What is the impact of free societies versus authoritarian regimes in flattening the curve of COVID-19

IMMEDIATE

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In free societies, the duration of COVID-19, in theory, will depend on how compliant people are, and for how long. It is a safe assumption to say that the more authoritative regimes are going to have more success at social distancing. Thus, this has appeared to be successful in China, if their numbers are accurate. Western countries are less adept at having a restriction on their civil liberties, even in a time of pandemic crisis. No government other than the most repressive will believe it can keep its country on lock down for months on end—and even if it could, the economic effects would be intolerable.

1. INTRODUCTION

Government-imposed restrictions in different countries with different restrictions have varying effects in limiting the spread of COVID-19. Simply recommending basic health advice, such as staying home, is not effective. Without enforcement, government officials have a hard time getting people to listen and comply with needed restrictions. Not long after actions were taken in many parts of Europe, French President Emmanuel Macron mobilized the French army to enforce state orders that anyone leaving home must be on essential business [1].

Enforcement included closing all cafes, restaurants, cinemas, nightclubs, museums, and sports centers. Both British prime minister Boris Johnson and German chancellor Angela Merkel issued directives and restrictive guidelines for their people. Spain's coalition government issued a 15-day state of emergency. Figure 1 shows the daily infections after the first day with 100 confirmed cases. Note that in the more repressive regimes, China, you do see a flattening of the curve. The United States and Europe appear to be parabolic.

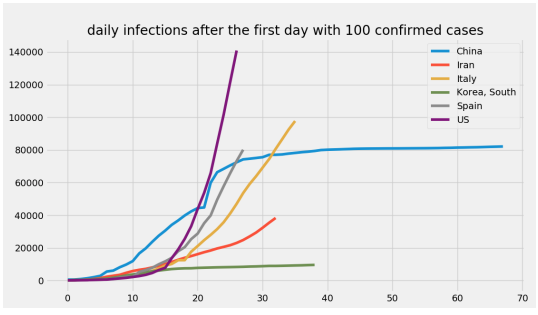

Fig. 1. Daily infections after the first day with 100 confirmed cases.

2. EXPONENTIAL GROWTH AND PANDEMICS

According to Phua, J. et al. and the American Hospital Association, China has a little under 50,000 ICU beds and the United States has access to roughly 100,000 beds, if all types of ICU beds were used during this crisis (surgical, cardiac, neonatal, pediatric, and others).Standardizing this by population, Figure 2 shows that China has access to significantly fewer ICU beds per 100,000 people than the United States [7].

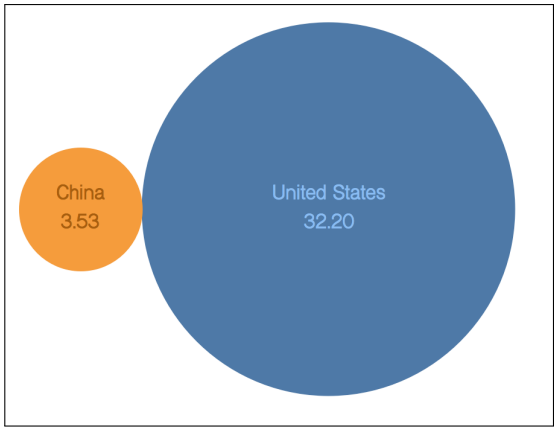

Fig. 2. ICU Beds per 100,000 people.

To compare theoretical ICU exhaustion, Figure 3 shows the number of days following the first confirmed case for the virus to theoretically overwhelm the number of ICU beds in each country (where the number of confirmed cases met or surpassed the number of beds). In China, it took 88 days for this to occur, whereas it only took 67 days from the first confirmed case to theoretically overwhelm ICU beds in the United States. Theo-

retically, despite the fact that the United States has significantly more ICU beds per 100,000 people, the rate of transmission could cause ICU beds in the United States to be exhausted far more quickly than that of China.

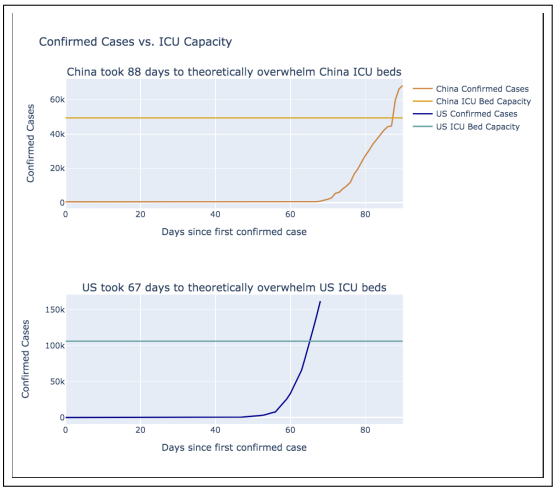

Fig. 3. Number of days since the first confirmed case it took for the number of confirmed cases to surpass the number of ICU beds.

