[2] COVID-19 tracker: infections by region/country/market/state/temperature/humidity/latitude and culture; Mortality rates; China’s lockdown relaxation, and what data we can trust

Differences in infection rates reflect in part the degree of government policy, testing, quarantine, and voluntary social distancing by individuals and companies. While there are questions about China data (see page 9), they appear to rhyme with the rest of Developed Asia (S. Korea, Japan, Singapore, Taiwan and Hong Kong).

- **South Korea** employs a wide range of tools to conduct contact tracing (finding possibly infected individuals): checking a person’s use of medical facilities and pharmacies, and for what reason; global positioning system (GPS) tracking of their movements; credit card transaction logs as another way of figuring out where they went and who they were with; close-circuit television (CCTV) records to see whether people are wearing masks or coughing

- **Singapore** has drive-thru testing stations, and its Infectious Diseases Act provides legal power to enforce contact tracing and quarantine and to prosecute those who do not comply. Singapore launched a new Bluetooth app that tracks users contacts with other app users, and is one of the tools used for enforcement

- **Hong Kong** imposes a 14-day mandatory quarantine and medical surveillance period on persons entering from mainland China, Korea, Japan, France, Germany, Spain, Italy and Iran; electronic wristbands connected to a smartphone app are placed on arriving passengers to ensure quarantine adherence, and conducts surprise visits to enforce

- **Taiwan** uses QR code scanning and online reporting of travel history and health symptoms to classify traveler infectious risks based on flight origin, and tracks people through mobile phones to ensure quarantine compliance. Taiwan also proactively seeks out patients with severe respiratory symptoms (based on info from a national health database) to see who had tested negative for influenza so that they could be retested for COVID-19, and uses machine learning and artificial intelligence techniques to identify possible carriers using info from health and immigration databases

- **China** works with mobile carriers to gather GPS information on infected people, and works with Tencent and Alibaba on the development of “virus passport” smartphone apps

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*Data sources*. We generally use daily infection and mortality data from Johns Hopkins for our analyses, with some exceptions noted the chart sources. While JHU data usually match sources such as covidtracking.com and Worldometers, this is not always the case. Any large differences usually work themselves out over time; even so, such differences are a warning against over-extrapolating any short term trends seen in the data. There are also patterns in some countries in which tests and infections drop over the weekend, only to rise the following week.
To further illustrate the impact of these policy choices, we looked at infection rates alongside a measure of “collectivism vs individualism” first developed by Geert Hofstede in the 1970’s. There is no single variable that perfectly explains differences in COVID infection rates across regions; given the examples on the prior page, I believe this one is an indispensable part of the story. A standard cluster analysis shows a high degree of significance when thinking about the data within a collectivism/individualism dimension.

**COVID-19 infections rates vs a measure of societal collectivism / individualism**

Total infections to date per million people

Source: Johns Hopkins University, IMF, G. Hofstede Cultural Dimensions (2015), JPMAM. Diamonds represent cluster centroids. April 27, 2020

**Infection rate: total reported cases to date**

Total infections to date per mm people [25 highest infection levels]

Source: Johns Hopkins University, IMF, JPMAM. April 27, 2020
Pace of new infections in the Developed World, scaled relative to the first chart on Western Europe.

Our data science team has created a visualization module for anyone that would like to explore virus infection and mortality data in more detail on their own. The module will be ready shortly and be accessible here.
Infection and mortality for US states

Top15xNYNJ refers to the 15 states that produce 70% of US GDP, excluding NY and NJ

US new daily infections per mm people
Linear scale, 3 day trailing average

Source: Johns Hopkins University, IMF, JPMAM. April 27, 2020

US mortality: Case fatality rate
Linear scale, 1 day trailing average

Source: Johns Hopkins University, IMF, JPMAM. April 27, 2020
Mortality rates

Mortality rates divide reported deaths by reported infections. Remember the following major uncertainties which can only be resolved after months or years have elapsed, during which time scientists conduct widespread testing and analyze excess mortality rates more thoroughly.

- **Numerator understatement #1**: some people that are ill and currently counted in the denominator will eventually die of the disease.
- **Numerator understatement #2**: some current deaths, particularly among the elderly, are not being categorized as related to COVID-19 (those dying at home or in assisted living facilities are not always tested, and sometimes are categorized as “interstitial pneumonia” instead).
- **Denominator understatement**: reported infections in some countries are a small fraction of actual infections; this degree of understatement is widely agreed upon, but not measurable without widely conducted serology tests.

Mortality rates for COVID-19 by country and Chinese Province, and compared to select communicable diseases

Deaths per reported infection (case fatality rate)

Mortality rates shown for all countries with at least 5,000 infections to date and that have had over 100 reported infections for at least 20 days. Sources: CDC, China National Health Commission, Center for Health Protection (HK), Global Health Data Exchange, Johns Hopkins University, Netherlands Institute for Health Services Research, Imperial College of London, Mayo Clinic, World Health Organization, JPMAM. April 27, 2020.
COVID infections in the Developing World

What should we make of the low reported infection rates in parts of the emerging world? There are questions about data reliability and the level of testing, and it’s also much sooner in the infection cycle. Even so, for most of the developing countries shown below, the reported infection rates are MUCH lower than they were in Europe or the US. It’s possible that weather and other environmental factors could play a role, which we examine on the next 2 pages.

