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Variation in government responses to COVID-19

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Version 7.0

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This working paper is updated frequently. Check for most recent version here: www.bsg.ox.ac.uk/covidtracker
The most up-to-date version of technical documentation will always be found on the project's GitHub repo: www.github.com/OxCGRT/covid-policy-tracker

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Abstract: COVID-19 has prompted a wide range of responses from governments around the world. There is a pressing need for up-to-date policy information as these responses proliferate, so that researchers, policymakes, and publics can evaluate how best to address COVID-19. We introduce the Oxford COVID-19 Government Response Tracker (OxCGRT), providing a systematic way to track government responses to COVID-19 across countries and sub-national jurisdictions over time. We combine this data into a series of novel indices that aggregate various measures of government responses. These indices are used to describe variation in government responses, explore whether the government response affects the rate of infection, and identify correlates of more or less intense responses.

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1. Introduction

The rapid spread of COVID-19 globally has created a wide range of responses from governments. Common measures include school closings, travel restrictions, bans on public gatherings, emergency investments in healthcare facilities, new forms of social welfare provision, contact tracing and other interventions to contain the spread of the virus, augment health systems, and manage the economic consequences of these actions. However, governments have varied substantially—both across countries, and often within countries—in the measures that they have adopted and how quickly they have adopted them. This variation has created debate as policymakers and publics deliberate over the level of response that should be pursued and how quickly to implement them or roll them back, and as public health experts learn in real time the measures that are more or less effective.

The Oxford COVID-19 Government Response Tracker (OxCGRT) provides a systematic cross-national, cross-temporal measure to understand how government responses have evolved over the full period of the disease's spread. The project tracks governments' policies and interventions across a standardized series of indicators and creates a suite of composites indices to measure the extent of these responses. Data is collected and updated in real time by a team of over one hundred Oxford students, alumni and staff, and project partners.

This working paper briefly describes the data OxCGRT collects and presents some basic measures of variation across governments. It will be updated regularly as the pandemic and governments' responses evolve, and as the technical specifications of the database evolve. However, for the most current and up-to-date technical documentation, please refer to our GitHub repository.[1]

2. Data and measurement

OxCGRT reports publicly available information on 18 indicators (see table 1) of government response.

The indicators are of three types:

- **Ordinal**: These indicators measure policies on a simple scale of severity / intensity. These indicators are reported for each day a policy is in place.
    - Many have a further flag to note if they are "targeted", applying only to a sub-region of a jurisdiction, or a specific sector; or "general", applying

[1] https://github.com/OxCGRT/covid-policy-tracker

throughout that jurisdiction or across the economy. (Note, the flag for indicator E1 means something different.)

- **Numeric**: These indicators measure a specific number, typically the value in USD. These indicators are only reported on the day they are announced.
- **Text**: This is a "free response" indicator that records other information of interest.

All observations also have a "notes" cell that reports sources and comments to justify and substantiate the designation.

Table 1: OxCGRT Indicators
See appendix for detailed descriptions and coding information.)

ID	Name	Type	Targeted/ General?
Containment and closure			
C1	School closing	Ordinal	Geographic
C2	Workplace closing	Ordinal	Geographic
C3	Cancel public events	Ordinal	Geographic
C4	Restrictions on gathering size	Ordinal	Geographic
C5	Close public transport	Ordinal	Geographic
C6	Stay at home requirements	Ordinal	Geographic
C7	Restrictions on internal movement	Ordinal	Geographic
C8	Restrictions on international travel	Ordinal	No
Economic response			
E1	income support	Ordinal	Sectoral
E2	debt/contract relief for households	Ordinal	No
E3	fiscal measures	Numeric	No
E4	giving international support	Numeric	No
Health systems			
H1	Public information campaign	Ordinal	Geographic
H2	testing policy	Ordinal	No
H3	contact tracing	Ordinal	No
H4	emergency investment in healthcare	Numeric	No
H5	investment in Covid-19 vaccines	Numeric	No
Miscellaneous			
M1	Other responses	Text	No

Data is collected from publicly available sources such as news articles and government press releases and briefings. These are identified via internet searches by a team of over one hundred Oxford University students and staff. OxCGRT records the original source material so that coding can be checked and substantiated.

All OxCGRT data is available under the Creative Commons Attribution CC BY standard.

OxCGRT has added new indicators and refined old indicators as the pandemic has evolved.[2] Future iterations may include further indicators or more nuanced versions existing indicators.

3. Relation between national and sub-national data

OxCGRT includes data at country-level for nearly all countries in the world. It also includes subnational-level data for selected countries, currently Brazil (all federal states and a number of cities), the United States (all states plus Washington, DC, and a number of teritories), and the United Kingdom (the four devolved nations and overseas territories).

OxCGRT data are typically used in two ways. First, and primarily, to describe all government responses relevant to a given jurisdiction. Second, less commonly, they are used to compare government responses across different levels of government.

To distinguish between these two uses, OxCGRT data are labelled in different ways. In the primary dataset, they include no suffixes, and simply represent the total package of policies that apply to residents in that jurisdiction. In various subordinate datasets, they are tagged with the suffixes "_ALL" or "_GOV."

_ALL observations capture all government responses set by a given jurisdiction and its sub-components, with the latter flagged as "targeted" as per the coding scheme described above. For subnational jurisdictions, _ALL observations do not incorporate general policies from higher levels of government that may supersede local policies. For example, if a country has an international travel restriction that applies country-wide, this would not be registered in _ALL observations for subnational governments.

_GOV observations, in turn, capture government decisions made at a given level of government. We collect this information at three levels, though the exact operationalization varies by country:

- NAT_GOV (national government)
- STATE_GOV (the jurisdictions immediately under the national level, typically states or provinces)
- CITY_GOV (the jurisdictions corresponsponding to the primary urban units, typically municipalities or counties) observations.

[2] For a description of these changes, see this link.

Higher- or lower-level jurisdictions' policies do not inform _GOV observations. However, _GOV observations do include different branches of government at the same level. For example, if a state-level court imposes or reverses a measure, even if it does so against the elected government of a state, we record it under STATE_GOV.

In the main OxCGRT dataset, no suffixes are applied. Here, we show the total set of policies that apply to a given jurisdiction, including those "inherited" from higher levels of government. For national governments, this means that the observations in the main dataset are functionally _ALL observations. For subnational jurisdictions in the main dataset, we combine NAT_GOV and STATE_ALL into a hybrid measure. Specifically, in the main dataset, we replace subnational-level responses with relevant NAT_GOV indicators when the following two conditions are met:

- The corresponding NAT_GOV indicator is general, not targeted.
- The corresponding NAT_GOV indicator is greater than the STATE_ALL indicator on the ordinal scale for that indicator.

Note that _ALL observations at the subnational level also capture policies from higher-level governments if they are specifically targeted at that subnational jurisdiction. For example, if a national government orders events to close in a particular city experiencing an outbreak. These kinds of policies are coded directly in STATE_ALL or CITY_ALL observations at the sub-national level, and are not inferred from NAT_GOV.

On Github, these different types data are available in three groups:

- Main OxCGRT dataset: national data for almost 190 countries, and state-level data for US and UK. This records all policies that apply to people in a relevant jurisdiction.
- US: NAT_GOV and STATE_ALL (ie, state observations are without inherited higher level policies)
- Brazil: NAT_GOV, STATE_GOV, and CITY_GOV (ie, state and city observations are without inherited higher level policies)

Table 2: Currently available OxCGRT data across different levels of government and types of observations

Level	**All countries**	**US**	**Brazil**	**UK**
Main OxCGRT dataset[3]	186 countries	USA national, plus 50 states, DC, Puerto Rico	Brazil national	UK national, plus 4 devolved nations and several overseas territories[4]
NAT_GOV	-	US Federal Government	Brazilian Federal Government	UK Government
STATE_ALL	-	50 US states, DC, US Virgin Islands	-	4 devolved nations
STATE_GOV	-	-	27 States	-
CITY_GOV	-	-	8 State capitals	-

4. Policy indices of COVID-19 government responses

Governments' responses to COVID-19 exhibit significant nuance and heterogeneity. Consider, for example, C1, school closing: in some places, all schools have been shut; in other places, universities closed on a different timescale than primary schools; in other places still, schools remain open only for the children of essential workers. Moreover, like any policy intervention, their effect is likely to be highly contingent on local political and social contexts. These issues create substantial measurement difficulties when seeking to compare national responses in a systematic way.

Composite measures – which combine different indicators into a general index – inevitably abstract away from these nuances. This approach brings both strengths and limitations. Helpfully, cross-national measures allow for systematic comparisons across countries. By measuring a range of indicators, they mitigate the possibility that any one indicator may be over- or mis-interpreted. However, composite measures also leave out

[3] This main dataset combines the other datasets to report the overall policy settings that apply to residents within the jurisdictions.
[4] Overseas territories include Bermuda, British Virgin Islands, and others.

much important information, and make strong assumptions about what kinds of information "counts." If the information left out is systematically correlated with the outcomes of interest, or systematically under- or overvalued compared to other indicators, such composite indices may introduce measurement bias.

Broadly, there are three common ways to create a composite index: a simple additive or multiplicative index that aggregates the indicators, potentially weighting some; Principal Component Analysis (PCA), which weights individual indicators by how much additional variation they explain compared to the others; Principal Factor Analysis (PFA), which seeks to measure an underlying unobservable factor by how much it influences the observable indicators.

Each approach has advantages and disadvantages for different research questions. In this paper we rely on simple, additive unweighted indices as the baseline measure because this approach is most transparent and easiest to interpret. PCA and PFA approaches can be used as robustness checks.

This information is aggregated into a series of four policy indices, with their composition described the appendix.

