The economics of a pandemic: the case of Covid-19

last update: 1st April 2020

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Financial support from the European Research Council and the Wheeler Institute is gratefully acknowledged.
This Lecture

1. Science
2. Health policies
3. Economics
4. Macroeconomic policies
The enemy

Source: The Economist, 14th March 2020
The basics about Covid-19: what it is

- The cause: Severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2)
- The disease: Coronavirus disease 2019 (COVID-19)
- Possible origin in wet animal market in Wuhan, China, early Dec 2019
- A strain of the same virus as SARS-CoV-1, which affected 8,000 people in 2002/03
- 96% DNA match between bat coronavirus and human found in a study from February; suggests link to humans is not direct but through intermediate host
  - Initially pangolins were suspected, but now seems to not be so; still unclear
- Made of 4 proteins and a strand of RNA (molecule which can store genetic information)
  - One protein is the spike, which gives the crown-like appearance
  - Two proteins sit in the membrane between the spikes to provide structural integrity
  - In the membrane, the fourth protein is a scaffold around the genetic material

The basics about Covid-19: how it works

- Enters through nose, mouth, or eyes. Attaches to cells in the respiratory tract producing a protein called ACE2
- It fuses with the cell and releases the RNA; the hijacked infected cell will produce proteins based on the “instructions” from the virus’ RNA
- Each infected cell can release millions of copies of the virus before dying
- Affects upper respiratory tract (airways from nose to vocal chords), can spread to lungs
- In serious cases, immune system can overreact and attack lung cells; in some cases, the infection leads to acute respiratory distress syndrome and possibly death
- The virus can also end up in droplets that escape the lungs through coughing or sneezing; this leads to contagion directly to other humans, or indirectly through contaminated surfaces
- Soap destroys the virus because its molecules can wedge themselves into the membrane and break it down

The basics about Covid-19: characteristics

Virus appears highly transmissible
  • Average patient infects 1.6 to 2.4 other people

Disproportionally affects older patients
  • Fatality rate in the 70s is 3-4 times larger than the average
  • Under 40 seems to be around 0.2%
  • Men are twice more likely to get infected than women

Many factors unclear:
  • What is the extent of undetected cases, due to mild or no symptoms, or lack of testing
  • Whether asymptomatic individuals can transmit the virus and how long is the incubation period
  • Whether recovery implies immunity, and for how long
  • Whether the virus is seasonal and will decrease during spring and summer

# Current drug efforts

<table>
<thead>
<tr>
<th>What</th>
<th>How</th>
<th>Development</th>
<th>Challenges</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Testing</strong>&lt;br&gt; For infection: Used to identify the presence of the virus</td>
<td>Two possible tests – PCR tests that can identify the virus and serologic tests that can identify antibodies (the body’s response to the virus)</td>
<td>• Tests for infection currently available for purchase&lt;br&gt; • Many organizations across nations are developing tests – either independently or with others’ research&lt;br&gt; • WHO protocol has been issued for creating tests</td>
<td>• Accuracy – do not know sensitivity of test or likelihood of false positives (which increases danger of continued spread)&lt;br&gt; • Bureaucracy – striking a balance between providing tests to large populations versus controlling approvals&lt;br&gt; • Mass production – supply shortages and allocation are limiting factors and driving prioritization of tests and associated PPE, impacted by potential private profiteering&lt;br&gt; • Staff training – to conduct and analyse tests</td>
</tr>
<tr>
<td><strong>Testing</strong>&lt;br&gt; For immunity: Used to identify if antibodies are disease-fighting</td>
<td>Blood tests can confirm whether antibodies present are disease-fighting, providing immunity</td>
<td>• Some tests currently available with results in 15 minutes&lt;br&gt; • Singapore has developed a test with at least 90% accuracy</td>
<td>• Accuracy – what is sensitivity or likelihood of false positives&lt;br&gt; • Duration – how long immunity lasts (months to a year)&lt;br&gt; • Contagion – how infectious is an immune individual&lt;br&gt; • Strength – how immune you are (e.g. does it withstand continued, severe exposure like for an ICU worker?)</td>
</tr>
<tr>
<td><strong>Vaccine</strong>&lt;br&gt; Used to prevent healthy people from getting infected</td>
<td>Using live vaccine traditional approach, but innovative approaches like recombinant or genetically instructed vaccines</td>
<td>• 35 organizations racing to create a vaccine, 4 have candidates in animal testing, 1 started human trials&lt;br&gt; • Utilizing and repurposing prior Sars candidates, given 80+% overlap of genetic material with Sars-CoV-19</td>
<td>• Speed vs. Safety – can take a decade to develop, even 18 months would be extremely fast and without a problem&lt;br&gt; • Mass production – facilities developing vaccine do not have capacity and require specialized equipment to manufacture, costly for drugs still in development&lt;br&gt; • Politics &amp; Economics – how to get drugs to those who need it – by country? by need? By purchase power?</td>
</tr>
<tr>
<td><strong>Treatment</strong>&lt;br&gt; Used to lessen the effects of the virus</td>
<td>Antivirals slow the replication of the virus early on, or drugs that stop the cascade of illness</td>
<td>• 69 drugs identified as potentials, 14 under investigation&lt;br&gt; • Faster to repurpose current drugs than develop new, but rigorous testing is required. Difficult to obtain significant sample sizes for so many trials&lt;br&gt; • Utilizing and repurposing prior Sars candidates, given 80+% overlap of genetic material with Sars-CoV-19</td>
<td>• Speed vs. Safety – initial scans will indicate that the protein binds, but does not confirm:&lt;br&gt; o The effects attributable to the drug&lt;br&gt; o That the drug does not cause negative effects&lt;br&gt; • Stock shortages – publication of early results about potential treatment drugs cause mass buyouts</td>
</tr>
</tbody>
</table>
The theoretical contagion curve

