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Variation in government responses to COVID-19

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www.bsg.ox.ac.uk/covidtracker

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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, and governments weigh decisions about the stringency of their policies against other concerns. We introduce the Oxford COVID-19 Government Response Tracker (OxCGRT), providing a systematic way to track the stringency of government responses to COVID-19 across countries and time. Using a novel index that combines various measures of government responses, we describe variation in government responses, explore whether rising stringency of response affects the rate of infection, and identify correlates of more or less stringent 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, 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 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 composite index to measure the stringency of these responses. Data is collected and updated in real time by a team of dozens of students and staff at Oxford University.

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.

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. 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 throughout that jurisdiction or across the economy). These indicators are reported for each day a policy is in place.
- **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 observerstions also have a "notes" cell thar 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	Gegraphic
C2	Workplace closing	Ordinal	Gegraphic
C3	Cancel public events	Ordinal	Gegraphic
C4	Restrictions on gathering size	Ordinal	Gegraphic
C5	Close public transport	Ordinal	Gegraphic
C6	Stay at home requirements	Ordinal	Gegraphic
C7	Restrictions on internal movement	Ordinal	Gegraphic
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		No
E4	giving international support		No
Heatlh systems			
H1	Public information campaign	Ordinal	Gegraphic
H2	testing policy	Ordinal	No
H3	contact tracing	Ordinal	No
H4	emergency investment in healthcare		No
H5	investment in Covid-19 vaccines		No
Miscellanious			
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.[1]

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.

[1] www.bsg.ox.ac.uk/covidtracker
[2] For a description of these changes, see this link.

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 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 a simple, additive unweighted index as the baseline measure because this approach is most transparent and easiest to interpret. PCA and PFA approaches can be used as robustness checks.

3. COVID-19 Government Response Stringency Index

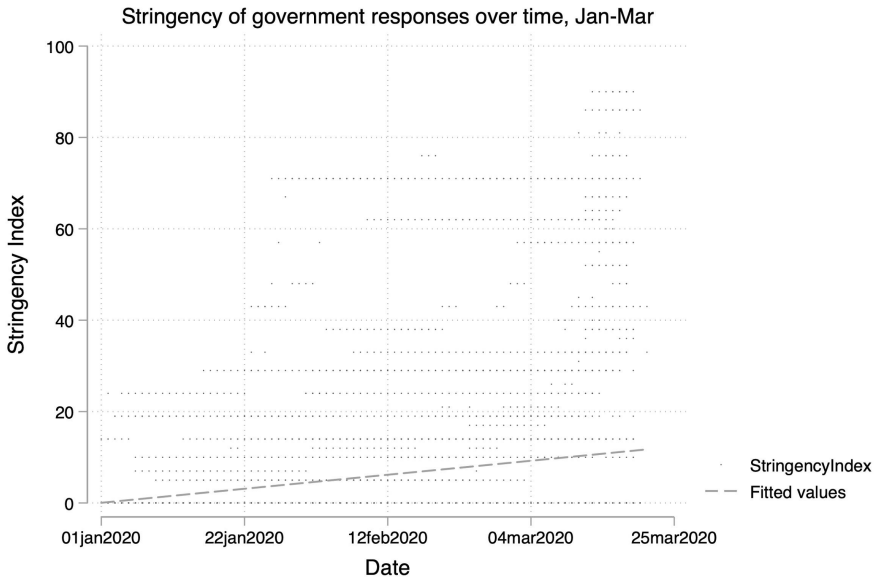
The Stringency Index captures variation in containment and closure policies only. For each policy response measure C1-C8 and H1, we create a score by taking the ordinal value and adding a weighted constant if the policy is general rather than targeted, if applicable. We then rescale each of these by their maximum value to create a score

between 0 and 100, with a missing value contributing 0.[3] These nine scores are then averaged to get the composite Stringency Index (Figure 1).

At the time of writing, OxCGRT has collected information on the stringency of government responses for over one hundred countries. More countries will be added in future iterations.

Importantly, the Stringency Index should not be interpreted as a measure of the appropriateness or effectiveness of a government's response. It does 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. Its value is instead to allow for efficient cross-national comparisons of government interventions.

