The Role of Government in Containing COVID-19

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Introduction

The coronavirus has disrupted the world as we know it. In the wake of being separated from Brown and spread across the world, we wanted to explore how effectively different types of governments have handled containing the virus.

With the global focus on implementing lockdowns, our intuition was that lockdowns would have the greatest impact on keeping number of cases low. However, we wanted to explore other ways in which government intervention affects the spread of the virus.

Hypotheses

We decided to explore:

- Which factor/index plays the most important role in determining a country's total spread?
- What's the nature of impact on cases?

Data

We used the **Johns Hopkins Covid-19 global cases** dataset to find the number of total infections in each country. The government effectiveness and human freedom indices were found from the **World Bank's** country data set, and the stringency index was from **Oxford's Government Response Tracker**, showing stringency of lockdown measures taken by countries.

Since Human Freedom and Government Effectiveness are **static variables** (only updated yearly), we used 2019 values. As for Stringency Index, Total tests and total cases, we consider values as of April 14, 2020 when evaluating alongside static variables.

Challenges

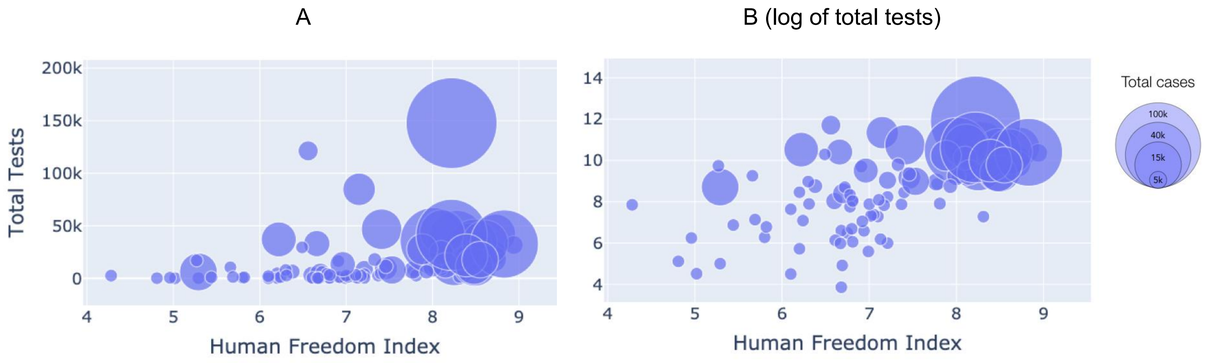
- Excluding countries where testing and lockdown data is not very available (incl key countries e.g. China)
- Static variables
- Small dataset with outliers which can lead to misleading results (unethical)
- Continuous to categorical, results can change based on thresholds (testing groups can skew the results)

1) Which variables impact cases?

We ran a **multiple regression** to model the total cases from government effectiveness, stringency index, human freedom, and total tests. We found that the coefficients of **total tests and human freedom are significant**, with effect sizes of **0.41 (p=0.00)** and **3,859.64 (p=0.037)**, respectively. That is, a country with 1-unit higher human freedom index would have 3,859 more cases per million people. Interestingly **stringency index is not significant: -7.82(p=0913)**

	Coefficient	P-Value
Government effectiveness	234.16	0.918
Stringency index	-7.82	0.913
Human Freedom	3,859.64	0.037
Total tests	0.41	0.000

Relative Impact of Testing and Freedom on Cases

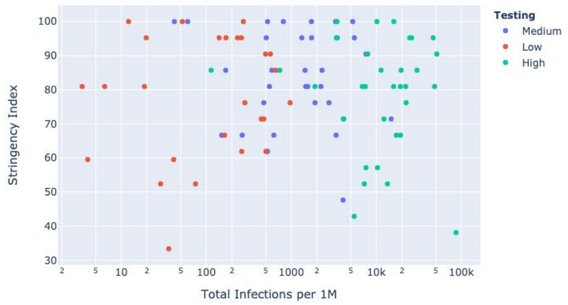


2) In what way do variables impact cases?

We decided to explore the nature of the effect of the variables on cases per million using **one-tailed T-tests with a 5% level of significance.** Given that the regression showed testing being significant with a small coefficient, we were curious about exploring impact between the other variables by controlling for testing. Thresholds: Low, Medium, High such that each bin has the same number of countries.

The evidence does not show that high stringency index (severe lockdowns) is associated with a lower number of cases per million (**cannot reject the null,** alternative hypothesis states cases decrease with increase in stringency). Similarly, there is no evidence to show that high government effectiveness is associated with a lower number of cases per million (**cannot reject the null,** alternative hypothesis states cases decrease with increase in government effectiveness). However, our results show that at a low human freedom index is associated with a lower number of cases per million in the high testing group (**reject null**; alternative hypothesis states cases increase with increase in human freedom). This result should however be taken with a grain of salt as this is only true in the high testing group and binning of countries into groups may be skew our results.

Effect of Stringency Index on Coronavirus Infections



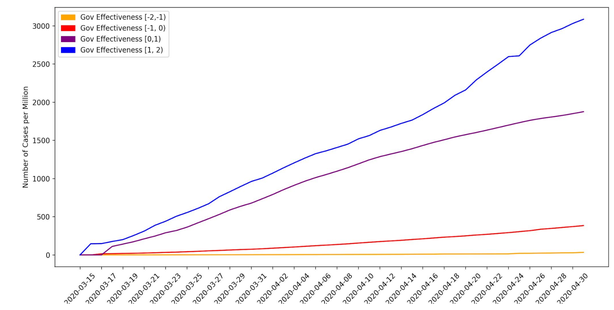
Testing Group	Low			Medium			High		
	T-value	T-Crit	Result	T-value	T-Crit	Result	T-value	T-Crit	Result
Government effectiveness	-4.39	1.71	NR	-0.89	1.703	NR	-1.41	1.71	NR
Stringency Index	-0.17	1.76	NR	1.44	1.75	NR	-0.12	1.75	NR
Human Freedom	1.43	1.71	NR	1.55	1.69	NR	1.82	1.71	R

3) Impact over time

To further investigate nature of impact, we explored whether nature of impact would change over time. We used a **line plot** to chart average coronavirus cases per million of countries with different degrees of government effectiveness from March 15 to May 1. As seen in the graph below, countries with higher government effectiveness (0-2) experienced linear growth of cases with gradient greater than that of countries with lower government effectiveness (-2-0)

While the visualization illustrates a correlation between government effectiveness and coronavirus cases, our multiple regression analysis in 1) demonstrated no correlation with a coefficient of 234.16 (p=0.918). Therefore, more data and investigation would be required. One avenue is to demonstrate the P-values across different dates.

Change in Coronavirus Cases per Million by Government Effectiveness



Conclusions

- Total tests and human freedom impact total cases. Higher tests and human freedom lead to more cases.
- Stringency index and government effectiveness do not affect total cases.
- Impact over time however refutes this claim as it shows correlation between government effectiveness and total cases.
- More investigation is required.

Next Steps

- More countries with complete data
- Controlled Data: get values 100 days after case 0.
- Two tailed T-tests to test any correlation.
- Repeat tests periodically due to the constantly changing situation: cases, tests, lockdowns