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AUTHOR'S NOTE

All authors contributed to the authoring of this publication. A.K. (lead and principal investigator of the project) conceived the study, designed the database (including developing the codebook and coding guidelines, and curating the data), managed the project and the research team, supervised collection of the data, and created the online visualizations and tables. N.Z. conducted the validation and all statistical analyses of the data, including the exploratory factor analysis and the RI, and contributed substantially to the data collection (including assisting with the management of some members of the research team). I.P. provided crucial institutional support and encouragement for the entire project – without which GovRM-COVID-19 would not have been possible – and conducted all the theoretical analyses for the different weighting of the indicators of the RI.

We would like to gratefully acknowledge and deeply thank all the volunteer members of the GovRM-COVID19 research team who collected and coded the data. Their names and roles are presented in detail at https://en.kedid.org/research/programs/govrm-covid19/

Introduction

1 On 11 March 2020 the World Health Organization (WHO) declared the COVID-19 disease, caused by the SARS-CoV-2 virus, a pandemic (Ghebreyesus, 2020). This was only the second time that the WHO had declared a pandemic in the 21st century (the first was in 2009-2010 for the influenza A pandemic caused by the H1N1 virus)[1]. So far, there have

been more than 620 million confirmed cases of COVID-19 and more than 6.5 million deaths across the globe (WHO, 2022). From the declaration of COVID-19 as a pandemic until today, most countries have adopted a wide variety of restrictive measures, of unprecedented number and scale, categorized as Non-Pharmaceutical (public health) Interventions (NPIs; Perra, 2021; Seale et al., 2020, p. 1; Mendez-Brito et al., 2021, p. 281). These NPIs often resulted in restrictions on multiple individual rights and freedoms, including some of the most fundamental ones (e.g., freedom of movement and individual liberty), leading to discussions among various institutions and scholars regarding the compatibility of NPIs with relevant international and national legislation (EUFRA, 2021; Mingazov & Sinyavskiy, 2020; Sekalala et al., 2020; Lebret, 2020; Forman & Kohler, 2020; Orzechowski et al., 2021). The European Union's (EU) Agency for Fundamental Rights found that "the COVID-19 pandemic and the measures it prompted raised an unprecedented collective challenge to the fundamental and human rights..." (EUFRA, 2021, p. 3). Most of the relevant literature has highlighted the fact that, while derogations from the majority (not all, e.g., the right to life) of human rights by governments are possible during an emergency situation, such as the COVID-19 pandemic, they are subject to strict conditions as well as to judicial scrutiny and review.

2 The Observatory of Government Restrictive Measures for the COVID-19 pandemic (GovRM-COVID19) was established in November 2020 as a research project within the Center for Research on Democracy and Law of the University of Macedonia (Greece), with the aim of specifically examining the restrictions – in the form of NPIs – imposed on individual freedoms and human rights by governments across the world to contain the spread of the pandemic (Kyriakidis & Papadopoulos, 2020). The Observatory collects, and makes publicly available, detailed legal data (cross-national and longitudinal) from 2020 onwards, for government NPIs along 13 thematic indicators, establishing a database of when and how governments imposed various pandemic-related restrictions. In addition, an overall Restrictiveness Index (RI) is calculated, providing an understanding of a country's NPI situation on any given day.

3 The aim of the Observatory is to provide researchers with accurate, exact data on how various governments around the world have restricted individual rights and freedoms because of, and during, the COVID-19 pandemic, offering an opportunity for comparative research between different countries and different policy strategies. In addition, the Observatory, including all the data gathered, is online and publicly available for anyone to use. While similar databases exist elsewhere (e.g., Cheng et al., 2020; Desvars-Larrive et al., 2020; Hale et al., 2021), the primary purpose behind the creation of the Observatory has been the codification of legislated NPIs with precision and accuracy. Hence, the Observatory introduces an almost exclusive focus on official public legislation as the source for identifying the type and intensity of implemented NPIs, as opposed to less credible sources from the mass media or the internet used by other initiatives.

4 We first discuss the concept of NPIs and situate it during pandemics. We then give an overview of the dataset and discuss the various indicators. After presenting the ways in which we address data accuracy and reliability, we provide a factor analysis of our data to ascertain the existence of any clusters of NPIs and explain how we derived the value for the overall RI. We then compare our dataset with others to highlight benefits and drawbacks and draw recommendations for scholarly research using the database.

Non-Pharmaceutical Interventions during pandemics

5 NPIs are non-medicinal, non-healthcare, social-based measures that are implemented to inhibit the spread of a pathogen virus until vaccines and other immunization or pharmaceutical countermeasures (therapeutics, etc.) become available (Morse et al., 2006, p. 929; WHO Writing Group, 2006a, p. 81; Lin et al., 2010). As Perra (2021) argues, "NPIs refer to a wide range of both top-down (i.e., governmental) and bottom-up (i.e., self-initiated) measures aimed at interrupting infection chains by altering key aspects of our behavior" (pp. 2-3). The foundation for implementing NPIs is the documented impact that human behavior has on the transmission, and thus progression, of communicable diseases (Perra, 2021, p. 2). However, up until the COVID-19 pandemic, scholarship related to NPIs was considerably limited[2], lacking in controlled studies and largely based on previous (sometimes even anecdotal) evidence or observations, such as scholarship related to the 1918-1919 "Spanish Flu" or the SARS pandemic (Perra, 2021; Peak et al., 2017; Markel et al., 2007; Aledort et al., 2007; Morse et al., 2006; WHO Writing Group, 2006a; 2006b).