- Overall government response index
- Stringency index
- Containment and health index
- Economic support index

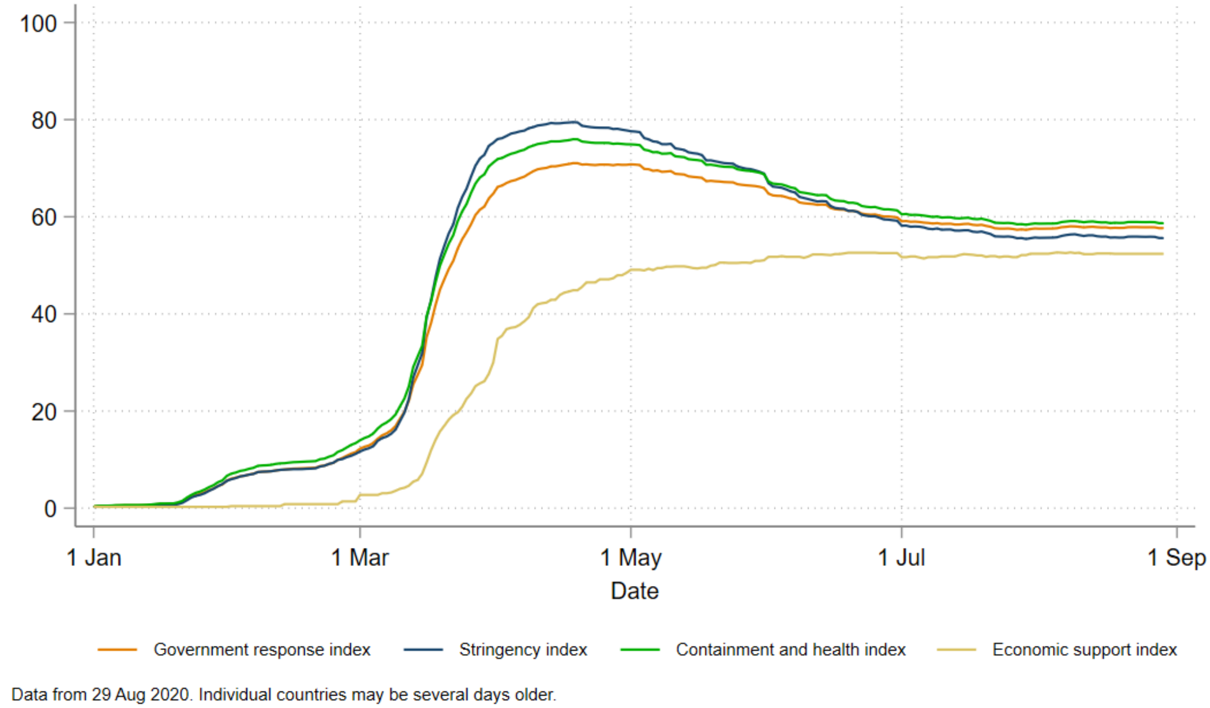
Each index is composed of a series of individual policy response indicators. For each indicator, we create a score by taking the ordinal value and adding an extra half-point if the policy is general rather than targeted, if applicable. We then rescale each of these by their maximum value to create a score between 0 and 100, with a missing value contributing 0.[5] These scores are then averaged to get the composite indices (Figure 1).

Importantly, the indices should not be interpreted as a measure of the appropriateness or effectiveness of a government's response. They do not provide information on how well policies are enforced, nor does it capture demographic or cultural characteristics that may affect the spread of COVID-19. Furthermore, they are not comprehensive measures of policy. They only reflect the indicators measured by the OxCGRT (see Table 1), and thus will miss important aspects of a government response. For instance, the "economic support index" does not include support to firms or businesses, and does not

[5] We use a conservative assumption to calculate the indices. Where data for one of the component indicators are missing, they contribute "0" to the Index. An alternative assumption would be to not count missing indicators in the score, essentially assuming they are equal to the mean of the indicators for which we have data for. Our conservative approach therefore "punishes" countries for which less information is available, but also avoids the risk of over-generalizing from limited information.

take into account the total fiscal value of economic support. The value and purpose of the indices is instead to allow for efficient and simple cross-national comparisons of government interventions. Any analysis of a specific country should be done on the basis of the underlying policy, not on an index alone.

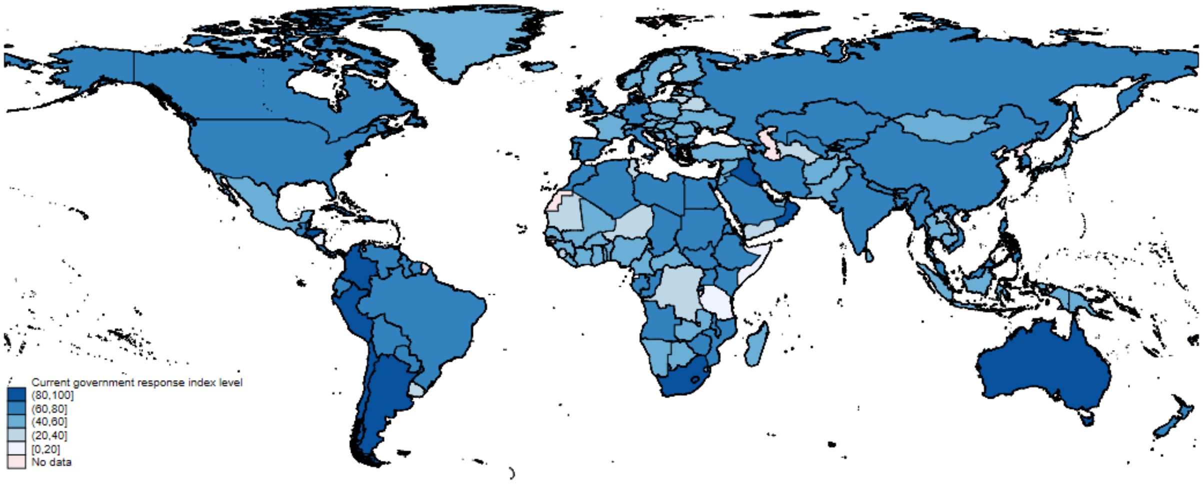
Figure 1: Global mean index values for over 180 countries over time



5. Variation in government responses

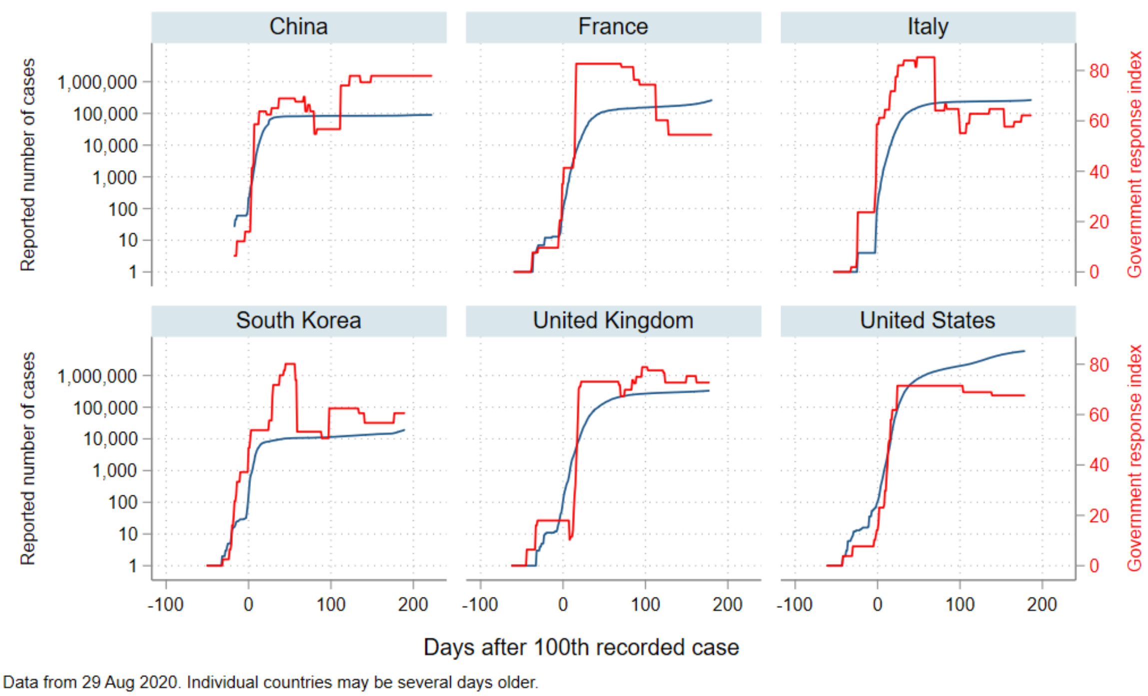
How have governments' responses varied? In general, government responses have become stronger over the course of the outbreak, particularly ramping up over the month of March (see Figure 1). However, variation can be seen across countries (Figure 2). This variation is becoming less pronounced over time as more countries implement comprehensive suites of measures.

Figure 2: COVID-19 Government Response Index by country, August 29, 2020



We expect the response measures to broadly track the spread of the disease. However, the rate at which such measures are adopted plays a critical role in stemming the infection. Relying on data primarily collated by the European Centre for Disease Control, Figure 3 compares the rate of confirmed cases (the black line) since the first reported death to changes in a country's government response index (the red line). Some governments immediately ratchet up measures as an outbreak spreads, while in other countries the increase in the stringency of responses lags the growth in new cases.