Figure 1: Stringency of government responses over time



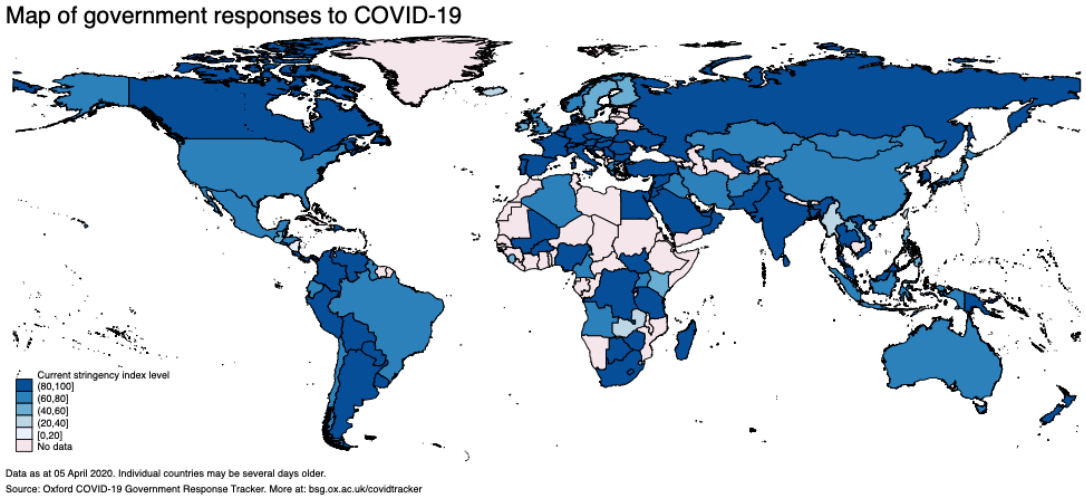
OxCGRT also tracks countries' economic and health system responses to COVID-19 via E1-E4 and H2-H5. These indicators will be discussed in future iterations of the working paper.

[3] We use a conservative assumption to calculate the Stringency Index. Where data for one of the seven 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.

4. Variation in government responses

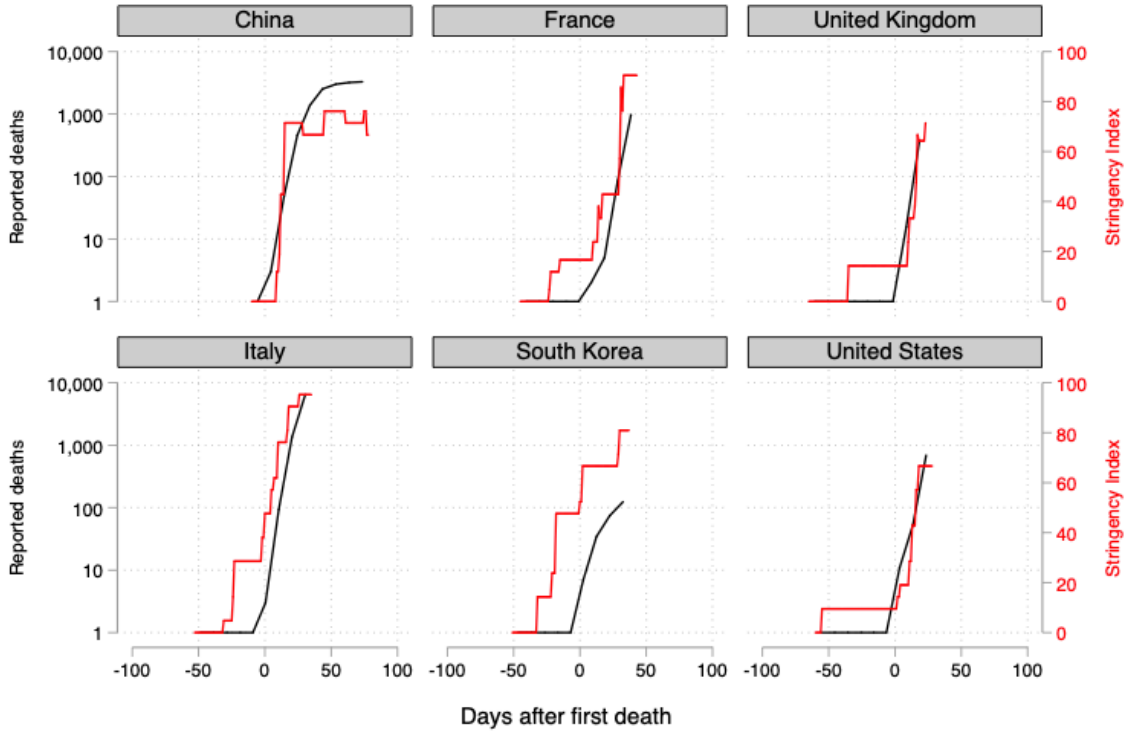
How have governments' responses varied? In general, government responses have become more stringent over the course of the outbreak. However, variation can be seen across countries (Figure 2). This variation is becoming less pronounced over time as more countries implement comprehensive suites of measures.