Adapted from the CDC and The Economist
Visit flattenthecurve.com
The empirical contagion curve(s)

New Covid-19 cases by day worldwide

Thousands of cases

China changes guidelines

Feb 01 Feb 15 Mar 01 Mar 15 Apr 01

New cases Recovered

Last update: 2020-03-31
Source: Johns Hopkins University CSSE, FT, own calculations.
Patterns of contagion in different countries

Italy has turned the corner, with numbers of new cases now in decline, following in China’s footsteps.

New confirmed cases of coronavirus in the past week, by number of days since 200 new cases in one week.

Nationwide lockdowns: ★

Source: FT analysis of Johns Hopkins University, CSSE; Worldometers; FT research. Data updated March 31, 19:00 GMT.
Patterns of fatalities in different countries

Italy's daily death toll is plateauing, but in Spain, the UK and US every day brings more new deaths than the last.

New deaths with coronavirus in the past week, by number of days since 20 deaths in one week.
Patterns of fatalities in different cities and regions

New deaths in Lombardia and Madrid are plateauing, but deaths are still accelerating in New York and London

New deaths with coronavirus in the past week, by number of days since 20 deaths in one week

Showing US states and selected subnational regions in Italy, Spain, China, France, S Korea and UK

Source: NHS; Covid Tracking Project; Providencia data19; Santé Publique France; Berliner Morgenpost; Open2H; Stockholm University; Leuven University. Data updated March 31, 19:00 GMT

© FT
The current situation worldwide

The rest of the world has surpassed China

Number of cases

1,000,000
750,000
500,000
250,000
100,000
50,000
25,000
10,000
5,000
2,500
1,000
500
250
100

Number of deaths

Feb 01 Feb 15 Mar 01 Mar 15 Apr 01

Worldwide
China
Others

Feb 01 Feb 15 Mar 01 Mar 15 Apr 01

Worldwide
China
Others

Source: Johns Hopkins University CSSE, own calculations.

Last update: 2020-03-31
United States are now the epicentre of the crisis

Source: Johns Hopkins University CSSE (https://coronavirus.jhu.edu/map.html). Click the image to open the page.
Developing economies face higher risks

In Africa, South Asia and to a lesser extent Latin America:

- Much lower health system capacity (e.g. fewer intensive care units and ventilators).
- People have less possibility to wash their hands with soap frequently.
- Underlying health conditions can pose additional risks (25m + Africans with HIV), or can be exacerbated as attention is drawn from current outbreaks to preventing Covid-19.
- Challenges for governments to enact social distancing in crowded communities where many family members share same room to sleep and staying at home means close quarters and no paycheck.
- More exposed to the world trade cycle because their goods (and services) are highly dependent on advanced economies demand and thus more vulnerable to the crisis.
- Far less access to the internet and therefore working from home will have far more disruptions and unprecedented economic costs than the already very large and heterogeneous costs that it will have in advanced economies (more later).

Source: The Economist “Africa is woefully ill-equipped to cope with covid-19”, 26 March
And the trend is beginning in the developing world

African countries are seeing a rise in cases

Number of cases in selected countries

Source: Johns Hopkins University CSSE, own calculations.
World Health Organization declared a pandemic on 11 March

- WHO definition: “A pandemic is the worldwide spread of a new disease. An influenza pandemic occurs when a new influenza virus emerges and spreads around the world, and most people do not have immunity.”
- US CDC definition: “Pandemic refers to an epidemic that has spread over several countries or continents, usually affecting a large number of people.”