Figure 3: Reported COVID-19 deaths and government response index, selected countries

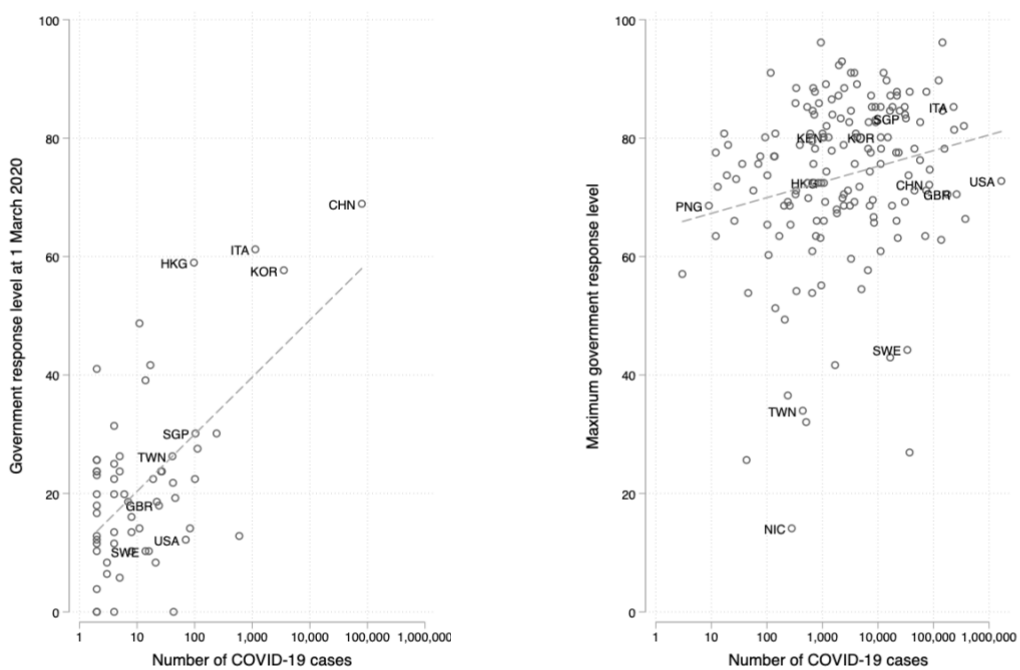


Differential responses can also be seen across the entire period. One measure of interest is the Response-Risk Ratio, which compares a government's response to the risk it faces. Risk is difficult to measure, since the number of cases recorded is in part a function of how much testing is carried out, which itself is a measure that will co-vary to some extent with the overall government's response index (being that testing is reflected in indicator H2). The number of deaths is less correlated with testing regime (but still dependent on how each country defines COVID-19 deaths).

Figure 4 presents the Response-Risk Ratio operationalised as the maximum level of government response a country has reached compared to the total number of cases in that country. Countries above the line can be interpreted as having more stringent measures than the average country (or at least, have enacted measures on a greater number of dimensions to a higher degree), given their number of confirmed cases. Conversely, countries below the line show a lower level of policy action than the average country given their number of confirmed cases. Thus, the closer a country is to the top-left corner of Figure 4, the higher the level of their response in light of the risk it faces, and conversely, the closer a country is to the bottom-right corner, the smaller its response given its risk. Over time, we are observing more countries implement a larger response at a lower case load.

<u>Figure 4: Response-Risk Ratio</u>

(a) as at 1 March 2020 (b) as at 27 May 2020



6. Conclusion

As governments continue to respond to COVID-19, it is imperative to study what measures are effective and which are not. While the data presented here do, of course, not measure effectiveness directly, they can be useful input to studies that analyse factors affecting disease progression. OxCGRT seeks to contribute to this knowledge gap by providing comparable measures of individual policy actions, as well as several comparable aggregate indices. We find significant variation in both the measures that governments adopt and when they adopt them. Going forward, governments will benefit from adopting an evidence-based approach to the measures they deploy.

OxCGRT will continue to evolve over the coming months as the pandemic progresses. We envision not only updating the data on a regular basis, but also refining and improving the indicators we record for each country. The most up-to-date technical documentation can always be found on our GitHub repository.[6]

It is our hope that scholars, medical professionals, policymakers, and concerned citizens will make use of the OxCGRT data to enhance all countries' responses to the COVID-19 pandemic. We welcome constructive feedback and collaboration on this project as it evolves.

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6 https://github.com/OxCGRT/covid-policy-tracker

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Codebook

This coding scheme is tweaked and revised from time-to-time. Please refer to our GitHub repository for the most up-to-date technical documentation: [*https://github.com/OxCGRT/covid-policy-tracker/blob/master/documentation/codebook.md*](https://github.com/OxCGRT/covid-policy-tracker/blob/master/documentation/codebook.md)

Closures and containment

ID	Name	Description	Measurement	Coding instructions
C1	School closing	Record closings of schools and universities	Ordinal scale + binary for geographic scope	0 - No measures 1 - recommend closing 2 - Require closing (only some levels or categories, eg just high school, or just public schools) 3 - Require closing all levels No data - blank 0 - Targeted 1- General No data - blank
C2	Workplace closing	Record closings of workplaces	Ordinal scale + binary for geographic scope	0 - No measures 1 - recommend closing (or work from home) 2 - require closing (or work from home) for some sectors or categories of workers 3 - require closing (or work from home) all-but-essential workplaces (e.g. grocery stores, doctors) No data - blank 0 - Targeted 1- General No data - blank
C3	Cancel public events	Record cancelling public events	Ordinal scale + binary for geographic scope	0- No measures 1 - Recommend cancelling 2 - Require cancelling No data - blank 0 - Targeted 1- General No data - blank

C4	Restrictions on gatherings	Record the cut-off size for bans on private gatherings	Ordinal scale + binary for geographic scope	0 - No restrictions 1 - Restrictions on very large gatherings (the limit is above 1000 people) 2 - Restrictions on gatherings between 101-1000 people 3 - Restrictions on gatherings between 11-100 people 4 - Restrictions on gatherings of 10 people or less No data - blank 0 - Targeted 1 - General No data - blank
C5	Close public transport	Record closing of public transport	Ordinal scale + binary on geographic scope	0 - No measures 1 - Recommend closing (or significantly reduce volume/route/means of transport available) 2 - Require closing (or prohibit most citizens from using it) 0 - Targeted 1- General No data - blank
C6	Stay at home requirements	Record orders to “shelter-in- place” and otherwise confine to home.	Ordinal scale + binary on geographic scope	0 - No measures 1 - recommend not leaving house 2 - require not leaving house with exceptions for daily exercise, grocery shopping, and ‘essential’ trips 3 - Require not leaving house with minimal exceptions (e.g. allowed to leave only once a week, or only one person can leave at a time, etc.) No data - blank 0 - Targeted 1- General No data – blank
C7	Restrictions on internal movement	Record restrictions on internal movement	Ordinal scale + binary on geographic scope	0 - No measures 1 - Recommend not to travel between regions/cities 2 – internal movement restrictions in place 0 - Targeted 1- General No data - blank

C8	International travel controls	Record restrictions on international travel	Ordinal scale	0 - No measures 1 - Screening 2 - Quarantine arrivals from high-risk regions 3 - Ban on arrivals from some regions 4 – Ban on all regions or total border closure No data - blank

Economic measures

ID	Name	Description		Coding instructions
E1	Income support	Record if the government is covering the salaries or providing direct cash payments, universal basic income, or similar, of people who lose their jobs or cannot work. (Includes payments to firms if explicitly linked to payroll/ salaries)	Ordinal scale + binary scale for **sectoral** scope	0 - no income support 1 - government is replacing less than 50% of lost salary (or if a flat sum, it is less than 50% median salary) 2 - government is replacing 50% or more of lost salary (or if a flat sum, it is greater than 50% median salary) No data - blank 0 - formal sector workers only 1 - transfers to informal sector workers too No data - blank
E2	Debt / contract relief for households	Record if govt. is freezing financial obligations (e.g. stopping loan repayments, preventing services like water from stopping, or banning evictions)		0 - No 1 - Narrow relief, specific to one kind of contract 2 - broad debt/contract relief
E3	Fiscal measures	What economic stimulus policies are adopted?	USD	Record monetary value USD of fiscal stimuli, including spending or tax cuts NOT included in E4, H4, or H5 (see below) -If none, enter 0 No data - blank Please use the exchange rate of the date you are

				coding, not the current date. Exchange rate info here.
E4	Providing support to other countries	Announced offers of COVID-19 related aid spending to other countries	USD	Record monetary value announced if additional to previously announced spending -if none, enter 0 No data - blank Please use the exchange rate of the date you are coding, not the current date. Exchange rate info here.

Health measures

ID	Name	Description	Measurement	Coding instructions
H1	Public info campaigns	Record presence of public info campaigns	Binary + binary on geographic scope	0 -No COVID-19 public information campaign 1 - public officials urging caution about COVID-19 2 - coordinated public information campaign (e.g. across traditional and social media) No data - blank 0 - Targeted 1- General No data - blank
H2	Testing policy	Who can get tested?	Ordinal scale	0 – No testing policy 1 – Only those who both (a) have symptoms AND (b) meet specific criteria (e.g. key workers, admitted to hospital, came into contact with a known case, returned from overseas) 2 – testing of anyone showing COVID-19 symptoms 3 – open public testing (e.g. “drive through” testing available to asymptomatic people) No data N.B. we are looking for policies about testing for having an infection (PCR tests) - not for

				policies about testing for immunity (antibody tests).
H3	Contact tracing	Are governments doing contact tracing?	Ordinal scale	0 - No contact tracing 1 - Limited contact tracing - not done for all cases 2 - Comprehensive contact tracing - done for all identified cases No data
H4	Emergency investment in health care	Short-term spending on, e.g., hospitals, masks, etc	USD	-Record monetary value in USD of new short-term spending on health -If none, enter 0 No data - blank Please use the exchange rate of the date you are coding, not the current date. Exchange rate info here.
H5	Investment in vaccines	Announced public spending on vaccine development	USD	Record monetary value announced if additional to previously announced spending -If none, enter 0 No data - blank Please use the exchange rate of the date you are coding, not the current date. Exchange rate info here.

Miscellaneous

ID	Name	Description	Measurement	Coding instructions
M1	Misc. wild card	Record policy announcements that do not fit anywhere else	Free text	Note unusual or interesting interventions that you think are worth flagging. Include relevant documentation.