Figure 2: COVID-19 Government Response Stringency Index by country, April 5, 2020



We expect the stringency of 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 WHO data, Figure 3 compares the rate of confirmed deaths (the black line) since the first reported death to changes in a country's Stringency 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 stringency Index, selected countries

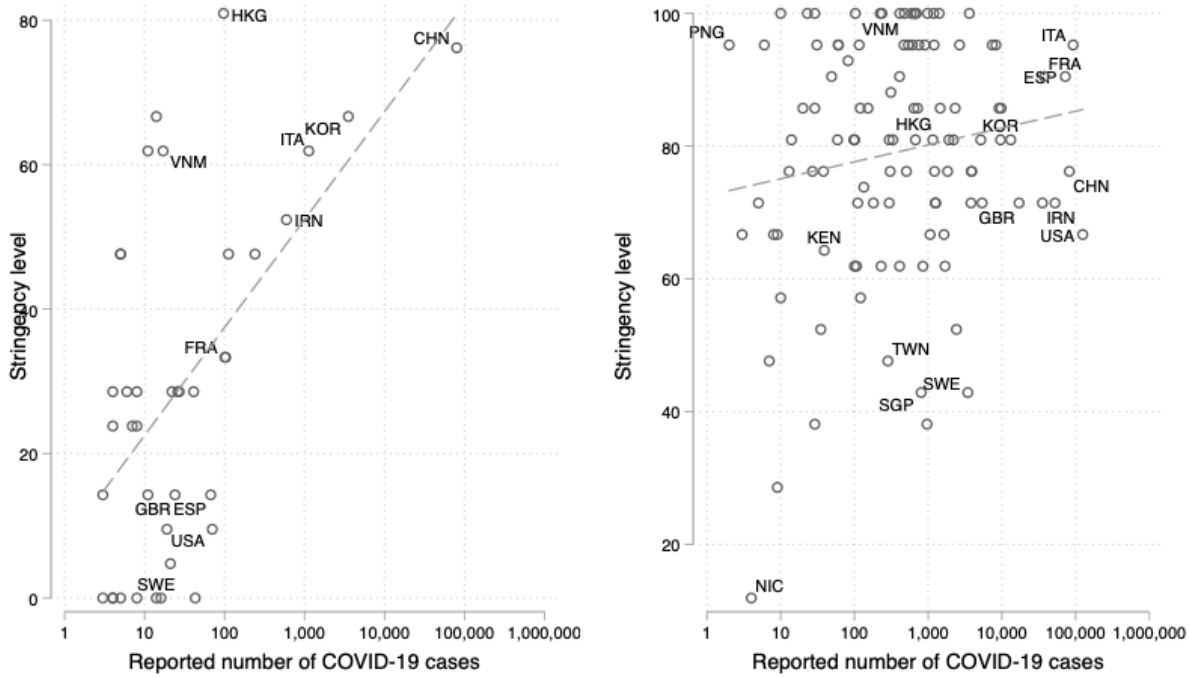


Differential responses can also be seen across the entire period. One measure of interest is the Stringency-Risk Ratio, which compares a government's response to the risk it faces. Risk is difficult to measure, since the number of cases recorded is in part a function of how much testing is carried out, which is likely to co-vary with the stringency of the government's response. The number of deaths is not correlated with testing (unless deaths are misattributed) but also correlated with the stringency or the response.