Declaration about geographic spread, not about the severity of the disease

Source: WHO; Washington Post “WHO declares a pandemic of coronavirus disease covid-19”
A historical perspective on contagious diseases

- 14th century Europe: bubonic plague. 25 million (pop. 100 million)
- 1918-1920 Worldwide Influenza epidemic. 50 million or higher
- 1981-currently AIDS: >25 million lives + 33 million living with HIV
- Recent smaller outbreaks:
  - 2002-04 SARS: 8k cases, 774 death
  - 2009 Avian flu: 151k-575k deaths
  - 2014-16 Ebola: >11k deaths

Covid-19 appears both more deadly and contagious than other well known influenzas: a main cause though is the lack of a vaccine but

HUGE measurement errors!!!

**Far more cases among the young!**

**KEY DIFFERENCE**

Iceland tested large share of the population, at ‘random’, even asymptomatics

**BUT**

Netherlands tested only severe symptomatics

**Germany**

- similar demographic structure than Italy
- 160,000 tests weekly
- one of the highest number of reported cases (majority among the young)
- fatality rate of 0.5%

Source: National Institute for Public Health and the Environment Ministry of Health, Welfare and Sport (RIVM, Netherlands); Icelandic Directorate of Health (Covid); Mai (27 March, Vox.com)
Far more cases among the young (cont’ed)

KEY DIFFERENCE
Korea has tested large share of the population, quasi ‘at random’

BUT
Italy has tested only (worst) symptomatic cases.

External validity
is the Korean evidence driven by the followers of the Shincheonji Church of Jesus?

A quasi-natural experiment
The town of Vo’ (Veneto, Italy). Tested all 3300 inhabitants. Most cases among young asymptomatic

Source: Backhaus (13 Mar, Medium.com), Buck (20 March, ft.com)
...but far more fatalities among the old

Data from three countries show that older populations are at greater risk.

Case-fatality rate by age segment,\(^1\) % mortality

<table>
<thead>
<tr>
<th>Age</th>
<th>0–9</th>
<th>10–19</th>
<th>20–29</th>
<th>30–39</th>
<th>40–49</th>
<th>50–59</th>
<th>60–69</th>
<th>70–79</th>
<th>&gt;80</th>
<th>Average</th>
</tr>
</thead>
<tbody>
<tr>
<td>South Korea</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
<td>0.1</td>
<td>0.1</td>
<td>0.4</td>
<td>1.4</td>
<td>5.3</td>
<td>9.3</td>
<td>0.8–0.9</td>
</tr>
<tr>
<td>China(^2)</td>
<td>0.0</td>
<td>0.2</td>
<td>0.2</td>
<td>0.2</td>
<td>0.4</td>
<td>1.3</td>
<td>3.6</td>
<td>8.0</td>
<td>14.8</td>
<td>2.3–4.0</td>
</tr>
<tr>
<td>Italy</td>
<td>0.0</td>
<td>0.2</td>
<td>0.2</td>
<td>0.3</td>
<td>0.4</td>
<td>1.0</td>
<td>3.5</td>
<td>12.5</td>
<td>20.2</td>
<td>6.8–7.2</td>
</tr>
</tbody>
</table>

\(^1\)As of data from Feb 11, 2020, in China and as of March 16 and 15, 2020, in South Korea and Italy, respectively.

\(^2\)Data reported from China Feb 11, 2020, reports 2.3%, however latest deaths/cases from WHO indicate this may be higher.

Source: China CDC; Korea CDC; L’Istituto Superiore di Sanità (ISS) Italy; WHO; McKinsey analysis

Italians are older

Source: https://www.populationpyramid.net/, based on United Nations Data
Old Italians are more connected to the young

Average daily contacts with those 70+ by age group

Number of daily contacts with those 70+

How accurate is the fatality rate?

- Mortality rate = \( \frac{\text{Death}}{\text{Population}} \)

- Fatality rate = \( \frac{\text{Death}}{\text{Cases}} \)
  
  - Measuring fatality rate is much more difficult and imprecise because the majority of tests are done on sick patients and thus is hard to estimate the number of total cases because of undetected infections (e.g. asymptomatic).
  
  - Measured fatality rates are thus likely to overstate grossly the actual fatality rate (more on next slide).

- But also the number of officially recorded deaths could be inaccurate! (see slide 22)
A simple formula to estimate the numbers of infected

- The conclusion depends on the assumption on fatality rate
- Assume a fatality rate around 1%
- The estimated number of infected in a country can then be inferred by simply multiplying the number of Covid-19 fatalities by a factor of 100* (=100/1).