Calculation of policy indices

The composition and calculation of our indices is updated from time-to-time. Please refer to our GitHub repository for the most up-to-date technical documentation: https://github.com/OxCGRT/covid-policy-tracker/blob/master/documentation/index_methodology.md

Policy indices

All of our indices are simple averages of the individual component indicators. This is described in equation 1 below where *k* is the number of component indicators in an index and I_j is the sub-index score for an individual indicator.

$$(1) \qquad index = \frac{1}{k}\sum_{j=1}^{k} I_j$$

The different indices are comprised as follows:

Index	*k*	C1	C2	C3	C4	C5	C6	C7	C8	E1	E2	E3	E4	H1	H2	H3	H4	H5	M1
Government response index	13	x	x	x	x	x	x	x	x	x	x			x	x	x			
Containment and health index	11	x	x	x	x	x	x	x	x					x	x	x			
Stringency index	9	x	x	x	x	x	x	x	x					x					
Economic support index	2									x	x								
Legacy stringency index (see end of doc)	7	x	x	>	?	x	?	?	x					x					

Two versions of each indicator are present in the database. A regular version which will return null values if there is not enough data to calculate the index, and a "display" version which will extrapolate to smooth over the last seven days of the index based on the most recent complete data. This is explained below.

Calculating sub-index scores for each indicator

All of the indices use ordinal indicators where policies a ranked on a simple numerical scale. The project also records five non-ordinal indicators – E3, E4, H4, H5 and M1 – but these are not used in our index calculations.

Some indicators – C1-C7, E1 and H1 – have an additional binary flag variable that can be either 0 or 1. For C1-C7 and H1 this corresponds to the geographic scope of the policy. For E1, this flag variable corresponds to the sectoral scope of income support.

The codebook has details about each indicator and what the different values represent.

Because different indicators (j) have different maximum values (N_j) in their ordinal scales, and only some have flag variables, each sub-index score must be calculated separately. The different indicators are:

Indicator	**Max value (N_j)**	**Flag? (F_j)**
C1	3 (0, 1, 2, 3)	Yes=1
C2	3 (0, 1, 2, 3)	Yes=1
C3	2 (0, 1, 2)	Yes=1
C4	4 (0, 1, 2, 3, 4)	Yes=1
C5	2 (0, 1, 2)	Yes=1
C6	3 (0, 1, 2, 3)	Yes=1
C7	2 (0, 1, 2)	Yes=1
C8	4 (0, 1, 2, 3, 4)	No=0
E1	2 (0, 1, 2)	Yes=1
E2	2 (0, 1, 2)	No=0
H1	2 (0, 1, 2)	Yes=1
H2	3 (0, 1, 2, 3)	No=0
H3	2 (0, 1, 2)	No=0

Each sub-index score (I) for any given indicator (j) on any given day (t), is calculated by the function described in equation 2 based on the following parameters:

- the maximum value of the indicator (N_j)
- whether that indicator has a flag (F_j=1 if the indicator has a flag variable, or 0 if the indicator does not have a flag variable)
- the recorded policy value on the ordinal scale ($v_{j,t}$)
- the recorded binary flag for that indicator, if that indicator has a flag ($f_{j,t}$)

This normalises the different ordinal scales to produce a sub-index score between 0 and 100 where each full point on the ordinal scale is equally spaced. For indicators that do have a flag variable, if this flag is recorded as 0 (i.e. if the policy is geographically targeted or for E1 if the support only applies to informal sector workers) then this is treated as a half-step between ordinal values.

Note that the database only contains flag values if the indicator has a non-zero value. If a government has no policy for a given indicator (i.e. the indicator equals zero) then the corresponding flag is blank/null in the database. For the purposes of calculating the index, this is equivalent to a sub-index score of zero. In other words, $I_{j,t}=0$ if $v_{j,t}=0$.

$$(2) \qquad I_{j,t} = 100\frac{v_{j,t} - 0.5(F_j - f_{j,t})}{N_j}$$

Here is an explicit example of the calculation for a given country on a single day:

Indicator	$v_{j,t}$	$f_{j,t}$	N_j	F_j	$I_{j,t}$
C1	2	1	3	yes=1	66.67
C2	no data	no data	3	yes=1	0.00
C3	2	0	2	yes=1	75.00
C4	2	0	4	yes=1	37.50
C5	0	null	2	yes=1	0.00
C6	1	0	3	yes=1	16.67
C7	1	1	2	yes=1	50.00
C8	3	N/A	4	no=0	75.00
E1	2	0	2	yes=1	75.00
E2	2	N/A	2	no=0	100.00
H1	2	0	2	yes=1	75.00
H2	3	N/A	3	no=0	100.00
H3	2	N/A	2	no=0	100.00

Index	
Government response	59.29
Containment and health	54.17
Stringency	43.98
Economic support	87.50

Dealing with gaps in the data for display purposes

Because data are updated on twice-weekly cycles, but not every country is updated in every cycle, recent dates may be prone to missing data. If fewer than *k-1* indicators are present for an index on any given day, the index calculation is rejected and no value is returned. For the economic support indicator, where *k*=2, the index calculation is rejected if either of the two indicators are missing.

To increase consistency of recent data points which are perhaps mid contribution, index values pertaining to the past seven days are rejected if they have fewer policy indicators than another day in the past seven days, i.e. if there is another recent data point with all *k* indicators included, then no index will be calculated for dates with *k-1*.

Further, we produce two versions of each index. One with the raw calculated index values, plus we produce a "display" version which will "smooth" over gaps in the last seven days, populating each date with the last available "good" data point.

For example, the date at the time of writing was 22 May. The table below gives an example of which index calculations would be rejected based on the number of policy indicators with data on each data. In this table, we will consider the overall government response index where *k*=13.

Date	No. of valid indicators	No. of indicators in index (*k*)	Raw index	"Display" index
10/05/2020	11	13	null	null
11/05/2020	12	13	60	60
12/05/2020	10	13	null	null
13/05/2020	13	13	65	65
14/05/2020	10	13	null	null
15/05/2020	10	13	null	null
16/05/2020	10	13	null	65
17/05/2020	13	13	70	70
18/05/2020	13	13	75	75
19/05/2020	12	13	null	75
20/05/2020	12	13	null	75
21/05/2020	6	13	null	75
22/05/2020 (today)	4	13	null	75

Legacy stringency index

We also report a legacy stringency index that approximates the logic of the first version of the Stringency Index, which only had seven components under our old database structure with the old indicators S1-S7. We generally do not recommend using this legacy index, but it may be useful for continuity purposes.

The legacy indicator only uses seven indicators, and it chooses a single indicator between C3 and C4, and between C6 and C7, selecting whichever of those pairs provides a higher sub-index score. This is because C3 and C4 aim to measure the information previously measured by S3, and similarly for C6, C7 and the old S6. This method, shown in equation 3, faithfully recreates the logic of the old stringency index.

$$(3) \qquad SI_{legacy} = \frac{1}{7}\left(I_{C1} + I_{C2} + max(I_{C3}, I_{C4}) + I_{C5} + max(I_{C6}, I_{C7}) + I_{C8} + I_{H1}\right)$$

The individual sub-index scores for the legacy index are calculated through a slightly different formula to the one described in equation 2 above. This formula is described in equation 4 below (with a separate formula for C8, the only indicator in this index without a flagged variable).

$$(4) \qquad I_{j,t} = 100\left(\frac{v_{j,t} + f_{j,t}}{N_j + 1}\right) \quad | \quad I_{C8,t} = 100\left(\frac{v_{C8,t}}{N_{C8}}\right)$$

Variation in government responses to COVID-19

Version 7.0
1 September 2020

This working paper is updated frequently. Check for most recent version here: www.bsg.ox.ac.uk/covidtracker
The most up-to-date version of technical documentation will always be found on the project's GitHub repo: www.github.com/OxCGRT/covid-policy-tracker

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Abstract: COVID-19 has prompted a wide range of responses from governments around the world. There is a pressing need for up-to-date policy information as these responses proliferate, so that researchers, policymakers, and the public can evaluate how best to address COVID-19. We introduce the Oxford COVID-19 Government Response Tracker (OxCGRT), providing a systematic way to track government responses to COVID-19 across countries and sub-national jurisdictions over time. We combine this data into a series of novel indices that aggregate various measures of government responses. These indices are used to describe variation in government responses, explore whether the government response affects the rate of infection, and identify correlates of more or less intense responses.

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1. Introduction

The rapid spread of COVID-19 globally has created a wide range of responses from governments. Common measures include school closings, travel restrictions, bans on public gatherings, emergency investments in healthcare facilities, new forms of social welfare provision, contact tracing and other interventions to contain the spread of the virus, augment health systems, and manage the economic consequences of these actions. However, governments have varied substantially—both across countries, and often within countries—in the measures that they have adopted and how quickly they have adopted them. This variation has created debate as policymakers and publics deliberate over the level of response that should be pursued and how quickly to implement them or roll them back, and as public health experts learn in real time the measures that are more or less effective.

The Oxford COVID-19 Government Response Tracker (OxCGRT) provides a systematic cross-national, cross-temporal measure to understand how government responses have evolved over the full period of the disease's spread. The project tracks governments' policies and interventions across a standardized series of indicators and creates a suite of composites indices to measure the extent of these responses. Data is collected and updated in real time by a team of over one hundred Oxford students, alumni and staff, and project partners.

This working paper briefly describes the data OxCGRT collects and presents some basic measures of variation across governments. It will be updated regularly as the pandemic and governments' responses evolve, and as the technical specifications of the database evolve. However, for the most current and up-to-date technical documentation, please refer to our GitHub repository.[1]

2. Data and measurement

OxCGRT reports publicly available information on 18 indicators (see table 1) of government response.

The indicators are of three types:

- **Ordinal**: These indicators measure policies on a simple scale of severity / intensity. These indicators are reported for each day a policy is in place.
    - Many have a further flag to note if they are "targeted", applying only to a sub-region of a jurisdiction, or a specific sector; or "general", applying

[1] https://github.com/OxCGRT/covid-policy-tracker

throughout that jurisdiction or across the economy. (Note, the flag for indicator E1 means something different.)

- **Numeric**: These indicators measure a specific number, typically the value in USD. These indicators are only reported on the day they are announced.
- **Text**: This is a "free response" indicator that records other information of interest.

All observations also have a "notes" cell that reports sources and comments to justify and substantiate the designation.

Table 1: OxCGRT Indicators
See appendix for detailed descriptions and coding information.)