Note: each y axis is scaled to the data in that particular chart.
Reported infections by latitude, temperature and humidity

There are a lot of factors that influence the rate of infection and mortality across countries. In addition to social distancing and quarantine, scientists across multiple disciplines have reported that COVID-19 incidence can be traced to weather, latitude, pollution, smoking/vaping, obesity, age distributions, intergenerational cohabitation, gender, pre-existing conditions, population density, whether BCG infant tuberculosis vaccines are widely used, etc. While many studies claim to isolate the impact of individual factors, I doubt that COVID infection or mortality outcomes can be ascribed that neatly to any one determinant.

Even so, we do examine seasonal environmental factors given the patterns seen so far. Infections may be concentrated in the Northern Hemisphere due to under-reporting or lack of testing in the Southern Hemisphere; the fact that the virus has not taken root as aggressively below the equator but it may soon; or because there’s something about this virus that does not transmit as rapidly outside certain temperature/humidity zones. Whatever the reasons, here are our tracking models of infections as a function of latitude, temperature and humidity.

Here’s a look at the concentration of reported infections as a function of temperature and humidity. To date, global infections have occurred within the range of temperature and humidity conditions highlighted in the surface plot on the left. This weather-based concentration of infections is tighter than a population weighted distribution of weather conditions around the globe since the onset of the virus (right chart). These results conform to research discussed in Section 6 showing influenza outbreaks being concentrated in periods of the year with low specific humidity\(^2\), low temperatures and low levels of precipitation. Each disease is different; what we are doing here is simply monitoring COVID-19 characteristics to date.

\(^2\) Jeffrey Shaman at Columbia’s Earth Institute published a paper in 2009 that found that while relative humidity might affect some biological responses, measures of the actual water vapor content of air (such as specific humidity) can be of greater biological significance in understanding and estimating seasonal influenza outbreaks. Specific humidity measures the amount of water vapor per unit of atmospheric air, measured in grams per kilogram.
Here are two charts which look at infections as a function of latitude. Triangulating the two charts, 87% of reported infections have occurred between latitudes of 22.5° N and 57.5° N where 59% of the world’s population lives. One limitation on latitude data: infections are reported by state/province for some large countries (US, China, Canada, Australia) but not for others (Brazil, India, Russia, Mexico), whose infections are only reported for a single latitude.

Global reported infections by latitude

Source: Johns Hopkins University, JPMAM. April 27, 2020
Can we trust the Chinese data?

I don’t know how reliable the China data is, and I’m not aware of any shadow methods for finding out. The chart at the bottom right may explain why there is a debate about this issue. However, two things can be said. First, based on real estate, electricity generation² and car sales comparisons, China’s lockdown was an entirely more restrictive experience than the US version, which could explain some of the infection rate differences. Second, China’s reported infection and mortality rate is lower but still similar to the rest of Developed Asia. I have never heard any concerns about COVID information reliability in Japan, South Korea, Singapore, Hong Kong and Taiwan. So, even if the mainland China data are understated by some indeterminate amount, I still believe in the overall proof of concept of what Asia has done with respect to containing the pandemic.

US electricity production vs Chinese coal consumption (a proxy for its electricity production), % of 2019 level

While there are questions about Chinese COVID data, they rhyme with the rest of Developed Asia

<table>
<thead>
<tr>
<th></th>
<th>Total reported infections per 1mm people</th>
<th>Mortality % of total reported infections</th>
<th>Mortality per 1mm people</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hubei</td>
<td>1,151</td>
<td>6.6%</td>
<td>76.3</td>
</tr>
<tr>
<td>China ex Hubei</td>
<td>11</td>
<td>0.8%</td>
<td>0.1</td>
</tr>
<tr>
<td>China total</td>
<td>58</td>
<td>5.6%</td>
<td>3.2</td>
</tr>
<tr>
<td>Japan</td>
<td>112</td>
<td>2.7%</td>
<td>3.0</td>
</tr>
<tr>
<td>South Korea</td>
<td>210</td>
<td>2.3%</td>
<td>4.8</td>
</tr>
<tr>
<td>Hong Kong</td>
<td>138</td>
<td>0.4%</td>
<td>0.5</td>
</tr>
<tr>
<td>Taiwan*</td>
<td>18</td>
<td>1.4%</td>
<td>0.3</td>
</tr>
<tr>
<td>Singapore</td>
<td>2,465</td>
<td>0.1%</td>
<td>2.4</td>
</tr>
<tr>
<td>US</td>
<td>2,985</td>
<td>5.7%</td>
<td>170.0</td>
</tr>
<tr>
<td>Italy</td>
<td>3,298</td>
<td>13.5%</td>
<td>446.2</td>
</tr>
<tr>
<td>France total</td>
<td>2,543</td>
<td>14.1%</td>
<td>357.4</td>
</tr>
</tbody>
</table>

Source: Johns Hopkins University, IMF, JPMAM. April 27, 2020

US vs China residential real estate transactions y/y % change

Freedom of information/opinion: China vs Dev. Asia


² We compare daily coal production in China (which represents the largest share of Chinese electricity production) to US weekly electricity production, since US coal production is less indicative of US activity given the ongoing secular shift to natural gas and renewables. The same is not happening in China, at least not at the same pace: all of the world’s countries except China reduced net coal-fired generation capacity by 8 GW from January 2018 to June 2019. Over the same period, China increased its coal capacity by 43 GW and has another 121 GW under construction.

As of the end of March 2020, US car sales were down 35% vs 2019 according to data from the St Louis Fed, whereas in China, car sales dropped by over 90% in February 2020 vs 2019.
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