkets and pharmacies, public transport and workplaces were included and averaged without weighting. The Stringency Index was obtained from the Oxford Policy Tracker and records information on "the strictness of 'lockdown style' policies that primarily restrict people's behaviour."(Hale et al. 2020)

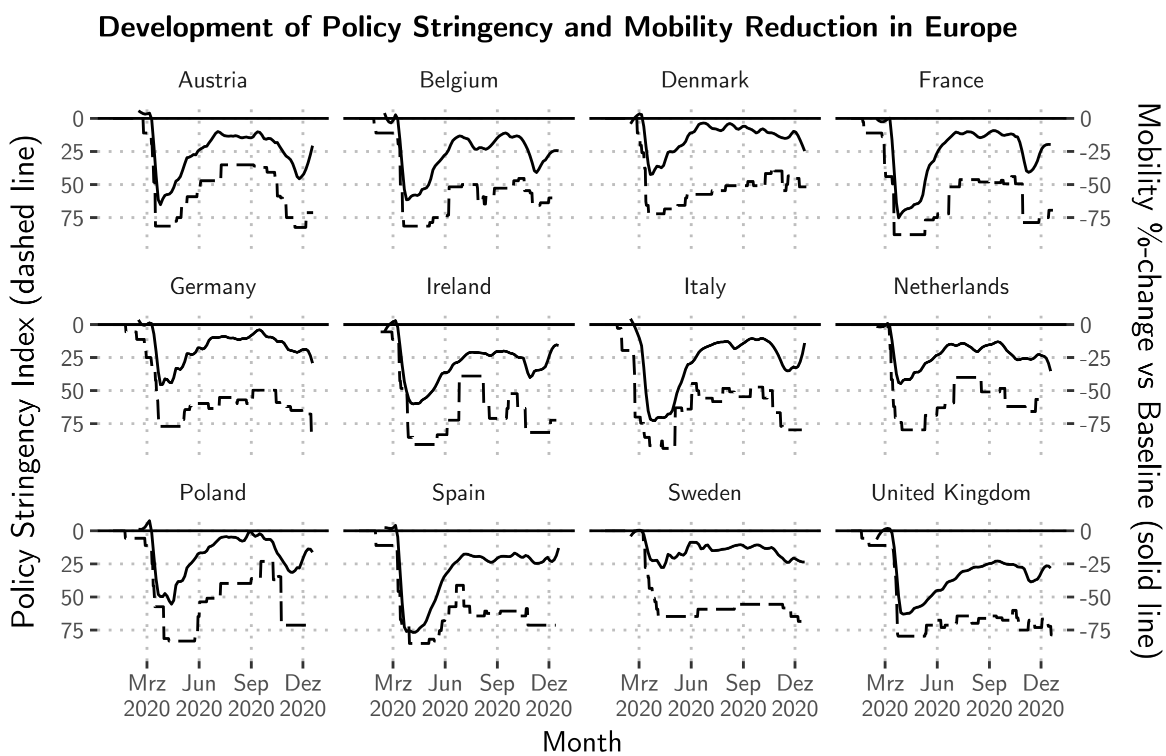
For this analysis, policy-compliance is approximated as the difference between the level of policy-stringency and the observed reduction in mobility.

```
Compliance = 100 - (Policy Stringency Index - %-change in Mobility)
```

To assess our hypothesis more thoroughly, policy-compliance is additionally corrected for COVID-19-cases ("Data on 14-Day Notification Rate of New Covid-19 Cases and Deaths" 2020) and public attention on the topic, as approximated by Google search queries with the terms *"covid"* and *"corona"* ("Google Trends" n.d.).

Countries included in the analysis were chosen based on their membership to the EU (including the United Kingdom) and their GDP.