6 NPIs focus on four areas (WHO Writing Group, 2006a, p. 81; also, for the COVID-19 pandemic, Seale et al., 2020 and Mendez-Brito et al., 2021): limiting the international spread of the virus through travel restrictions; reducing the spread of the virus within countries through quarantining, social distancing, cancelling mass gatherings, etc.; encouraging individual hygiene measures, such as hand washing; and adopting appropriate public communication and outreach strategies. It is worth noting that application of some types of NPIs prior to the COVID-19 pandemic, particularly in relation to individuals (isolation/quarantine, restrictions on movement, etc.), had already raised problems of a legal and societal nature (stigma, limitation of rights, etc.), which, in turn, often adversely impacted the effective implementation of these measures (WHO Writing Group, 2006b, p. 89). As Aledort et al. (2007) suggest, "efforts to forcibly limit public assembly or movement were seen as legally and ethically problematic [...] There are also important practical and logistical limitations to mandatory long-term community restrictions and compulsory quarantine, in addition to the problem of likely public opposition to such measures" (6). More broadly, it has been argued that a balance has to be maintained between the aim of the NPIs to reduce the spread of a disease and the considerable anticipated disruption to social life (Lin et al., 2010, p.10). In addition, a multitude of factors, such as educational level, socioeconomic status, perceived level of threat to the community, etc., may impact the implementation, and thus the effectiveness, of NPIs (Seale et al., 2020).

Description of the GovRM-COVID19 Observatory

Overview and coding principles

7 GovRM-COVID19 includes legal data on restrictions imposed by national (and, in the case of non-unitary systems, such as federal or devolved systems, sub-national) governments on the following 13 indicators:

- Freedom of individual movement;
- Use of face masks/coverings;

- Public gatherings;
- Education;
- Food services;
- Food retailers;
- Sports facilities;
- Inner-country travel;
- International transportation;
- Work and other interior spaces not included in other categories;
- Public events;
- Retail stores;
- Religious places and ceremonies.

8 The dataset is set as a panel, using the date of enforcement of each measure provisioned in the relevant legislation as the unit of analysis. Hence, the presentation of data is by date.

9 As the aim of the Observatory is to document and code legislative interventions in the form of NPIs related to the COVID-19 pandemic, the choice of indicators was derived from the fundamental human rights of individuals, e.g., security of persons, freedom of movement, freedom of religion, freedom of peaceful assembly, and others, as articulated, inter alia, in the Universal Declaration of Human Rights (United Nations, 1948). The indicators are representative of most aspects of social life (broadly defined) and are, in most cases, considered necessary for, or imperative in, human survival and existence (e.g., food retailers to procure food, public gatherings to socialize and exchange ideas, religious places to express religious sentiment). Other databases use similar indicators (Hale et al., 2021; Cheng et al., 2020) but not with the same breadth of scope or accuracy of measurement. Although there are additional NPIs to those used, which are country-specific, we chose indicators that travel well across countries and time, yielding the optimal balance between general applicability and national specificity.

10 The restriction level (intensity) in all indicators is measured on an ordinal scale of 0-3: 0 represents the fact that no measures were in force, 1 indicates recommendations, 2 represents partial restrictions, and 3 signifies complete restrictions. A single scale was chosen to help standardize the intensity of restrictions across indicators by using a common definition of scale. Any loss of nuance within a specific indicator is compensated by greater consistency of measurement. Table 1 presents the Codebook of the Observatory, including all the above information and, in addition, explanatory details and potential exceptions for each indicator (e.g., not considering Olympic/ Paralympic athletes for coding sports facilities' restrictions). It is worth noting that test/recovery/vaccination certificates, where and if applicable, are considered as partial restrictions (value of 2) across all indicators except international transportation. In addition, all services deemed essential (hospitals, gas stations, farms, food producers, food delivery services, etc.) are exempted from the data, unless explicitly included as an indicator (e.g., food retailers, such as supermarkets).

Table 1: GovRM-COVID19 Observatory Codebook

Indicator	Intensity	Description	Details

Freedom of individual movement (excluding inner-country travel and international transportation)	**1**	Recommendation to avoid exiting the house	-
	2	Partial restriction on freedom of movement	Restrictions including being only allowed out of the house for specific reasons, under time constraints (e.g., night curfew), only with people from the same household or relatives, only after notification to the authorities (e.g., text messages or written statements.), etc.
	3	Complete restriction	-
Use of face masks/ coverings	**1**	Recommendation for use	-
	2	Mandatory use in some indoor/outdoor spaces	-
	3	Mandatory use in all indoor and outdoor spaces	-
Public gatherings[3]	**1**	Recommendation for avoiding public gatherings	-
	2	Partial ban of gatherings	Restrictions including spatial or numeric limitations, obligation for prior notification to the authorities, etc.
	3	Ban of all public gatherings	-
Education[4]	**1**	Recommendation for closure	For institutions of some or all grades.
	2	Partial closure (of some or all grades, with some or no additional measures)	Restrictions including spatial or numeric limitations (e.g., only a certain number of students per classroom), social distancing, health protection measures (e.g., mandatory masks), etc.
	3	Total closure	Special educational institutions, such as those offering special-needs education, are not considered because of their special character.
Food services (restaurants, bars, etc., excluding food retailers)	**1**	Recommendation for closure	-

	2	Partial closure	Restrictions including spatial or numeric limitations (e.g., certain number of tables or certain number of customers per square meter), health protection measures (e.g., mandatory masks), etc.
	3	Total closure	Take-away or delivery services are not taken into consideration, given that those were essential services.
Food retailers (supermarkets, grocery stores, etc.)	**1**	Recommendation for closure	-
	2	Partial closure	Restrictions including spatial or numeric limitations (e.g., certain number of customers per square meter), health protection measures (e.g., mandatory masks), etc.
	3	Total closure	Take-away or delivery services are not taken into consideration, given that those were essential services.
Sports facilities (indoor, outdoor)	**1**	Recommendation for closure	-
	2	Partial closure	Restrictions including spatial or numeric limitations (e.g., certain number of athletes per square meter), health protection measures (e.g., mandatory masks), etc.
	3	Total closure	Olympic/Paralympic and professional or registered athletes are excluded, considering that, in most cases, they were allowed to practice.
Inner-country travel (between Municipalities, Regions, etc.)[5].	**1**	Recommendation to avoid travel	-
	2	Restriction of travel	Restrictions including local/regional/ state lockdowns, limitations (e.g., valid test/recovery/vaccination certificate) or prohibition of travel between municipalities/regions/states, etc.
	3	Complete restriction of travel (all areas of a country)	No travel allowed between any one area of a country and another.