ID	Name	Type	Targeted/ General?
Containment and closure			
C1	School closing	Ordinal	Geographic
C2	Workplace closing	Ordinal	Geographic
C3	Cancel public events	Ordinal	Geographic
C4	Restrictions on gathering size	Ordinal	Geographic
C5	Close public transport	Ordinal	Geographic
C6	Stay at home requirements	Ordinal	Geographic
C7	Restrictions on internal movement	Ordinal	Geographic
C8	Restrictions on international travel	Ordinal	No
Economic response			
E1	income support	Ordinal	Sectoral
E2	debt/contract relief for households	Ordinal	No
E3	fiscal measures	Numeric	No
E4	giving international support	Numeric	No
Health systems			
H1	Public information campaign	Ordinal	Geographic
H2	testing policy	Ordinal	No
H3	contact tracing	Ordinal	No
H4	emergency investment in healthcare	Numeric	No
H5	investment in Covid-19 vaccines	Numeric	No
Miscellaneous			
M1	Other responses	Text	No

Data is collected from publicly available sources such as news articles and government press releases and briefings. These are identified via internet searches by a team of over one hundred Oxford University students and staff. OxCGRT records the original source material so that coding can be checked and substantiated.

All OxCGRT data is available under the Creative Commons Attribution CC BY standard.

OxCGRT has added new indicators and refined old indicators as the pandemic has evolved.[2] Future iterations may include further indicators or more nuanced versions existing indicators.

3. Relation between national and sub-national data

OxCGRT includes data at country-level for nearly all countries in the world. It also includes subnational-level data for selected countries, currently Brazil (all federal states and a number of cities), the United States (all states plus Washington, DC, and a number of teritories), and the United Kingdom (the four devolved nations and overseas territories).

OxCGRT data are typically used in two ways. First, and primarily, to describe all government responses relevant to a given jurisdiction. Second, less commonly, they are used to compare government responses across different levels of government.

To distinguish between these two uses, OxCGRT data are labelled in different ways. In the primary dataset, they include no suffixes, and simply represent the total package of policies that apply to residents in that jurisdiction. In various subordinate datasets, they are tagged with the suffixes "_ALL" or "_GOV."

_ALL observations capture all government responses set by a given jurisdiction and its sub-components, with the latter flagged as "targeted" as per the coding scheme described above. For subnational jurisdictions, _ALL observations do not incorporate general policies from higher levels of government that may supersede local policies. For example, if a country has an international travel restriction that applies country-wide, this would not be registered in _ALL observations for subnational governments.

_GOV observations, in turn, capture government decisions made at a given level of government. We collect this information at three levels, though the exact operationalization varies by country:

- NAT_GOV (national government)
- STATE_GOV (the jurisdictions immediately under the national level, typically states or provinces)
- CITY_GOV (the jurisdictions corresponsponding to the primary urban units, typically municipalities or counties) observations.

[2] For a description of these changes, see this link.

Higher- or lower-level jurisdictions' policies do not inform _GOV observations. However, _GOV observations do include different branches of government at the same level. For example, if a state-level court imposes or reverses a measure, even if it does so against the elected government of a state, we record it under STATE_GOV.

In the main OxCGRT dataset, no suffixes are applied. Here, we show the total set of policies that apply to a given jurisdiction, including those "inherited" from higher levels of government. For national governments, this means that the observations in the main dataset are functionally _ALL observations. For subnational jurisdictions in the main dataset, we combine NAT_GOV and STATE_ALL into a hybrid measure. Specifically, in the main dataset, we replace subnational-level responses with relevant NAT_GOV indicators when the following two conditions are met:

- The corresponding NAT_GOV indicator is general, not targeted.
- The corresponding NAT_GOV indicator is greater than the STATE_ALL indicator on the ordinal scale for that indicator.

Note that _ALL observations at the subnational level also capture policies from higher-level governments if they are specifically targeted at that subnational jurisdiction. For example, if a national government orders events to close in a particular city experiencing an outbreak. These kinds of policies are coded directly in STATE_ALL or CITY_ALL observations at the sub-national level, and are not inferred from NAT_GOV.

On Github, these different types data are available in three groups:

- Main OxCGRT dataset: national data for almost 190 countries, and state-level data for US and UK. This records all policies that apply to people in a relevant jurisdiction.
- US: NAT_GOV and STATE_ALL (ie, state observations are without inherited higher level policies)
- Brazil: NAT_GOV, STATE_GOV, and CITY_GOV (ie, state and city observations are without inherited higher level policies)

Table 2: Currently available OxCGRT data across different levels of government and types of observations

Level	All countries	US	Brazil	UK
Main OxCGRT dataset[3]	186 countries	USA national, plus 50 states, DC, Puerto Rico	Brazil national	UK national, plus 4 devolved nations and several overseas territories[4]
NAT_GOV	-	US Federal Government	Brazilian Federal Government	UK Government
STATE_ALL	-	50 US states, DC, US Virgin Islands	-	4 devolved nations
STATE_GOV	-	-	27 States	-
CITY_GOV	-	-	8 State capitals	-

4. Policy indices of COVID-19 government responses

Governments' responses to COVID-19 exhibit significant nuance and heterogeneity. Consider, for example, C1, school closing: in some places, all schools have been shut; in other places, universities closed on a different timescale than primary schools; in other places still, schools remain open only for the children of essential workers. Moreover, like any policy intervention, their effect is likely to be highly contingent on local political and social contexts. These issues create substantial measurement difficulties when seeking to compare national responses in a systematic way.

Composite measures – which combine different indicators into a general index – inevitably abstract away from these nuances. This approach brings both strengths and limitations. Helpfully, cross-national measures allow for systematic comparisons across countries. By measuring a range of indicators, they mitigate the possibility that any one indicator may be over- or mis-interpreted. However, composite measures also leave out

[3] This main dataset combines the other datasets to report the overall policy settings that apply to residents within the jurisdictions.
[4] Overseas territories include Bermuda, British Virgin Islands, and others.

much important information, and make strong assumptions about what kinds of information "counts." If the information left out is systematically correlated with the outcomes of interest, or systematically under- or overvalued compared to other indicators, such composite indices may introduce measurement bias.

Broadly, there are three common ways to create a composite index: a simple additive or multiplicative index that aggregates the indicators, potentially weighting some; Principal Component Analysis (PCA), which weights individual indicators by how much additional variation they explain compared to the others; Principal Factor Analysis (PFA), which seeks to measure an underlying unobservable factor by how much it influences the observable indicators.

Each approach has advantages and disadvantages for different research questions. In this paper we rely on simple, additive unweighted indices as the baseline measure because this approach is most transparent and easiest to interpret. PCA and PFA approaches can be used as robustness checks.

This information is aggregated into a series of four policy indices, with their composition described the appendix.

- Overall government response index
- Stringency index
- Containment and health index
- Economic support index

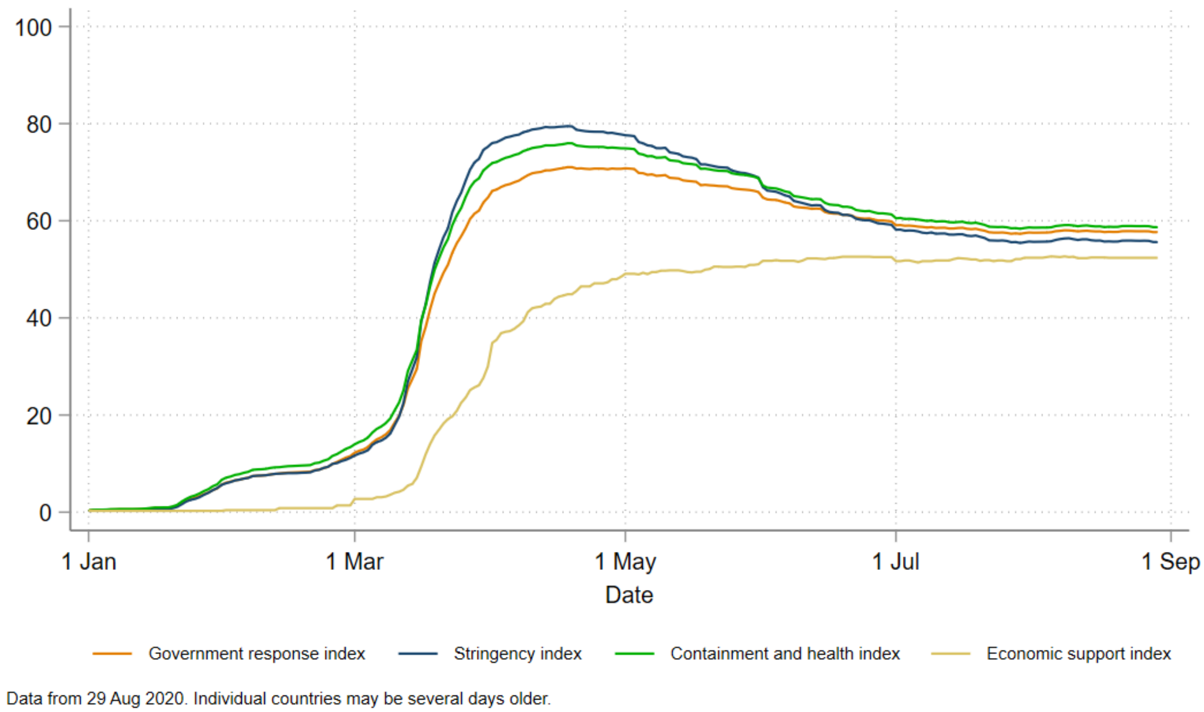
Each index is composed of a series of individual policy response indicators. For each indicator, we create a score by taking the ordinal value and adding an extra half-point if the policy is general rather than targeted, if applicable. We then rescale each of these by their maximum value to create a score between 0 and 100, with a missing value contributing 0.[5] These scores are then averaged to get the composite indices (Figure 1).