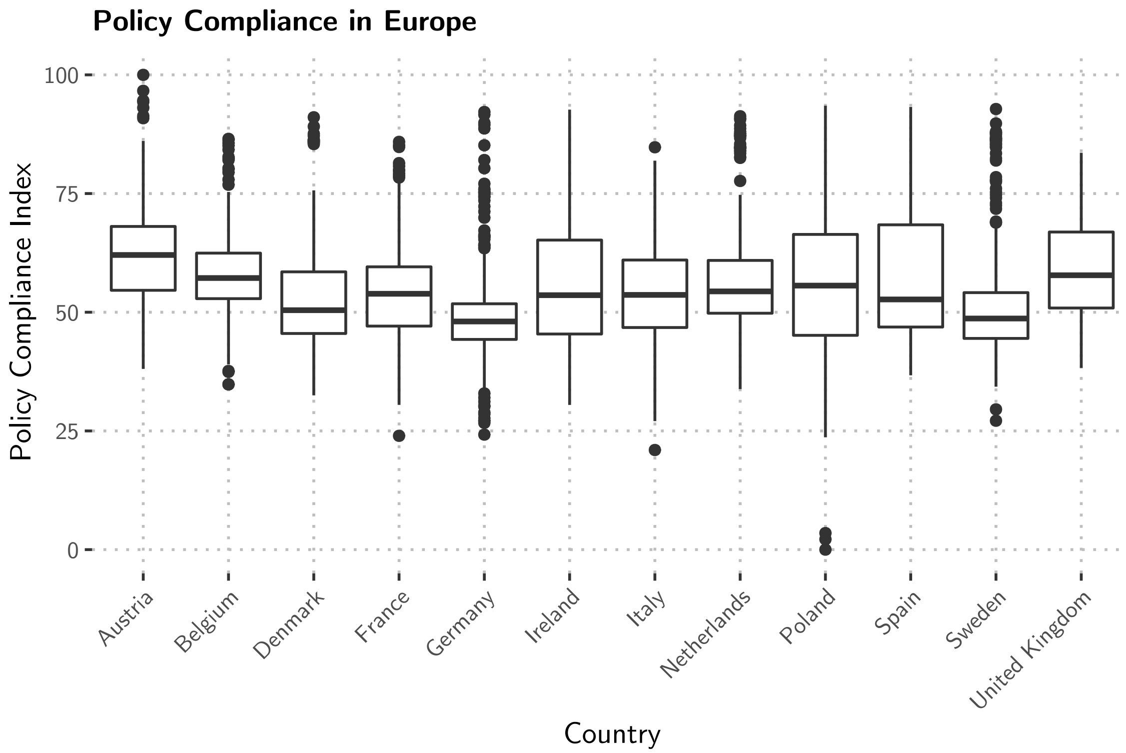
The following diagram shows how in March, April and May lockdown-style policies were introduced and how mobility was reduced in concordance in almost all the countries assessed. However, beginning immediately from there on, mobility started to increase again, with the gap between policy stringency and observed mobility-reduction widening - signaling reduced levels of policy-compliance.