Figure 4 presents the Stringency-Risk Ratio operationalized as the maximum level of stringency a government 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, given their number of confirmed cases. Conversely, countries below the line show less stringency 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 more stringent its response in light of the risk it faces, and conversely, the closer a country is to the bottom-right corner, the less stringent its response given its risk. Over time, we are observing more countries take stringent measures at a lower case load.

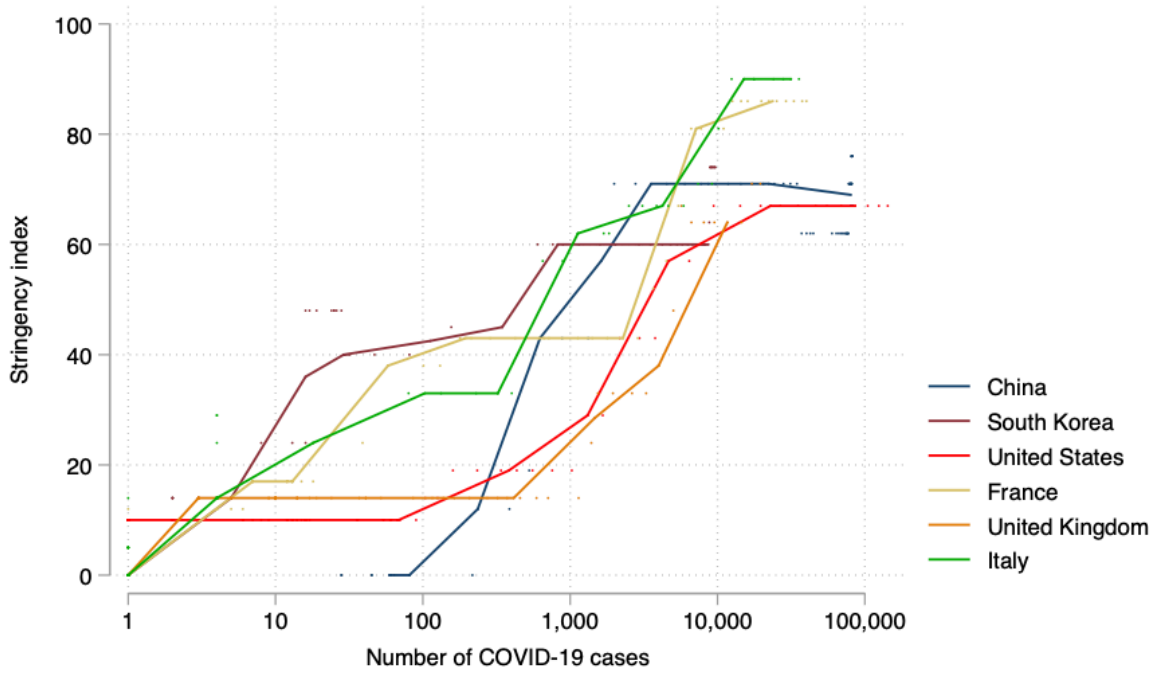
Figure 4: Stringency-Risk Ratio

(a) as at 1 March 2020 (b) as at 5 April 2020



Another way of thinking about this is to consider at which point in a country's infection trajectory they choose to implement more stringent policies. We generally see that countries increase their level of stringency as their number of confirmed COVID-19 cases rise, however there is significant variation in the rate and timing of this relationship. Figure 5 compares this relationship for the same six countries considered in Figure 3 above.

Figure 5. Stringency-Risk change over time



Data as at 30 March 2020. Individual countries may be several days older.
Source: Oxford COVID-19 Government Response Tracker. More at: bsg.ox.ac.uk/covidtracker

5. 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 a comparable measure of the stringency of government responses over time. 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 weeks 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.