International transportation (ships, planes, etc.)[6].	**1**	Mandatory test/ recovery/vaccination certificate presentation and/or check and/or quarantine	-
	2	Intensity level 1 plus ban of travel from some countries	Nationals and citizens of the respective country are not counted because travel was always allowed in their case.
	3	Intensity level 1 plus ban of travel from all countries	
Work and other interior spaces not included in other categories (civil service/ public employees, beauty salons, barber shops, etc.,)	**1**	Recommendation for working remotely	-
	2	Partial closure of workplaces	Restrictions including spatial or numeric limitations (e.g., certain number of employees per square meter), health protection measures (e.g., mandatory masks), etc.
	3	Total closure of workplaces	Work that is impossible to be conducted remotely, along with essential services, are excluded.
Public events (concerts, conferences, festivals, etc.)	**1**	Recommendation for not holding public events	-
	2	Partial ban of public events	Restrictions including banning of only some types of events (e.g., only concerts), spatial or numeric limitations (e.g., certain number of attendees per square meter), health protection measures (e.g., mandatory masks), etc.
	3	Ban of all public events	Events permitted only for the purpose of being televised (no audience, etc.), are not considered.
Retail sector (clothes shops, outlets, shopping malls, etc.)	**1**	Recommendation for closure	-
	2	Partial closure	Restrictions including closure of only some types of stores (e.g., shopping malls), spatial or numeric limitations (e.g., certain number of customers per square meter), health protection measures (e.g., mandatory masks), etc.

	3	Total closure	Online retail stores/purchases are not included.
Religious places and ceremonies (churches, marriages, funerals, etc.)	**1**	Recommendation for closure	-
	2	Partial closure	Restrictions including spatial or numeric limitations (e.g., certain number of individuals per square meter), health protection measures (e.g., mandatory masks), etc.
	3	Total closure	The operation of religious places or the holding of religious ceremonies only by religious leaders, priests, and other official church representatives, employees or personnel, is not included, considering that, in most cases, it was allowed. Accordingly, funerals are also not considered in the coding.

Source: The Authors

11 All indicators are geographic (the Observatory is structured around countries) and are examined for each case (country) at the national level, if the legislative instruments related to NPIs' restrictions were decided and adopted by the unitary (i.e., non-federal or non-devolved) government, such as the cases of Greece or Cyprus, or at the subnational level, if the NPI-related legislation was adopted by the state or devolved governments, such as the cases of the United States of America (USA) or the United Kingdom (UK). In the latter case, the data are averaged at the national level to give an approximation across administrative regions. The guiding principle behind whether to examine one or the other level of decision-making is the level of the legal authority responsible for adopting and monitoring the implementation of the relevant measures. Of course, not all non-unitary systems devolve equal amounts of decision-making authority to the sub-national level. However, these differences (many of which are quite nuanced) have little impact on the aim of the Observatory, which is not to assign responsibility or to hold accountable a specific actor for the COVID-19 legislation, but merely to code restrictions. Specific NPI decisions taken by local/municipal/regional authorities are not examined, as these authorities rarely had substantial decision-making authority.

12 Because the principal aim of the Observatory is to record the restrictions imposed, in cases of the simultaneous existence of measures that are of different intensity but which belong to the same indicator, the most restrictive or intense measure is coded. The same applies when measures of different intensities apply to different portions of each day[7]. Accordingly, in cases where a jurisdiction has legislation that distinguishes areas according to their epidemiological situation (e.g., green, yellow, or red zones), and provides for measures of different intensity for each area (e.g., either from no measure to measure, or from partial to complete restrictions), the most restrictive measure implemented is coded[8].

13 In terms of the distinction between different indicators, it is potentially the case that some may be considered subsumed under others in various jurisdictions, since each jurisdiction maintained its own system of conceptualizing and categorizing NPIs (given, inter alia, the different socio-political and legal traditions), especially in light of the absence of internationally accepted guidelines. For example, in the US state of North Carolina, a mass gathering was defined "as any event or convening that brings together more than one hundred (100) persons in a single room or single space at the same time," which could be considered to include religious ceremonies/places (North Carolina 2020, 2). However, in Greece "public gatherings" referred only to civil gatherings of individuals, while restrictions to, for example, religious ceremonies, public events, or conferences, were provisioned separately (Hellenic Republic, 2020, p. 48684, p. 48693, p. 48695, p. 48709). The Observatory's database maintained a single Codebook, as presented in Table 1 above, and every effort was made to stay as true as possible to each jurisdiction's specifics within the broad guidelines of the Codebook.

Data collection method and reliability

14 Data collection followed a rigorous procedure, checking for accuracy and reliability. Perhaps the most important contribution of GovRM-COVID19 is in the sources used. There is a near-exclusive[9] focus on primary or secondary legislation: the specific legal act issued by the national or subnational legislative or executive authority is coded for each indicator on each day. In addition, the intensity value coded is then processed to include a hyperlink that leads to the exact legal act used for the coding. As such, the source itself is completely and freely accessible for anyone to have instant access to it. This ensures accuracy of data, as well as transparency and validity in terms of data accessibility and duplication of research: anyone accessing the data knows exactly which measure, and at what intensity, is being implemented on any day in a national or sub-national jurisdiction, and can access the legal act itself. The searches for each legislation and coding, as well as data reviews, are all done manually by members of the research team without the aid of any external software. Considering the tremendous breadth of legislation, the substantially different legal systems (even between countries at the same decision-making-level category, e.g., unitary), relevant linguistic and accessibility differences, and the intricate level of detail required for coding the above within the limits of a single set of coding rules, the process is extremely time consuming and requires substantial personnel commitment – researchers must have a combination of traits, such as relevant University education, knowledge of languages, etc.

15 Because of the highly detailed and accurate method of collecting data, the selection of members of the research team is very meticulous. All members are recruited using a two-stage (shortlisting and interview) selection process pursuant to multiple international calls for applications and evaluation of member skills, CVs, etc. All researchers are, at the very least, undergraduate University students within the Social Sciences (primarily Law and Political Science). Country managers, who assist in the supervision of researchers in the coding process and conduct the review of coded data, have, at least, an undergraduate degree, often a postgraduate degree or commensurate professional experience, and are selected and/or promoted from researchers based on the above criteria.