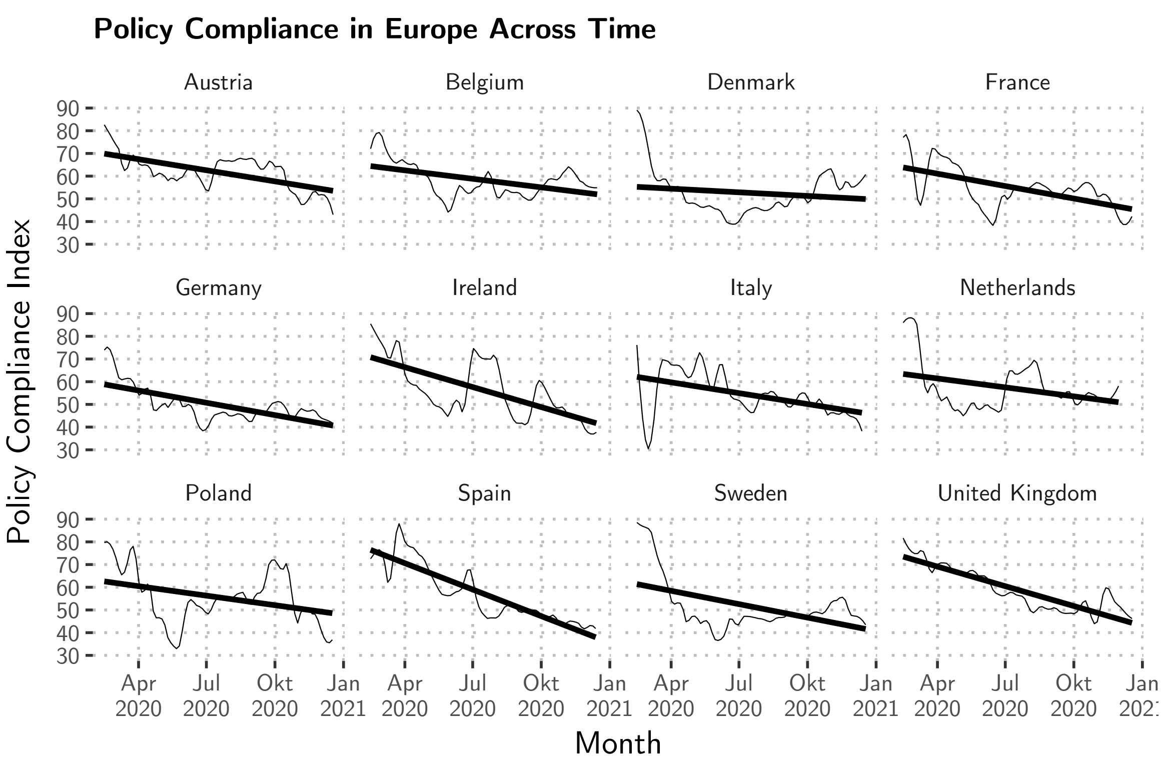
Variation in Policy-Compliance

In order to build our model, we can make a preliminary, bivariate analysis that shows the variance of policy compliance across different European countries.

The boxplot shows us that, indeed, the levels of policy compliance across European countries differ while the intra-group variance is roughly the same.



Additionally, as we want to assess the change of policy compliance across time in Europe, we can fit a linear regression line to the compliance data. This shows us that in all of the European countries analyzed, compliance with mobility-reducing-policies has reduced.



Modelling

Linear Non-Hierachical Model

The following non-hierarchical model predicts compliance as the dependent variable, with the Stringency Index, Date and Country as the independent variables.

$$Compliance = \beta_0 + \beta_1 * Date + \beta_2 * Country + \epsilon \quad (1)$$

It yields the following result.

Variable	Coefficient	Std. Error	P-Value
Date	-6.291e-02	1.936e-03	***
Belgium	-3.599e+00	8.334e-01	***
Denmark	-9.119e+00	8.314e-01	***
France	-7.065e+00	8.314e-01	***
Germany	-1.196e+01	8.314e-01	***
Ireland	-5.587e+00	8.341e-01	***
Italy	-7.642e+00	8.348e-01	***
Netherlands	-5.099e+00	8.444e-01	***
Poland	-6.166e+00	8.327e-01	***
Spain	-4.647e+00	8.348e-01	***
Sweden	-1.021e+01	8.314e-01	***
United Kingdom	-2.807e+00	8.314e-01	***

$R^2 = 0.28$; Adj. $R^2 = 0.28$; Num. obs. = 520; $*** \ p < 0.001$; $** \ p < 0.01$; $* \ p < 0.0$

The coefficients for Data and the individual Countries, when compared to Austria, are statistically significant. The coefficient for date is negative, with only little standard error. Also the coefficients for the countries are negative, signalling that Austria showed the highest level of compliance, with Germany and Sweden at the bottom of the list. We can control this relationship for the influence of public attention to the pandemic and for COVID-19 cases per 100.000 and 14 days.

$$Compliance = \beta_0 + \beta_1 * Date + \beta_2 * Country + \beta_3 * PublicAttention + \beta_4 * Cases/(100.000 * 14days) + \epsilon \quad (2)$$

It yields the following result. Except for Date, none of the continuous variables Public Attention and Cases per 100,000 and 14 Days are statistically significant. Date is statistically significant at the 0.05 level. Its coefficient shows that when holding Publicity, Cases and Country constant, Compliance decreases on average by 0.07 points each day. Interestingly, some of the coefficients for individual countries are not significant anymore when controlling for public attention and COVID-19 cases.