Importantly, the indices should not be interpreted as a measure of the appropriateness or effectiveness of a government's response. They do not provide information on how well policies are enforced, nor does it capture demographic or cultural characteristics that may affect the spread of COVID-19. Furthermore, they are not comprehensive measures of policy. They only reflect the indicators measured by the OxCGRT (see Table 1), and thus will miss important aspects of a government response. For instance, the "economic support index" does not include support to firms or businesses, and does not

[5] We use a conservative assumption to calculate the indices. Where data for one of the component indicators are missing, they contribute "0" to the Index. An alternative assumption would be to not count missing indicators in the score, essentially assuming they are equal to the mean of the indicators for which we have data for. Our conservative approach therefore "punishes" countries for which less information is available, but also avoids the risk of over-generalizing from limited information.

take into account the total fiscal value of economic support. The value and purpose of the indices is instead to allow for efficient and simple cross-national comparisons of government interventions. Any analysis of a specific country should be done on the basis of the underlying policy, not on an index alone.

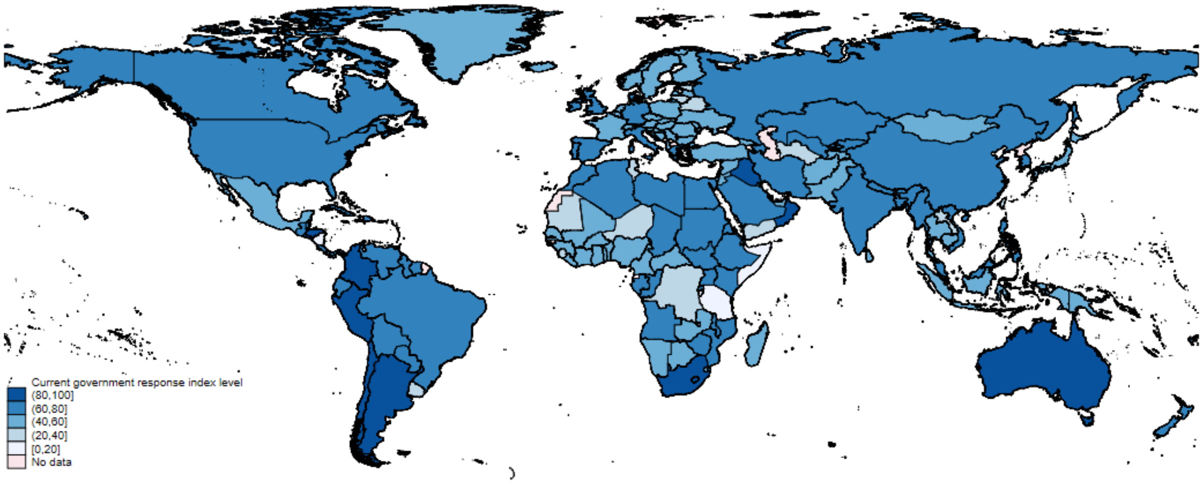
Figure 1: Global mean index values for over 180 countries over time



5. Variation in government responses

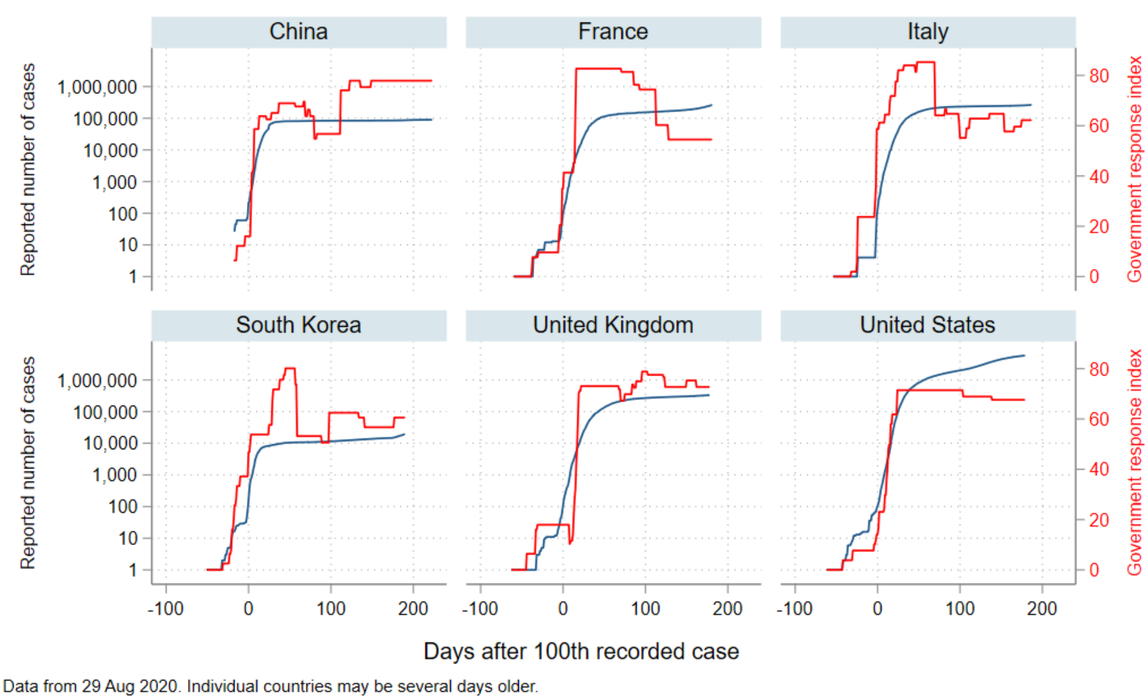
How have governments' responses varied? In general, government responses have become stronger over the course of the outbreak, particularly ramping up over the month of March (see Figure 1). However, variation can be seen across countries (Figure 2). This variation is becoming less pronounced over time as more countries implement comprehensive suites of measures.

Figure 2: COVID-19 Government Response Index by country, August 29, 2020



We expect the response measures to broadly track the spread of the disease. However, the rate at which such measures are adopted plays a critical role in stemming the infection. Relying on data primarily collated by the European Centre for Disease Control, Figure 3 compares the rate of confirmed cases (the black line) since the first reported death to changes in a country's government response index (the red line). Some governments immediately ratchet up measures as an outbreak spreads, while in other countries the increase in the stringency of responses lags the growth in new cases.

Figure 3: Reported COVID-19 deaths and government response index, selected countries

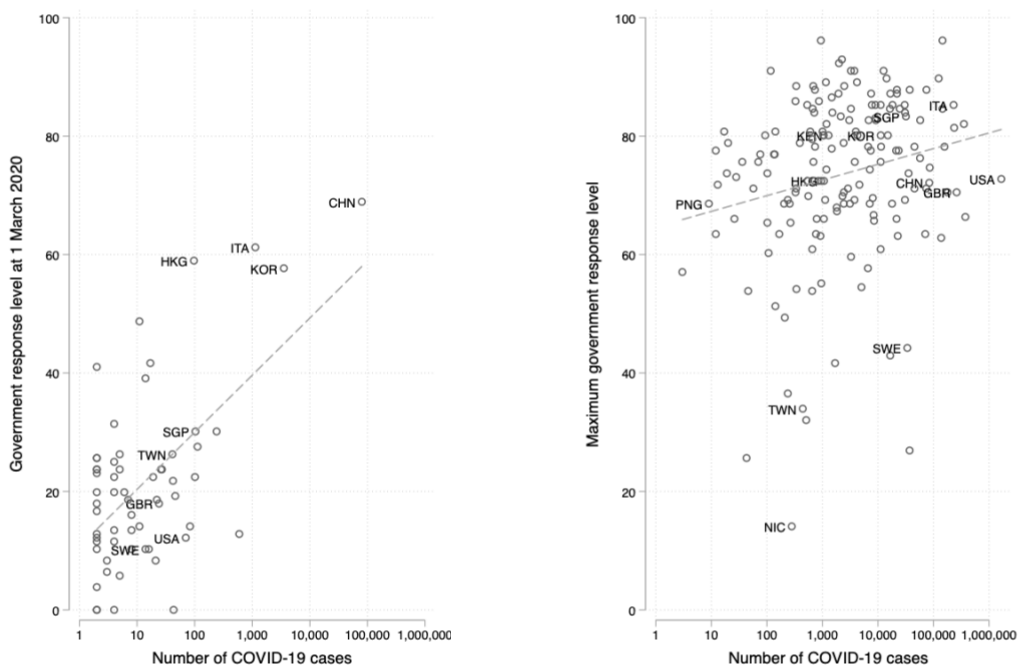


Differential responses can also be seen across the entire period. One measure of interest is the Response-Risk Ratio, which compares a government's response to the risk it faces. Risk is difficult to measure, since the number of cases recorded is in part a function of how much testing is carried out, which itself is a measure that will co-vary to some extent with the overall government's response index (being that testing is reflected in indicator H2). The number of deaths is less correlated with testing regime (but still dependent on how each country defines COVID-19 deaths).

Figure 4 presents the Response-Risk Ratio operationalised as the maximum level of government response a country has reached compared to the total number of cases in that country. Countries above the line can be interpreted as having more stringent measures than the average country (or at least, have enacted measures on a greater number of dimensions to a higher degree), given their number of confirmed cases. Conversely, countries below the line show a lower level of policy action than the average country given their number of confirmed cases. Thus, the closer a country is to the top-left corner of Figure 4, the higher the level of their response in light of the risk it faces, and conversely, the closer a country is to the bottom-right corner, the smaller its response given its risk. Over time, we are observing more countries implement a larger response at a lower case load.

Figure 4: Response-Risk Ratio

(a) as at 1 March 2020 (b) as at 27 May 2020



6. Conclusion

As governments continue to respond to COVID-19, it is imperative to study what measures are effective and which are not. While the data presented here do, of course, not measure effectiveness directly, they can be useful input to studies that analyse factors affecting disease progression. OxCGRT seeks to contribute to this knowledge gap by providing comparable measures of individual policy actions, as well as several comparable aggregate indices. We find significant variation in both the measures that governments adopt and when they adopt them. Going forward, governments will benefit from adopting an evidence-based approach to the measures they deploy.

OxCGRT will continue to evolve over the coming months as the pandemic progresses. We envision not only updating the data on a regular basis, but also refining and improving the indicators we record for each country. The most up-to-date technical documentation can always be found on our GitHub repository.[6]

It is our hope that scholars, medical professionals, policymakers, and concerned citizens will make use of the OxCGRT data to enhance all countries' responses to the COVID-19 pandemic. We welcome constructive feedback and collaboration on this project as it evolves.