16 All members of the research team undergo rigorous training by the Principal Investigator and are supervised throughout the coding process by constant review and feedback. Each researcher is assigned two countries, or subnational entities, at maximum, considering the level of research and detail required to search and code legislation of different types and languages, as well as the sheer volume of legislation to be searched. Indeed, legal acts may not always be text-searchable, and even if they are, terminology varies from jurisdiction to jurisdiction. Data are entered into draft Google Sheets by the researchers, and then reviewed and corrected, first by country managers, and then by the Principal Investigator, after which point the data are made public. There are approximately two or three meetings per week between country managers and researchers of the respective countries, and at least one additional weekly meeting between all members of the research team and the Principal Investigator (meetings last between one and five hours each). During these meetings, any issues that have arisen in terms of sources, consistency, legislative and jurisdictional differences, etc., in the coding are examined and resolved, followed – if necessary – by corrections.

17 Since November 2020, data have been coded and finalized for 12 national and subnational jurisdictions (France, Greece, Cyprus, Germany, UK, USA, Ireland, Italy, Malta, Norway, New Zealand, Ukraine) through at least 2021, with data for more jurisdictions entered daily. A total of 49 researchers and 6 country managers from three countries (Greece, USA, Italy) have been members of the research team to date.

18 Apart from data accuracy, instrument reliability was tested using Cronbach's Alpha, the scale reliability coefficient. This suggests that a large portion of the variance in the test may be attributed to general and group factors, a fact which itself implies that there is significant internal scale consistency in a set of items as a group. Scholars propose a coefficient of above 0.70 to be acceptable, at least in the social sciences (Cortina, 1993). In our case, the average inter-item covariance of the 13 items on the scale is .1483407. Cronbach's Alpha measures at .7853, which is considered acceptable, signifying that our NPI indicators are reliable.

Factor analysis and technical validity

19 Because we have no a priori notions of theory, we conduct Exploratory Factor Analysis (EFA) to transform the 13 indicators/items in our set into a small number of dimensions that may aid researchers in getting a simpler and clearer picture of the overall dataset. Do the data cluster around a few dimensions that describe NPI trends across countries? We use the entire dataset, completed as of March 15, 2022, including the nations of the UK and five US states. Although not reported, we also analyzed the data excluding the UK and the US states with similar results. All analyses were implemented with STATA 15.1.

20 To familiarize the reader with our data, we present the descriptive statistics of our NPIs (Table 2).

Table 2: Descriptive Statistics of NPIs

Indicator	Obs	Mean	Standard Deviation	Minimum	Maximum

Freedom of individual movement	4972	.8572003	.9726301	0	3
Use of face masks/coverings	4972	1.661102	1.081283	0	3
Public gatherings	4972	1.584071	.9826352	0	3
Education	4971	1.957353	.6236388	0	3
Food services	4972	2.300483	.7759562	0	3
Food retailers	4972	1.381738	.9418265	0	3
Sports facilities	4973	2.080434	.7206061	0	3
Inner-country travel	4973	.4820028	.8430349	0	3
International transportation	4972	1.589099	.7248123	0	3
Work and other interior spaces not included in other categories	4973	1.944098	.4958515	0	3
Public events	4973	2.150412	.7447175	0	3
Retail sector	4973	1.892218	.7674268	0	3
Religious places and ceremonies	4973	1.849588	.8232214	0	3

Source: The Authors

21 Higher means indicate more intense use of restrictions, while higher standard deviations relative to the means in the indicators of inner country travel and freedom of movement imply more uneven NPI use across countries and times. We also calculate the correlations among NPIs, all of which are within a very reasonable range (Table 3).

Table 3: NPI Correlations

Indicator	Freedom of individual movement	Use of facemasks/ coverings	Food services	Public gatherings	Food retailers	Sports facilities	Inner-country travel	International transportation	Work and other interior spaces not included in other categories	Public events	Retail sector	Religious places and ceremonies	Education
Freedom of individual movement	1.0000												
Use of face masks/coverings	-0.1121	1.0000											
Food services	0.5624	0.0443	1.0000										
Public gatherings	0.3752	0.2674	0.3840	1.0000									
Food retailers	0.2327	0.3415	0.2999	0.2173	1.0000								
Sports facilities	0.3346	-0.1408	0.5847	0.1460	0.0621	1.0000							
Inner-country travel	0.2895	0.0637	0.3894	0.2868	0.1587	0.2411	1.0000						
International transportation	-0.1184	0.2562	-0.0673	0.0325	0.0366	0.0356	-0.0419	1.0000					
Work and other interior spaces not included in other categories	0.1482	0.0920	0.3883	0.1946	0.1197	0.5408	0.2440	0.1777	1.0000				
Public events	0.3906	-0.0128	0.4904	0.2735	0.3640	0.3976	0.3309	-0.0426	0.3542	1.0000			
Retail sector	0.3172	0.3111	0.4162	0.3784	0.4681	0.3638	0.2284	0.1325	0.3951	0.3401	1.0000		
Religious places and ceremonies	0.3132	0.0198	0.4273	0.0744	0.2563	0.4578	0.2299	-0.0753	0.3518	0.5626	0.3406	1.0000	
Education	0.2485	-0.0841	0.3290	0.0841	0.2169	0.2048	0.1624	0.1211	0.2086	0.4465	0.1563	0.2886	1.0000

Source: The Authors

22 Given that different countries experienced the COVID-19 pandemic at different time intervals, it is possible that correlations for the entire dataset are low. However, for studies with a strong country-time component, correlations may be much higher. This is because many NPIs were introduced, or were in force, at the same time in the same country.

23 EFA is an especially appropriate analytical technique when researchers are unsure of the underlying relationships between variables in a given population. It attempts to discover hidden (latent) variables that reconstruct the complexity of observed data but which remove noise and redundant information at the same time (Matsunaga, 2010, p. 98). In other words, EFA is a data reduction technique that uncovers underlying concepts in the form of factors that influence covariation among multiple observations (Henson & Roberts, 2006). How many observations are necessary for face validity? Numbers vary widely, but our sample of 4,968 observations more than suffices.[10]

24 The procedure is implemented in two steps: extraction and rotation. Extraction is the main analytical stage that determines the number of factors underlying variation and correlations among our 13 indicators, and also identifies items that load on to particular factors. Rotation aims at ease of loading interpretation. To reduce the number of factors to a small set of latent variables, we chose principal component factor analysis as the extraction method. This assumes no unique variance and chooses each additional factor so as to explain more variance not explained by the previous factors. A corollary of its assumption is that the total variance is equal to 1.