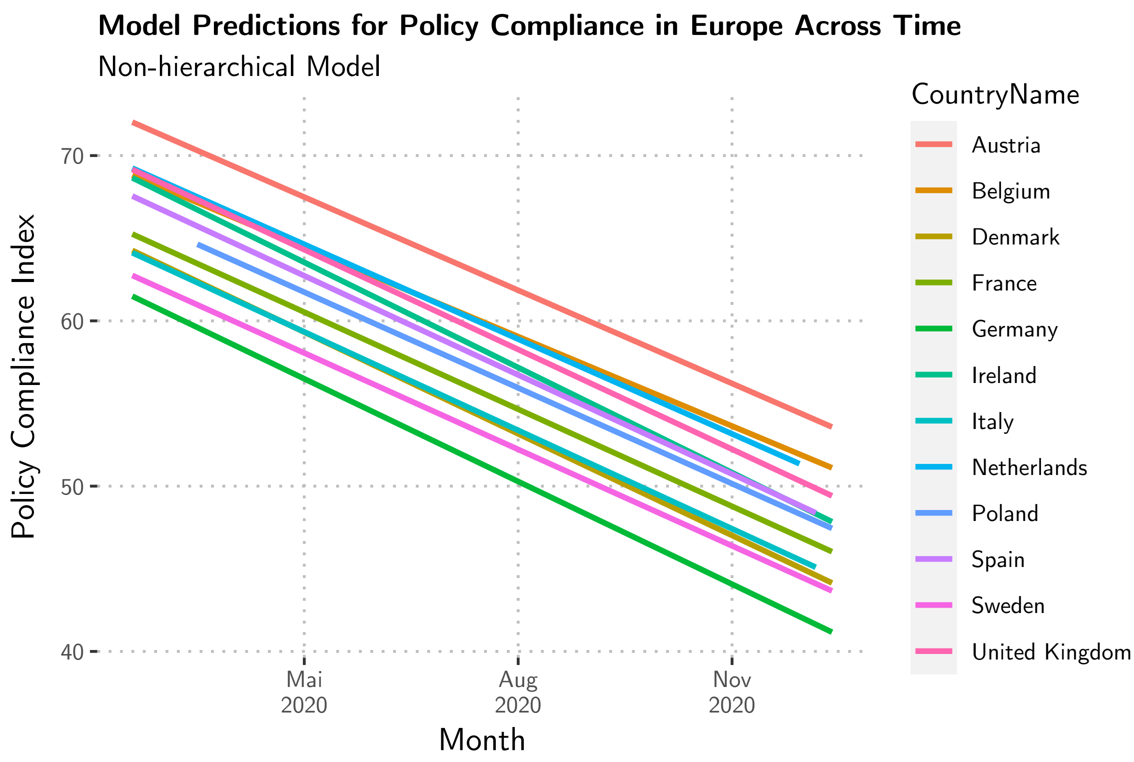
Variable	Coefficient	Std. Error	P-Value
Date	-7.142e-02	6.264e-03	***
Belgium	-3.211e+00	2.122e+00	
Denmark	-8.285e+00	2.124e+00	***
France	-7.145e+00	2.112e+00	***
Germany	-1.106e+01	2.124e+00	***
Ireland	-4.066e+00	2.133e+00	.
Italy	-8.116e+00	2.165e+00	***
Netherlands	-2.967e+00	2.142e+00	

Variable	Coefficient	Std. Error	P-Value
Poland	-5.667e+00	2.169e+00	**
Spain	-4.790e+00	2.239e+00	*
Sweden	-9.533e+00	2.113e+00	***
United Kingdom	-3.250e+00	2.126e+00	
Public Attention	-1.085e-02	2.393e-02	
Cases per 100,000 and 14 Days	4.710e-03	2.557e-03	.

$R^2 = 0.31$; Adj. $R^2 = 0.29$; Num. obs. = 520; $*** p < 0.001$; $** p < 0.01$; $* p < 0.05$

Linear Multi-Level Model

The following plot visualizes the different intercepts, predicted by the non-hierarchical model. Along with the regression output of our non-hierarchical model, the fixed effects estimated for the different expressions of our country variable show substantial differences, with Germany showing more than 10 points less policy-compliance than our reference country Austria. In addition, we can see that despite the relationships between Date and Compliance being negative for all countries, there are different slopes.



Thus, in the following, a random intercept will be included for country, as well as a random slope for Date, in order to estimate the rate of change in policy compliance in different countries. This yields the following formula in lme4-syntax with the following results.

```
ComplianceIndex ~ Date + Public Attention + Cases per 100,000 and 14 Days + (Date |
Country)
```

Random effects	-	-	-
Groups	Name	Variance	Std. Dev.
Country	Intercept	96.44	9.82
	Date	0.00	0.00
Residual		96.43	9.82