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6 https://github.com/OxCGRT/covid-policy-tracker

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Bugei Nyaosi
Camilla Sacchetto
Carla Almeida da Vila
Carolina Martinelli
Carolina Scherer Beidacki
Caroline Weglinski
Cassy Inman
Celso Antônio Coelho Júnior
Charlotte Rougier
Chelsea Jackson
Chenxi Zhu
Chloe Mayoux
Christian Lumley
Clara Pavillet
Connor Lyons
Cristhian Pulido
Dan Mocanu
Dane Alivarius
Dang Dao Nguyen
Daniel Pereira Cabral
Dario Moreira
Davi Mamblona Marques Romão
Dayane Ferreira
Delgermaa Munkhgerel
Denilson Soares Gomes Junior
Diane Brandt
Dita Listya
Edgar Picon-Prado
Edward O'Brien
Elaine Fung
Eleanor Altamura
Elisabeth Mira Rothweiler
Elisangela Oliveira de Freitas
Ellen Sugrue
Emily Cameron-Blake
Emma Leonard
Emmanuel Mawuli Abalo
Ethan Teo
Fabiana da Silva Pereira
Fatima Zehra Naqvi
Femi Adebola
Finn Klebe
Francesca Lovell-Read
Francesca Valmorbida McSteen
Gabriel de Azevedo Soyer
Gabriel Podesta
Garima Rana
Gauri Chandra
George Sheppard
Grace Mzumara
Guilherme Ramos
Guillermo Miranda
Gulnoza Mansur
Hakeem Onasanya
Hala Sheikh Al Souk
Hang Yuan
Heather Walker
Helen Tatlow
Henrique Oliveira da Motta
Horácio Figueira de Moura Neto
Huma Zile
Hunter McGuire
Ifigenia Xifre Villar
Ilya Zlotnikov
Inaara Sundargy
India Clancy
Ingrid Maria Johansen
Innocent Mbaguta
Isabel Jorgensen
Isabel Seelaender Costa Rosa
Isabela Blumm
Isabela Blumm
Jake Lerner
James Fox
James Green
Javier Pardo-Diaz
Jeanna Kim
Jenna Hand
Jeroen Frijters
Jessica Anania
Joanna Klimczak
João Ferreira Silva
João Gabriel de Paula Resende
John Miller
Joris Jourdain

José Renato Venâncio Resende
Joseph Ssentongo
Joy Carveth
Juan David Gutierrez
Judy Cossins
Juhi Kore
Juliana Moura Bueno
Ka Yu Wong
Kaisa Saarinen
Kaitlyn Green
Kangning Zhang
Karoline Becker
Katherine McCreery
Katherine Tyson
Katrina Marina
Kaushalya Gupta
Kelly Daniels
Kristie Jameson
Lama Khaiyat
Lana Ahmad
Laura Chamberlain
Laura Chavez-Varela
Laura de Lisle
Laura dos Santos Boeira
Laura Hallas
Leanne Giordono
Leimer Tejeda Frem
Letícia Plaza
Liliana Estrada Galindo
Lin Shi
Lione Alushula
Liu (Victoria) Yang
Lore Purroy Sanchez
Louisa-Madeline Singer
Lucas Tse
Lucia Soriano
Lucy Goodfellow
Luiz Guilherme Roth Cantarelli
Manikarnika Dutta Dutta
Manjit Nath
Marcela Mello Zamudio
Marcela Reynoso Jurado
Mareeha Kamran
María de los Ángeles Lasa
Maria Leticia Claro de Faria Oliveira
Maria Luciano
Maria Paz Astigarraga Baez
Maria Puolakkainen
Mariam Raheem
Marianne Lafuma
Marie Mavrikios
Mark Boris Andrijanic
Marta Koch
Martha Stolze
Martina Lejtreger
Matheus Porto Lucena
Maurice Kirschbaum
Maurício Nardi Valle
Megan McDowell
Melody Leong
Michael Chen
Michelle Sharma
Minah Rashad
Monika Pyarali
Moza Ackroyd
Muktai Panchal
Nadia Nasreddin
Nadine Dogbe
Natalia Brigagão
Natália Colvero Maraschin
Natália de Paula Moreira
Natalia Espinola
Nate Dolton-Thornton
Natsuno Shinagawa
Negin Shahiar
Nicole Guedes Barros
Nomondalai Batjargal
Oksana Matiiash
Olga Romanova
Olivia Route
Pamela Gongora
Paola Del Carpio Ponce
Paola Schietekat Sedas
Paraskevas Christodoulopoulos
Patricia Silva Castillo
Pedro Arcain Riccetto
Pedro Ferreira Baccelli Reis
Pedro Santana Schmalz
Phyu Phyu Thin Zaw
Pollyana Lima
Pollyana Pacheco Lima
Precious Olajide
Prianka Rao
Primrose Adjepong

Priya Lakshmy Tbalasubramaniam
Priyanka Bijlani
Qingling Kong
Quynh Lam
Rahima Hanifa
Raveena Joseph
Rene' Landers
Rene' Landers
Ricardo Miranda Rocha Leitao
Robert Gorwa
Robin Thompson
Rodrigo Furst de Freitas Accetta
Rose Wachuka Macharia
Rotimi Elisha Alao
Rushay Naik
Saba Mahmood
Safa Khan
Salim Salamah
Saptarshi Majumdar
Sara Sethia
Sena Pradipta
Serene Singh
Seun Adebayo
SeungCheol Ohk
Shabana Basij-Rasikh
Shoaib Khan
Shwetanshu Singh
Silvia Shen
Simphiwe Stewart
Siu Cheng
Sophie Pearlman
Stefaan Sonck Thiebaut
Stephanie Guyett
Susan Degnan
Syed Shoaib Hasan Rizvi
Tamoi Fujii
Tanyah Hameed
Tatianna Mello Pereira da Silva
Tatsuya Yasui
Tebello Qhotsokoane
Teresa Soter Henriques
Terrence Epie
Teruki Takiguchi
Tetsekela Anyiam-Osigwe
Theo Bernard
Thomas Hale
Thomas Rowland
Tilbe Atav
Tim Nusser
Tiphaine Le Corre
Toby Phillips
Trevor Edobor
Twan van der Togt
Uttara Narayan
Veronique Gauthier
Will Marshall
William Dowling
William Hart
Yotam Vaknin
Yulia Taranova
Zara Raheem
Zilin Tu
Zoe Lin
Zoha Imran
Zunaira Mallick

Codebook

This coding scheme is tweaked and revised from time-to-time. Please refer to our GitHub repository for the most up-to-date technical documentation: https://github.com/OxCGRT/covid-policy-tracker/blob/master/documentation/codebook.md

Closures and containment

ID	Name	Description	Measurement	Coding instructions
C1	School closing	Record closings of schools and universities	Ordinal scale + binary for geographic scope	0 - No measures 1 - recommend closing 2 - Require closing (only some levels or categories, eg just high school, or just public schools) 3 - Require closing all levels No data - blank 0 - Targeted 1- General No data - blank
C2	Workplace closing	Record closings of workplaces	Ordinal scale + binary for geographic scope	0 - No measures 1 - recommend closing (or work from home) 2 - require closing (or work from home) for some sectors or categories of workers 3 - require closing (or work from home) all-but-essential workplaces (e.g. grocery stores, doctors) No data - blank 0 - Targeted 1- General No data - blank
C3	Cancel public events	Record cancelling public events	Ordinal scale + binary for geographic scope	0- No measures 1 - Recommend cancelling 2 - Require cancelling No data - blank 0 - Targeted 1- General No data - blank

C4	Restrictions on gatherings	Record the cut-off size for bans on private gatherings	Ordinal scale + binary for geographic scope	0 - No restrictions 1 - Restrictions on very large gatherings (the limit is above 1000 people) 2 - Restrictions on gatherings between 101-1000 people 3 - Restrictions on gatherings between 11-100 people 4 - Restrictions on gatherings of 10 people or less No data - blank 0 - Targeted 1 - General No data - blank
C5	Close public transport	Record closing of public transport	Ordinal scale + binary on geographic scope	0 - No measures 1 - Recommend closing (or significantly reduce volume/route/means of transport available) 2 - Require closing (or prohibit most citizens from using it) 0 - Targeted 1- General No data - blank
C6	Stay at home requirements	Record orders to “shelter-in- place” and otherwise confine to home.	Ordinal scale + binary on geographic scope	0 - No measures 1 - recommend not leaving house 2 - require not leaving house with exceptions for daily exercise, grocery shopping, and ‘essential’ trips 3 - Require not leaving house with minimal exceptions (e.g. allowed to leave only once a week, or only one person can leave at a time, etc.) No data - blank 0 - Targeted 1- General No data – blank
C7	Restrictions on internal movement	Record restrictions on internal movement	Ordinal scale + binary on geographic scope	0 - No measures 1 - Recommend not to travel between regions/cities 2 – internal movement restrictions in place 0 - Targeted 1- General No data - blank

C8	International travel controls	Record restrictions on international travel	Ordinal scale	0 - No measures 1 - Screening 2 - Quarantine arrivals from high-risk regions 3 - Ban on arrivals from some regions 4 – Ban on all regions or total border closure No data - blank

Economic measures

ID	**Name**	**Description**		**Coding instructions**
E1	Income support	Record if the government is covering the salaries or providing direct cash payments, universal basic income, or similar, of people who lose their jobs or cannot work. (Includes payments to firms if explicitly linked to payroll/ salaries)	Ordinal scale + binary scale for **sectoral** scope	0 - no income support 1 - government is replacing less than 50% of lost salary (or if a flat sum, it is less than 50% median salary) 2 - government is replacing 50% or more of lost salary (or if a flat sum, it is greater than 50% median salary) No data - blank 0 - formal sector workers only 1 - transfers to informal sector workers too No data - blank
E2	Debt / contract relief for households	Record if govt. is freezing financial obligations (e.g. stopping loan repayments, preventing services like water from stopping, or banning evictions)		0 - No 1 - Narrow relief, specific to one kind of contract 2 - broad debt/contract relief
E3	Fiscal measures	What economic stimulus policies are adopted?	USD	Record monetary value USD of fiscal stimuli, including spending or tax cuts NOT included in E4, H4, or H5 (see below) -If none, enter 0 No data - blank Please use the exchange rate of the date you are

				coding, not the current date. Exchange rate info here.
E4	Providing support to other countries	Announced offers of COVID-19 related aid spending to other countries	USD	Record monetary value announced if additional to previously announced spending -if none, enter 0 No data - blank Please use the exchange rate of the date you are coding, not the current date. Exchange rate info here.