25 Table 4 presents the eigenvalues, proportion, and cumulative explanation. Eigenvalues give us the scalars of linear transformations of our data, while proportion tells us how much of the total variance is explained. The cumulative column adds explained variance as the number of factors increases.

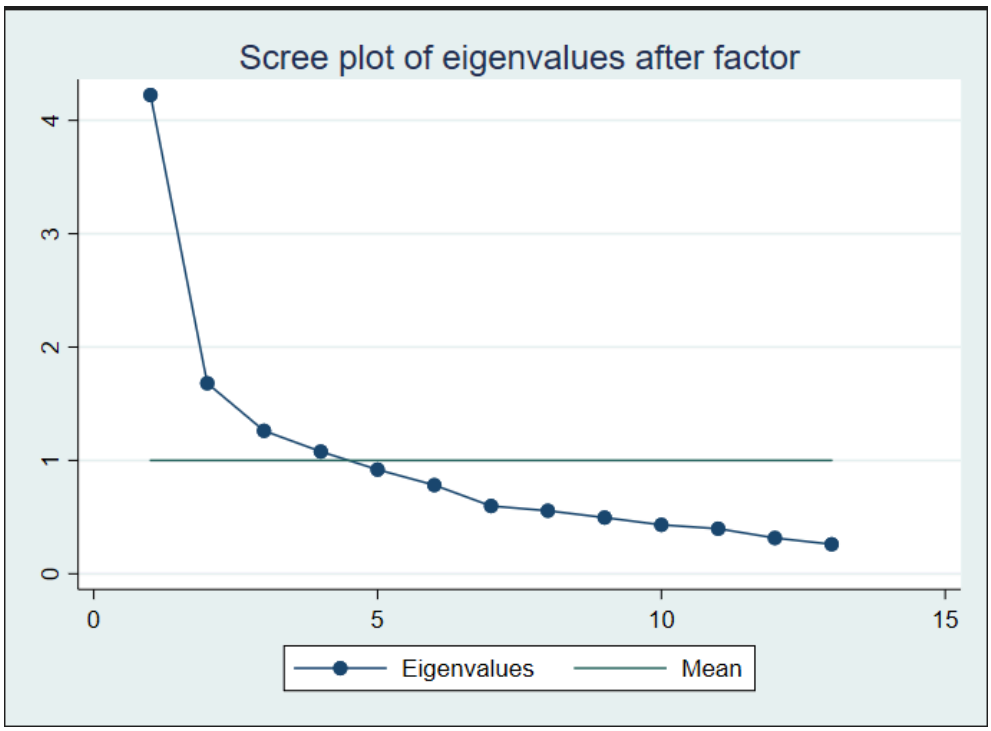
Table 4: The Extraction Step of Factor Analysis

Factor	Eigenvalue	Difference	Proportion	Cumulative
1	4.22449	2.54335	0.3250	0.3250
2	1.68113	0.41949	0.1293	0.4543
3	1.26164	0.18369	0.0970	0.5513
4	1.07796	0.15913	0.0829	0.6342

(obs=4968; principal component factors; 4 factors retained)

26 What is the cutoff point to indicate that we have identified sufficient latent factors? There is no general agreement in the literature (Zwick & Velicer, 1986), but two of the most often used criteria are the scree test (Cattell, 1966) and the Kaiser-Guttman criterion of factors with eigenvalues of more than 1 (Matsunaga 2010, p. 102). Graph 1 displays the scree plot. As it is always mapped as a downward slope, the cutoff is near the beginning of the elbow. There is a subjective art to this visual examination because there may be more than one curve in the data.

Graph 1: Scree Plot of Eigenvalues after Factor Extraction



Source: The Authors

27 Graph 1 shows several important latent factors. Combining the two criteria, we opted to retain four of these factors, essentially every factor with an eigenvalue of more than 1. While the first factor is always more important and, in our case, explains more than

32 percent of the variance, the total variance accounted for by the retained four exceeds 62 percent.

28 The next stage in factor analysis is rotation. Rotations minimize the complexity of the factor loadings to make the structure simpler to interpret. There are two types of rotation: orthogonal and oblique. The main difference is that orthogonal assumes no correlation while oblique does. Given the preliminary nature of this exercise, we opted to report both an orthogonal varimax rotation and an oblique promax rotation. The results are almost identical, giving us greater confidence that our loadings are accurate.

29 What is the cutoff point for rotated factor loadings to belong to one latent factor rather than the other? There is no agreement in the literature (Gorsuch, 1983), but there is widespread agreement that researchers should use theory and data to make this decision (Bornstein 1996). We decided on a conservative estimate of .5. Ideally, one should only retain items of importance that load clearly and strongly on to a factor, but this may not always be the case. An item may load strongly on more than one latent factor, or it may not have very high loadings on any. Unfortunately, our results are plagued by these problems in two instances. International transportation loads moderately on factors 2 and 3, but it does not surpass the .5 criterion. Nevertheless, we suspect that it fits well with the underlying concept which we call 'freedom of action', which unsurprisingly also includes domestic transportation. Cross loading also occurs with food retail. It scores high on factors 2 and 3, but is over the threshold. Keeping it makes more sense as a correlate of retail proximity because it shares significantly more similarities with general retail stores than does any other NPI we coded. In this way, rather than deleting the items that don't fit, we choose to report them, shedding light and conceptual clarity on our findings. Table 5 presents the factor loadings from both rotations. Values in bold represent retained values above the cutoff point.