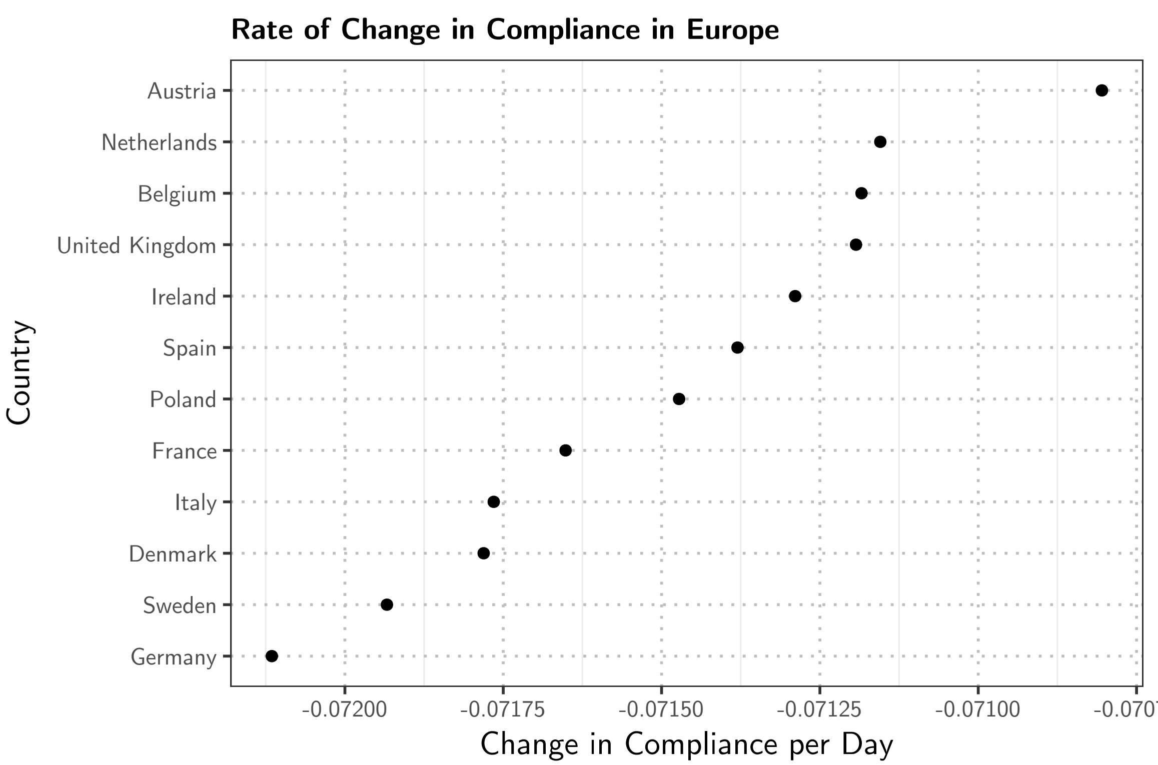
Number of observations: 520, Number of groups: 12

Fixed effects	-	-	-	-
	Estimate	Std. Error	t-value	p-value
Date	-0.07	0.01	-11.51	***
Public Attention	-0.01	0.02	-0.44	
Cases per 100,000 and 14 Days	0.00	0.00	1.87	

*** $p < 0.001$; ** $p < 0.01$; * $p < 0.05$

As we can see, the coefficients of the fixed effects at level one have not changed substantially. Still, the fixed effect of Date is the only one that is statistically significant.

The following plot shows the rate at which compliance changes per day in different European countries, according to our hierarchical model, that controls for public attention and COVID-19-cases.



Model comparison

Finally, to compare our hierarchical model-fit with the model-fit of our non-hierarchical model, we can compute a likelihood ratio test. This yields the following result.

```
Model 1: ComplianceIndex ~ Date + Country + Public Attention + Cases per 100,000 and 14 Days
```

```
Model 2: ComplianceIndex ~ Date + Public Attention + Cases per 100,000 and 14 Days + (Date | Country)
```

Model	Df	LogLik	Chisq	P-Value
1	16	-1922.8		
2	8	-1954.3	63.15	1.119e-10 ***

*** $p < 0.001$; ** $p < 0.01$; * $p < 0.05$

As we can see, the improvement of our hierarchical model over our non-hierarchical model is statistically significant at the 0.05 level.

Conclusion

This analysis has shown that, interestingly, levels of compliance with mobility-reducing COVID-19-policies differ across selected European countries and that policy-compliance expresses an alarming, negative trend, so that we can reject our Null-hypotheses. Additionally, we were able to show how the *rate* at which policy-compliance decreases differs across European countries.

References

"COVID-19 Community Mobility Report." 2020. Google LLC. https://www.google.com/covid19/mobility?hl=en-GB.

"Data on 14-Day Notification Rate of New Covid-19 Cases and Deaths." 2020. European Centre for Disease Prevention and Control. December 24, 2020. https://www.ecdc.europa.eu/en/publications-data/data-national-14-day-notification-rate-covid-19.

"Google Trends." n.d. Google LLC. Accessed December 26, 2020. https://trends.google.com/trends/?geo=UK.

Hale, Thomas, Noam Angrist, Emily Cameron-Blake, Laura Hallas, Beatriz Kira, Saptarshi Majumdar, Anna Petherick, Toby Phillips, Helen Tatlow, and Samuel Webster. 2020. "Oxford COVID-19 Government Response Tracker." Blavatnik School of Government. https://www.bsg.ox.ac.uk/research/research-projects/coronavirus-government-response-tracker.