3. TRANSMISSION AFTER GOVERNMENT IMPOSED RESTRICTION

Community transmission between these countries can be analyzed by comparing the epicenters of the virus for its respective country - Hubei province in China and New York state in the United States. Hubei was placed on complete lock down on January 23, 2020, restricting its citizens from leaving their places of residence without permission. The state of New York issued a Stay at Home order beginning on March 22, 2020, where citizens were instructed to stay at home as much as possible [5]. This is of particular importance to our research and the consequences of this behavior will be apparent over the next few months.

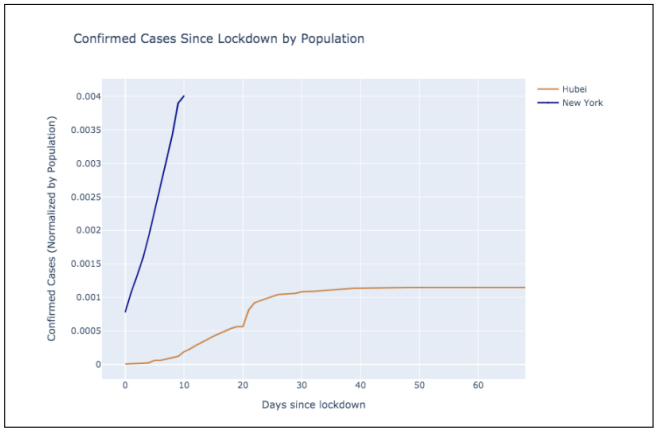

Fig. 4. Number of confirmed cases normalized by population since government-imposed restrictions.

When normalizing the number of confirmed COVID-19 cases in each of these areas by population of the corresponding locations, Figure 4 illustrates the rate of transmission after government-imposed restrictions were implemented. While the data is incomplete due to ongoing transmissions, New York has a significantly steeper rate of confirmed cases compared to Hubei when normalized by population. It is important to note that there is growing speculation as to the numbers that are coming out of China.

It can be speculated that the stricter restrictions imposed by the Chinese government may be more effective in containing the spread of the virus than the instructions given to New York residents.

4. THE SIR MODEL FOR SPREAD OF DISEASE

The SIR model is an epidemiological model that computes the theoretical number of people infected with a contagious illness with a closed population over time. This model is most frequently cited when we are discussing the spread of COVID-19.

$$0 = dN/dt = dS/dt + dI/dt + dR/dt, \ \ \forall t \geq 0. \qquad \textbf{(1)}$$

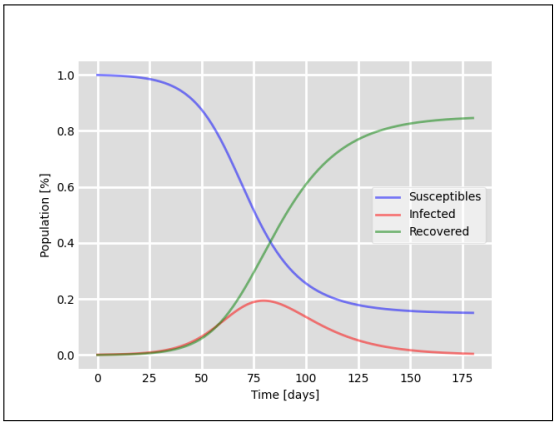

Fig. 5. Theoretical number of people infected with a contagious illness in a closed population over time.

A. Dependent Variables

Table 1 shows an example of the dependent variables. Based on the model, the only way that a person can leave the susceptible group is to become infected, and the only way that a person can leave the infected group is to recover or die. It is further assumed that those who have recovered or died from the disease are forever more immune

Table 1. Dependent Variables as a Function of Time

$S = S(t)$	number of susceptible individuals
$I = I(t)$	number of infected individuals
$R = R(t)$	number of recovered individuals

Let S, I, R, be a sequence of dependent variables and time, in days, in the independent variable.

These assumptions lead us to a set of three ordinary differen-

tial equations for $S(t)$, $I(t)$, and $R(t)$:

$$\frac{dS}{dt} = -\beta S(t)I(t) \quad \textbf{(2)}$$

$$\frac{dI}{dt} = \beta S(t)I(t) - kI(t) \quad \textbf{(3)}$$

$$\frac{dR}{dt} = kI(t). \quad \textbf{(4)}$$

5. SUMMARY AND CONCLUSIONS

The effects that government-imposed restrictions have in authoritarian regimes versus free societies can be illustrated by analyzing current COVID-19 trends between China and the United States. The main goal of "flattening the curve" is to spread out the rate of transmission so hospitals are not overwhelmed. While only a portion of patients with the virus will need intensive care, hospitals are concerned that ICU beds and other crucial resources will be exhausted too quickly if preventative measures are not taken seriously by the public.

Ultimately, how long this period of disruption lasts depends upon how compliant people are. The best solution is effective medical treatments, including vaccines, which are being heavily studied as well. For now, suppression strategies seem to be all that we have, but it will take one or more of these exit strategies to sufficiently deal with COVID-19 next time around. That's why measures like social distancing are so important right now: even if you're not in a high-risk group for covid-19, you should still stay home and avoid in-person socializing because your good behavior lowers the risk for those who are in high-risk groups.

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