Table 5: Factor Loadings (Rotated)

	Varimax Rotation					Promax rotation				
Indicator	**1**	**2**	**3**	**4**	**Uniqueness**	**1**	**2**	**3**	**4**	**Uniqueness**
Freedom of individual movement	0.15794	-0.06456	-0.69175	0.31230	0.39484	0.02275	-0.10505	-0.68739	0.17740	0.39484
Use of face masks/coverings	-0.05054	0.84400	0.01044	-0.06151	0.28121	-0.10283	0.85732	0.00975	-0.05481	0.28121
Public gatherings	0.14185	0.43551	-0.65550	-0.07909	0.35428	0.04741	0.39934	-0.70711	-0.24032	0.35428
Education	0.15316	-0.02879	0.06141	0.74151	0.42210	0.03405	-0.03363	0.19883	0.80220	0.42210
Food services	0.46975	0.05755	-0.58689	0.35684	0.30425	0.35195	-0.00616	-0.54499	0.20042	0.30425
Food retailers	-0.15035	0.56901	-0.20951	0.56947	0.28544	-0.33708	0.58610	-0.13371	0.60669	0.28544
Sports facilities	0.80175	-0.15058	-0.23650	0.20042	0.23842	0.79727	-0.23486	-0.17371	0.04883	0.23842
Inner-country travel	0.26292	0.08648	-0.52728	0.10070	0.63523	0.18530	0.04233	-0.53577	-0.03670	0.63523
International transportation	0.36155	0.48228	0.48783	-0.04944	0.39627	0.42429	0.47277	0.54933	-0.00850	0.39627
Work and other interior spaces not included in other categories	0.81570	0.16382	-0.02825	0.12571	0.29120	0.83075	0.08922	0.04450	0.00821	0.29120
Public events	0.28991	0.03808	-0.30105	0.70859	0.32177	0.13319	0.00607	-0.18911	0.67169	0.32177
Retail sector	0.37379	0.55155	-0.31248	0.25697	0.39240	0.26852	0.51211	-0.26387	0.16302	0.39240
Religious places and ceremonies	0.38721	-0.03740	-0.16066	0.62086	0.43738	0.27765	-0.07446	-0.04666	0.58897	0.43738

Highlighted area indicates significant correlation with latent variable

30 NPI/item loadings on to the four latent factors are as follows. The first and strongest factor we label 'group proximity'. This is composed of sports facilities and work restrictions. The second is 'retail restrictions' and is composed of use of masks, retail stores, and food retail stores. The third we label 'freedom of action'. This correlates with freedom of individual movement, public gatherings, food services, and inner-country travel. Finally, the fourth factor may be captured by the underlying concept of

'communal propinquity'. This consists of education, religious restraints, and public events.

Restrictiveness (composite) Index

31 GovRM-COVID19 data are used to construct a Restrictiveness Index (RI), aggregating the intensities of different indicators, but with the innovation of a theory-informed differentiation in weighing some indicators more than others. The RI gives an overall sense of NPI intensity at any given day within a country. More specifically, of the 13 indicators, we assign twice as much weight to the following four: freedom of individual movement, public gatherings, inner-country travel, and religious places and ceremonies. This is because these 4 concern fundamental individual freedoms that people enjoy as citizens of a country and which lie at the very core of Western liberal democracies – as opposed to, for example, international transportation.

32 Why weigh these NPIs more than others? We followed the established criterion of fundamentality of constitutionally protected rights. Such a criterion is offered in American constitutional law by the notion of substantive due process, used since the 1930s to identify a core of rights associated with personhood and human dignity, i.e., the core moral values of any liberal democratic constitutional order. Modern substantive due process faithfully captures the innermost commitment to privacy and personal autonomy, self-development, and authenticity (Hawley, 2014). The four indicators – freedom of individual movement, public gatherings, inner-country travel, and religious places and ceremonies – encapsulate the above, while the rest do not. These combined notions emphasize personal moral choice rather than economic values such as private property, freedom of enterprise, or right to contract. They derive from the concept of "ordered liberty" (US Supreme Court, 1937, p. 325; 1977, p. 503).

33 According to the modern substantive due process doctrine, our indicators of 'freedom of individual movement' and 'inner-country travel' clearly lie at the core of individual liberty, since they are the condition of possibility of the enumerated preferred freedoms in a liberal constitutional polity. Freedom from restraint on individual movement is fundamental to the point that "neither liberty nor justice would exist if [it] were sacrificed" (US Supreme Court, 1937, p. 326); if there were no freedom of movement (and one of its main upshots, i.e., freedom of intrastate travel), it is clear that other fundamental rights, such as freedoms of association, assembly, and religious exercise, would not even be given the practical possibility of being enjoyed at all. The same applies to the indicators 'religious places and ceremonies' – as the central locus of the preferred freedom of religious worship – and 'public gatherings,' with the latter being an outgrowth of the fundamental right of association with each other in public spaces for any reason.

34 On the contrary, however, indicators comprising the bundle of rights related to free and uninhibited economic activity (right to work, freedom of enterprise, and right to contract) are no longer considered as 'fundamental' insofar as they can and ought to be regulated for the public interest in view of, inter alia, the protection of public health, as long as there is some identifiable rational relation between the means used (the regulation) and the ends sought (the advancement of a meaningful state interest). The four indicators that have been assigned increased weight can be regarded as contributing to the pursuit of moral independence and self-fulfillment, and ultimately

of privacy and personal authenticity, without which no genuine moral identity can be constructed in accordance with people's deepest desires and aspirations (Hawley, 2014, pp. 302-322).

35 Taking all the above into consideration, the equation used for the construction of RI is presented below. The RI is calculated daily per country and has a minimum value of 0 and a maximum value of 3. Our RI is more meaningful than similar composite index numbers in other databases because the latter are calculated taking the mean value of their indicators, whereas we add theoretical value, nuance, and differential weights to our composite index number.

RI is calculated as

$$RI = 2W * \Sigma (X_{1-4}) + W * \Sigma (X_{5-13}) \quad (1)$$

where W is estimated as

$$1 = 2W * 4 + W * 9 \quad (2)$$

Where W is the differential weighted average of 13 indicators, X_{1-4} refers to four NPIs: freedom of individual movement, public gatherings, inner-country travel, and religious places and ceremonies, and X_{5-13} refers to the remaining nine NPIs. Solving (2) and expressing it in percent, W = 5.88 percent.