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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Codebook

Closures and containment

ID	Name	Description	Measurement	Coding instructions
C1 (prev S1)	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 (prev S2)	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 (eg grocery stores, doctors) No data - blank 0 - Targeted 1- General No data - blank
C3 (prev S3)	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 [new]	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 100-1000 people

				3 - Restrictions on gatherings between 10-100 people 4 - Restrictions on gatherings of less than 10 people No data - blank 0 - Targeted 1 - General No data - blank
C5 (prev S4)	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 (new]	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 every few days, or only one person can leave at a time, etc.) No data - blank 0 - Targeted 1- General No data – blank
C7 (prev S6)	Restrictions on internal movement	Record restrictions on internal movement	Ordinal scale + binary on geographic scope	0 - No measures 1 - Recommend closing (or significantly reduce volume/route/means of transport) 2 - Require closing (or prohibit most people from using it) 0 - Targeted 1- General No data - blank
C8 (prev S7)	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 high-risk regions

				4 - Total border closure No data - blank

Economic measures

ID	Name	Description		Coding instructions
E1 [new]	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 more than 50% 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 [new]	Debt / contract relief for households	Record if govt. is freezing financial obligations (eg 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 (prev S8)	Fiscal measures	What economic stimulus policies are adopted?	USD	Record monetary value USD of fiscal stimuli, including spending or tax cuts NOT included in S10 (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 [new]	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 (prev S5)	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 (prev S12)	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 (eg 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 (eg “drive through” testing available to asymptomatic people) No data Nb we are looking for policies about testing for having an infection (PCR tests) - not for policies about testing for immunity (antibody tests).

H3 (prev S13)	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 cases No data
H4 (prev S10)	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 (prev S11)	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.

Miscellanious

ID	Name	Description	Measurement	Coding instructions
M1 (new])	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 stringency index

Calculation

The stringency index is calculated using only the policy indicators C1 – C8 and H1. The value of the index on any given day is the average of nine sub-indices pertaining to the individual policy indicators, each taking a value between 0 and 100:

$$I = \frac{1}{9}\sum_{j=1}^{9} I_j$$

Indicators C1 to C7 and H1 have an additional flag corresponding to whether the policy has been applied locally, in specific areas/circumstances, or generally, nationwide. We define G_j to be 0 if the policy is targeted and 1 if general. Note that a policy can only be general if it has a non-zero value, since a zero value corresponds to no measures being taken.

Because different indicators *j* have different maximum values N_j in their ordinal scales, we weight the additional contribution of a general policy by the average number of ordinal points across the eight indicators that have the targeted/general qualification. This ensures that general policies are not "over-contributing" to indicators with fewer ordinal points or "under-contributing" to indicators with more ordinal points. Specifically:

Indicator	N_j	**Targeted/General?**
C1	3 (0, 1, 2, 3)	Yes
C2	3 (0, 1, 2, 3)	Yes
C3	2 (0, 1, 2)	Yes
C4	4 (0, 1, 2, 3, 4)	Yes
C5	2 (0, 1, 2)	Yes
C6	3 (0, 1, 2, 3)	Yes
C7	2 (0, 1, 2)	Yes
C8	4 (0, 1, 2, 3, 4)	No
H1	2 (0, 1, 2)	Yes

The additional weight for a policy of general scope is defined in relation to the number of ordinal points of the eight indicators that have the targeted/general flags, that is

$$w = \frac{1}{8}\sum_{j=1}^{8} \frac{1}{(N_j + 1)} \approx 0.29$$

Then we define, for these 8 indicators the sub-indices to be

$$I_j = 100\left(C_j \frac{1-w}{N_j} + w\, G_j\right)$$

where C_j is the ordinal value of indicator Cj and its weighting here ensures that the subindex I_j varies between 0 and 100. Since C8 has no notion of general vs targeted, we just have

$$I_9 = 100\frac{C_9}{N_9}$$

The sub-indices are thus linearly proportional to the ordinal value of that policy indicator, with a standardized 'bonus point' for a generally-applied policy.
We make the conservative assumption that an absence of data corresponds to a sub-index of zero.
Here is an explicit example of the calculation:

Indicator	Value	General?	Max value	Sub Index
Variable:	Cj	Gj	Nj	Ij
C1	No data	No data	3	0
C2	1	1	3	53
C3	2	0	2	71
C4	2	0	4	36
C5	1	1	2	65
C6	2	1	3	76
C7	2	1	2	100
C8	2	NA	4	50
H1	2	1	2	100
			Overall	61.11

If fewer than six policy indicators have data on a given day, the index calculation is rejected and no value is returned.