Health measures

ID	Name	Description	Measurement	Coding instructions
H1	Public info campaigns	Record presence of public info campaigns	Binary + binary on geographic scope	0 -No COVID-19 public information campaign 1 - public officials urging caution about COVID-19 2 - coordinated public information campaign (e.g. across traditional and social media) No data - blank 0 - Targeted 1- General No data - blank
H2	Testing policy	Who can get tested?	Ordinal scale	0 – No testing policy 1 – Only those who both (a) have symptoms AND (b) meet specific criteria (e.g. key workers, admitted to hospital, came into contact with a known case, returned from overseas) 2 – testing of anyone showing COVID-19 symptoms 3 – open public testing (e.g. “drive through” testing available to asymptomatic people) No data N.B. we are looking for policies about testing for having an infection (PCR tests) - not for

				policies about testing for immunity (antibody tests).
H3	Contact tracing	Are governments doing contact tracing?	Ordinal scale	0 - No contact tracing 1 - Limited contact tracing - not done for all cases 2 - Comprehensive contact tracing - done for all identified cases No data
H4	Emergency investment in health care	Short-term spending on, e.g., hospitals, masks, etc	USD	-Record monetary value in USD of new short-term spending on health -If none, enter 0 No data - blank Please use the exchange rate of the date you are coding, not the current date. Exchange rate info here.
H5	Investment in vaccines	Announced public spending on vaccine development	USD	Record monetary value announced if additional to previously announced spending -If none, enter 0 No data - blank Please use the exchange rate of the date you are coding, not the current date. Exchange rate info here.

Miscellaneous

ID	Name	Description	Measurement	Coding instructions
M1	Misc. wild card	Record policy announcements that do not fit anywhere else	Free text	Note unusual or interesting interventions that you think are worth flagging. Include relevant documentation.

Calculation of policy indices

The composition and calculation of our indices is updated from time-to-time. Please refer to our GitHub repository for the most up-to-date technical documentation: https://github.com/OxCGRT/covid-policy-tracker/blob/master/documentation/index_methodology.md

<u>Policy indices</u>

All of our indices are simple averages of the individual component indicators. This is described in equation 1 below where *k* is the number of component indicators in an index and I_j is the sub-index score for an individual indicator.

$$(1) \qquad index = \frac{1}{k}\sum_{j=1}^{k} I_j$$

The different indices are comprised as follows:

Index	*k*	C1	C2	C3	C4	C5	C6	C7	C8	E1	E2	E3	E4	H1	H2	H3	H4	H5	M1
Government response index	13	x	x	x	x	x	x	x	x	x	x			x	x	x			
Containment and health index	11	x	x	x	x	x	x	x	x					x	x	x			
Stringency index	9	x	x	x	x	x	x	x	x					x					
Economic support index	2									x	x								
Legacy stringency index (see end of doc)	7	x	x	>	?	x	?	?	x					x					

Two versions of each indicator are present in the database. A regular version which will return null values if there is not enough data to calculate the index, and a "display" version which will extrapolate to smooth over the last seven days of the index based on the most recent complete data. This is explained below.

<u>Calculating sub-index scores for each indicator</u>

All of the indices use ordinal indicators where policies a ranked on a simple numerical scale. The project also records five non-ordinal indicators – E3, E4, H4, H5 and M1 – but these are not used in our index calculations.

Some indicators – C1-C7, E1 and H1 – have an additional binary flag variable that can be either 0 or 1. For C1-C7 and H1 this corresponds to the geographic scope of the policy. For E1, this flag variable corresponds to the sectoral scope of income support.

The codebook has details about each indicator and what the different values represent.

Because different indicators (j) have different maximum values (N_j) in their ordinal scales, and only some have flag variables, each sub-index score must be calculated separately. The different indicators are:

Indicator	**Max value (N_j)**	**Flag? (F_j)**
C1	3 (0, 1, 2, 3)	Yes=1
C2	3 (0, 1, 2, 3)	Yes=1
C3	2 (0, 1, 2)	Yes=1
C4	4 (0, 1, 2, 3, 4)	Yes=1
C5	2 (0, 1, 2)	Yes=1
C6	3 (0, 1, 2, 3)	Yes=1
C7	2 (0, 1, 2)	Yes=1
C8	4 (0, 1, 2, 3, 4)	No=0
E1	2 (0, 1, 2)	Yes=1
E2	2 (0, 1, 2)	No=0
H1	2 (0, 1, 2)	Yes=1
H2	3 (0, 1, 2, 3)	No=0
H3	2 (0, 1, 2)	No=0

Each sub-index score (I) for any given indicator (j) on any given day (t), is calculated by the function described in equation 2 based on the following parameters:

- the maximum value of the indicator (N_j)
- whether that indicator has a flag (F_j=1 if the indicator has a flag variable, or 0 if the indicator does not have a flag variable)
- the recorded policy value on the ordinal scale ($v_{j,t}$)
- the recorded binary flag for that indicator, if that indicator has a flag ($f_{j,t}$)

This normalises the different ordinal scales to produce a sub-index score between 0 and 100 where each full point on the ordinal scale is equally spaced. For indicators that do have a flag variable, if this flag is recorded as 0 (i.e. if the policy is geographically targeted or for E1 if the support only applies to informal sector workers) then this is treated as a half-step between ordinal values.

Note that the database only contains flag values if the indicator has a non-zero value. If a government has no policy for a given indicator (i.e. the indicator equals zero) then the corresponding flag is blank/null in the database. For the purposes of calculating the index, this is equivalent to a sub-index score of zero. In other words, $I_{j,t}=0$ if $v_{j,t}=0$.

(2) $$I_{j,t} = 100\frac{v_{j,t} - 0.5(F_j - f_{j,t})}{N_j}$$

Here is an explicit example of the calculation for a given country on a single day:

Indicator	$v_{j,t}$	$f_{j,t}$	N_j	F_j	$I_{j,t}$
C1	2	1	3	yes=1	66.67
C2	no data	no data	3	yes=1	0.00
C3	2	0	2	yes=1	75.00
C4	2	0	4	yes=1	37.50
C5	0	null	2	yes=1	0.00
C6	1	0	3	yes=1	16.67
C7	1	1	2	yes=1	50.00
C8	3	N/A	4	no=0	75.00
E1	2	0	2	yes=1	75.00
E2	2	N/A	2	no=0	100.00
H1	2	0	2	yes=1	75.00
H2	3	N/A	3	no=0	100.00
H3	2	N/A	2	no=0	100.00

Index	
Government response	59.29
Containment and health	54.17
Stringency	43.98
Economic support	87.50

Dealing with gaps in the data for display purposes

Because data are updated on twice-weekly cycles, but not every country is updated in every cycle, recent dates may be prone to missing data. If fewer than *k-1* indicators are present for an index on any given day, the index calculation is rejected and no value is returned. For the economic support indicator, where *k*=2, the index calculation is rejected if either of the two indicators are missing.

To increase consistency of recent data points which are perhaps mid contribution, index values pertaining to the past seven days are rejected if they have fewer policy indicators than another day in the past seven days, i.e. if there is another recent data point with all *k* indicators included, then no index will be calculated for dates with *k-1*.

Further, we produce two versions of each index. One with the raw calculated index values, plus we produce a "display" version which will "smooth" over gaps in the last seven days, populating each date with the last available "good" data point.

For example, the date at the time of writing was 22 May. The table below gives an example of which index calculations would be rejected based on the number of policy indicators with data on each data. In this table, we will consider the overall government response index where *k*=13.

Date	No. of valid indicators	No. of indicators in index (*k*)	Raw index	"Display" index
10/05/2020	11	13	null	null
11/05/2020	12	13	60	60
12/05/2020	10	13	null	null
13/05/2020	13	13	65	65
14/05/2020	10	13	null	null
15/05/2020	10	13	null	null
16/05/2020	10	13	null	65
17/05/2020	13	13	70	70
18/05/2020	13	13	75	75
19/05/2020	12	13	null	75
20/05/2020	12	13	null	75
21/05/2020	6	13	null	75
22/05/2020 (today)	4	13	null	75

<u>Legacy stringency index</u>

We also report a legacy stringency index that approximates the logic of the first version of the Stringency Index, which only had seven components under our old database structure with the old indicators S1-S7. We generally do not recommend using this legacy index, but it may be useful for continuity purposes.

The legacy indicator only uses seven indicators, and it chooses a single indicator between C3 and C4, and between C6 and C7, selecting whichever of those pairs provides a higher sub-index score. This is because C3 and C4 aim to measure the information previously measured by S3, and similarly for C6, C7 and the old S6. This method, shown in equation 3, faithfully recreates the logic of the old stringency index.

$$(3) \qquad SI_{legacy} = \frac{1}{7}\left(I_{C1} + I_{C2} + max(I_{C3}, I_{C4}) + I_{C5} + max(I_{C6}, I_{C7}) + I_{C8} + I_{H1}\right)$$

The individual sub-index scores for the legacy index are calculated through a slightly different formula to the one described in equation 2 above. This formula is described in equation 4 below (with a separate formula for C8, the only indicator in this index without a flagged variable).

$$(4) \qquad I_{j,t} = 100\left(\frac{v_{j,t} + f_{j,t}}{N_j + 1}\right) \quad | \quad I_{C8,t} = 100\left(\frac{v_{C8,t}}{N_{C8}}\right)$$