36 Despite including few countries in our dataset, albeit with significant breadth of date coverage, we can still report interesting preliminary results. From the cases examined, Italy implemented by far the strictest measures, with an average RI for the entire period of 2.35 out of 3. Greece and Cyprus follow, but with a considerable average difference of approximately half a point (RIs of 1.76 and 1.71 respectively). This is consistent with the severity of the epidemiological situation in those countries, particularly Italy. At the other end of the spectrum, New Zealand and Norway implemented the least restrictive measures in our sample, with average RIs of 0.55 and 0.94 respectively.

37 The results are consistent not only with the epidemiological situation in these countries, but also with their constitutional and legal traditions, i.e., a more regionally based approach to policy-making, stressing individual responsibility and limited state intervention. In contrast, countries such as Greece and Cyprus have a more centralized decision-making structure, placing higher value on the (protective) role of the state. This point may be important in explaining the vast difference between the RIs in those cases and the RIs of New Zealand and Norway (there is almost a two-point – out of three – difference in the RIs of Italy and New Zealand). A contributing factor, of course, could also be the situation of the healthcare sector, particularly its ability to respond efficiently to urgent situations. For example, Norway has a healthcare sector in much better shape than that of Greece, with the former spending almost 3% of GDP more than the latter (OECD, 2022).

Comparison with existing datasets

38 So far there have been a number of similar datasets (e.g., Cheng et al., 2020; Desvars-Larrive et al., 2020; Hale et al., 2021.), many of which report more than NPIs. Related to NPIs, there are primarily two relevant datasets that have been extensively used: the

Oxford COVID-19 Government Response Tracker (OxCGRT; Hale et al., 2021) and the COVID-19 Government Response Event Dataset (CoronaNet v.1.0; Cheng et al., 2020). While these datasets offer important benefits, GovRM-COVID19 contains clear innovations and considerable added value compared with either of them.

39 The most important benefit of our dataset is the near-exclusive focus on the legislative sources for each measure implemented in each country every day. This is highly important considering that, beyond the need to confirm, and the ability to replicate, the coding, often even official speeches or press releases may be improper sources. We found that, in many cases, these sources: did not mention the implementation of measures, but rather announced such an intention; contained ambiguous expressions; did not clarify the beginning or end of the measure imposed; or led to ambiguity in terms of applicability (e.g., a press release from the UK Prime Minister may refer to the entire UK or only to England). This may result in considerable inaccuracies in coding; the only reliable way to know which measures were implemented, and when, is to look at the legislation enacting those measures.

40 Another important contribution of GovRM-COVID19 is the number of indicators. We achieve greater nuance and detail with 13 indicators, compared with OxCGRT and CoronaNet which have far fewer. OxCGRT includes only 9 indicators: there are 8 containment and closure indicators, plus that of facial coverings which is listed under "Health systems". CoronaNet also has 9 indicators (termed "Types") that are relevant to NPIs. However, neither database includes important indicators that in many cases enjoyed special status, such as restrictions related to religious places and ceremonies, sports facilities, and food services.

41 In addition, some indicators used in the above databases are somewhat vague or inaccurate. For example, "Mass Gatherings" in CoronaNet includes curfews and public events, private events (in houses), and reductions in the prison population, most of which are clearly separate. Gatherings need not have a specific purpose and could simply be meetings of some individuals in a public park to spend time, or talk, with each other. However, the term "event" denotes an activity with a specific purpose (a celebration, a concert, etc.). Furthermore, curfew refers to restricting the mobility of individuals as persons, not their ability to gather per se. Finally, reductions in prison population are not directly related to mass gatherings (prison is not an optional place to gather). For example, in Greece, there were different restrictions of different intensity for each of the following: individual curfews, public and private gatherings, and events such as concerts.

42 Similarly, in OxCGRT, schools are referenced as being fully closed even if legislation allowed them the option to stay open. This inconsistency would misleadingly increase the overall Stringency Index of OxCGRT (similar concept to the Observatory's RI) because, while schools may be actually closed, this is optional and not mandated (in this case) by the government, and therefore it is not indicative of how stringent a government's response to the pandemic is in terms of NPIs. There is also an inconsistency with how other indicators are coded: in terms of workplaces, in contrast to the above, OxCGRT measures the official mandate of closure, regardless of whether individuals still go to work. In addition, when workplaces are partially closed, i.e., they have spatial or other limitations, they are coded as recommended to be closed, although that incorrectly characterizes the restriction: a recommendation to close differs in intensity, meaning, and coverage compared with mandatory restrictions

while places were permitted to be open for business. The same is the case for public events (if events are permitted to function with spatial or numerical limitations, they are coded as recommended to not be held). With facial coverings, OxCGRT fails to make the important distinction between indoor and outdoor spaces, which was important in most countries.

43 Challenges also exist in data accuracy and reliability in the above databases. OxCGRT includes coding for the UK as well as its devolved jurisdictions. However, for the 13 indicators included in GovRM-COVID19, there was no legislation applicable to the entire UK, only the legislation of each devolved jurisdiction for its own territory. So, for example, there was no closure of schools imposed throughout the UK, as coded in OxCGRT between March and August 2020. There are additional issues in other jurisdictions as well. In Greece, there was no ban on public gatherings imposed until late September 2020, while OxCGRT references such restrictions in Greece six months earlier (late March 2020 onwards). Concordantly, OxCGRT has coded measures for New Zealand from 22 January 2020, whereas the first set of relevant legislative measures did not take effect until nearly two months later, on 9 March 2020.

44 Another important difference is the calculation of the RI. For the countries included in GovRM-COVID19, OxCGRT systematically reports higher Stringency Index values, often by more than 20 points. For example, our RI is, on average, 43.6 for Ireland, while the OxCGRT Stringency Index averages 63.7 for the same time period. Greece is another example with an average difference of 10 points during the same time period. In essence, based predominantly on non-legislative sources, OxCGRT seems to present national governments as being stricter than the actual legislation warrants. This is particularly striking considering that we place increased weight on the indicators that represent fundamental individual rights and liberties, as opposed to counting every NPI as the same.

45 Similar types of problems are encountered in CoronaNet v.1.0, which uses machine-learning on news articles relevant to COVID-19 policies (Cheng et al., 2020, p. 763). Aside from the problems related to the use of news articles as sources, as outlined above[11], the use of machine-learning software, while advantageous in terms of volume, may have considerable drawbacks in terms of accuracy. Terms used within legislation are quite nuanced, especially across different countries, and hence a machine-based approach seems inappropriate as a method for this type of analysis, being much less accurate than human coding. Furthermore, CoronaNet v.1.0 seems less detailed. For example, it reports data only for the entire UK and not for any devolved jurisdictions, despite the fact that decisions regarding restrictive measures were taken by those devolved jurisdictions. In sum, while the level of restrictions varies across time and countries, our database captures the legislative nuances of restrictions more theoretically, meaningfully, and empirically accurately than do other datasets.

46 Membership, and operation, of the research team are also different. We pursue a rigorous selection process and constant training and feedback with limited workload to maintain efficiency and accuracy. In contrast, no specific selection process is referenced in OxCGRT, in which researchers are trained mostly through self-directed tutorials and then evaluated based on a comprehension test, with their data reviewed only after they have entered them. They are also assigned four to six jurisdictions, which may result in difficulties or inconsistencies in coding, given the vastly different legislative framework of different countries (Hale et al., 2021, p. 535). CoronaNet also

does not reference any kind of evaluation or selection process, nor any type of training provided, nor feedback or monitoring prior to the validation/review stage. Even in the validation stage, only a random 10% of new data is reviewed and validated, and not always by the Principal Investigator (Cheng et al., 2020, pp. 763-764).

Conclusion

47 GovRM-COVID19 publishes the only dataset, to our knowledge, that uses exclusively legislative sources to code COVID-19 restrictive measures around the world. The aim is to provide a database that includes detailed, accurate, and publicly accessible country data regarding the NPIs implemented during the pandemic. This is an immensely demanding task in the level of detail and accuracy expected, but we believe that it constitutes a substantial contribution to the field and may be utilized by academics and policymakers alike to examine public health and other reasons behind the adoption of NPIs in different national settings. More importantly, researchers may wish to explore the public health, political, or economic consequences of NPIs to better inform policymakers about the wisdom of adopting some measures over others during future pandemics. In addition, in constructing our RI, we departed from established practice in other datasets by assigning weights to some of our indicators that constitute the absolute core of individual rights and freedoms enshrined in Western liberal democracies. We believe that our more theoretically nuanced and empirically accurate data will likely provide the foundations of better policy. However, while being extremely accurate in terms of the measures legislated, our model measures neither their actual implementation nor their compliance with the law. This research, along with expanding data collection to include more countries, forms a productive agenda for the future of GovRM-COVID19.

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NOTES

1. In fact, as early as 2006, it had been observed that "experience indicates that we are overdue for another influenza pandemic" (Morse et al., 2006, p. 929).

2. However, a multitude of measures had been proposed in the existing scholarship prior to the COVID-19 pandemic, including physical distancing, hand washing, face masks, social distancing, isolation, physical barriers in workspaces, improvement of air-handling systems, cancellation of mass gatherings, school closures, etc. (Morse et al., 2006, p. 292; WHO Writing Group, 2006a, p. 81).

3. The concept represents the ability of individuals to associate with each other in internal/external public spaces for any reason, including for the purposes of demonstrating for a cause. In cases of legislation in which activities included in a different indicator (e.g., public events) are understood to be part of public gatherings (e.g., North Carolina, USA), only public gatherings (and not other indicators) are coded unless explicit references to other indicators exist in the legislation.

4. This indicator includes all grade levels, from kindergarten through to tertiary education.

5. Essential goods' transportation and trade are excluded.

6. Essential goods transportation and trade are excluded.

7. For example, if there is a complete restriction of freedom of individual movement (level 3 intensity) from 22.00 to 05.00 each day, and, at the same time, there are partial restrictions (level 2 intensity) for the rest of the day in a jurisdiction, level 3 (the most restrictive) is coded.

8. For example, if in a jurisdiction, in terms of freedom of individual movement, level 1 in intensity is provisioned for green areas, level 2 for yellow, and level 3 for red, but areas are only categorized in green and yellow (with no areas in the red category), level 2 is coded, even though there are also, simultaneously, areas where level 1 in intensity applies (green areas). Correspondingly, if and when any areas become categorized as red, level 3 is coded.

9. If no official legislation is found (which has seldom been the case), and research in other official or media sources reveals accurately the actual implementation of measures, only then are non-legal sources used in the following order: official government press releases or other official material, and then reputable media sources.

10. The dataset actually contains 4,973 observations but some were dropped because of incomplete data.

11. Perhaps more troubling is the fact that, even as the basis for the design for their survey, Cheng et al. (2020) used, inter alia, a *New York Times* article referencing cross-national data on travel bans by multiple countries (764).

ABSTRACTS

In response to the COVID-19 pandemic, governments around the world imposed a wide variety of Non-Pharmaceutical Interventions (NPIs) in the form of restrictions of various aspects of social life, hoping to curb the spread of the SARS-CoV-2 virus. However, measures such as restrictions on public gatherings, the closure of schools, or the mandatory use of masks, raised several concerns in terms of both their necessity and effectiveness. The Observatory of Government Restrictive Measures for the COVID-19 pandemic (GovRM-COVID19), which began in November 2020 within the Center for Research on Democracy and Law of the University of Macedonia (Greece), has developed a database tracking all legislative measures imposing restrictions across different countries. The use of legislation as the main source of information with a daily frequency, as well as consideration of sub-federal entities in non-unitary (federal, devolved, etc.) states, provide one of the most accurate accounts of such restrictions. The end result is to

provide researchers with accurate data on how various governments around the world have restricted individual rights and freedoms as a result of, and during, the COVID-19 pandemic, offering an opportunity for comparative research across different countries and policy strategies.

INDEX

Keywords: Covid-19, pandemic, non-pharmaceutical interventions, database

AUTHORS

ALEXANDROS KYRIAKIDIS

Postdoctoral Researcher and Head of Operations and Research of the Center for Research on Democracy and Law, Department of International and European Studies, University of Macedonia, Greece.

NIKOLAOS ZAHARIADIS

Professor and Mertie Buckman Chair, Department of International Studies, Rhodes College, Memphis, USA.

IOANNIS PAPADOPOULOS

Professor and Director of the Center for Research on Democracy and Law, Department of International and European Studies, University of Macedonia, Greece.