ILLUSTRATIVE EXAMPLE BASED ON NUMBER OF OFFICIALLY REPORTED DEATHS as of 29TH MARCH 2020

<table>
<thead>
<tr>
<th>Assumption on true fatality rate</th>
<th>Prediction for total infected in Italy</th>
<th>Prediction for total infected in UK</th>
</tr>
</thead>
<tbody>
<tr>
<td>5%</td>
<td>216000</td>
<td>245600</td>
</tr>
<tr>
<td>1.5%</td>
<td>720000</td>
<td>81860</td>
</tr>
<tr>
<td>1%</td>
<td>1.08ML</td>
<td>122800</td>
</tr>
<tr>
<td>0.5%</td>
<td>2.16ML</td>
<td>245600</td>
</tr>
</tbody>
</table>
CAVEAT on the number of officially reported deaths

Especially for countries with large geographical concentration of cases like Italy:

• The number of officially recorded deaths by Covid-19 may also under-estimate the actual number of Covid-19 deaths.

• A simple strategy to estimate the size of this under-reporting is to look at the differences in the total number of death by municipality in March 2020 relative to March 2019 (and possibly March in previous years as well).

• The ratio between (i) the difference in total deaths in the same month over two consecutive years (relative to a far ‘less’ -----ideally not affected at all--- municipality with a similar population) and (ii) the officially recorded number of deaths by Covid-19 is an estimate of the size of this under-reporting. This is called ‘difference-in-difference' estimation.

• The estimate of this ‘Covid-19 death under-reporting’ needs then to multiply further the factor of 100 above to obtain a more accurate estimate of the number of infected cases in that municipality.
A case study: number of death in the city of Bergamo

1-24 March | Bergamo | Bari
--- | --- | ---
Population | 121633 | 320862
Number of deaths with Covid-19: March 2020 | 136 | 21
Total number of deaths: Marzo 2020 | 446 | 374
Total number of deaths: average Marchs 2010-2019 | 98 | 274

Assuming a fatality rate of 1% [with a range between 0.5% and 1.5%], the estimated number of infected in Bergamo on 24/03 is around 30000 residents [19000, 52000]. As of today, 31/03, more than 30% of residents is likely to be infected!
Estimating the total number of infected cases

Imperial College Covid-19 team estimates the impact of interventions in the replication number in 11 European countries

Methodology: use observed death rates over time as an input in a model of contagion to infer changes in the time series of the replication number

Results indicate preliminary numbers

- Interventions have decreased the replication number (on average across countries) by 64% of the pre-intervention value. The average replication number across countries is estimated to be 1.43.
- Across 11 EU countries, between 7 million and 43 million people have been infected [1.9% - 11.4% of the population]. E.g., United Kingdom 2.7% [1.2%-5.4%], Italy 9.8% [3.2%-26%], Spain 15% of the population [3.7%-41%]
- An estimated 59,000 deaths have been averted based on the interventions applied. This is comprised of 38,000 and 16,000 in Italy and Spain alone

Caveats

- Limited data – officially recorded death rates over time is taken at face value and it is a crucial input of the analysis. (see previous slide for an example of the inaccuracy of officially recorded death rates)
- Delicate assumption – similar interventions in different countries have the same effect in reducing the replication numbers in the two countries.
- Early results – The time since infections have been reported and interventions been implemented only offers preliminary results.
- Combined forces – Inability to differentiate effectiveness of distinct interventions based on rapid implementation

Predicted infections are still far from herd immunity

**Estimated percent of population infected as of March 28th**

<table>
<thead>
<tr>
<th>Country</th>
<th>% of total population infected (mean [95% credible interval])</th>
</tr>
</thead>
<tbody>
<tr>
<td>Austria</td>
<td>1.1% [0.36%-3.1%]</td>
</tr>
<tr>
<td>Belgium</td>
<td>3.7% [1.3%-9.7%]</td>
</tr>
<tr>
<td>Denmark</td>
<td>1.1% [0.40%-3.1%]</td>
</tr>
<tr>
<td>France</td>
<td>3.0% [1.1%-7.4%]</td>
</tr>
<tr>
<td>Germany</td>
<td>0.72% [0.28%-1.8%]</td>
</tr>
<tr>
<td>Italy</td>
<td>9.8% [3.2%-26%]</td>
</tr>
<tr>
<td>Norway</td>
<td>0.41% [0.09%-1.2%]</td>
</tr>
<tr>
<td>Spain</td>
<td>15% [3.7%-41%]</td>
</tr>
<tr>
<td>Sweden</td>
<td>3.1% [0.85%-8.4%]</td>
</tr>
<tr>
<td>Switzerland</td>
<td>3.2% [1.3%-7.6%]</td>
</tr>
<tr>
<td>United Kingdom</td>
<td>2.7% [1.2%-5.4%]</td>
</tr>
</tbody>
</table>

Summary of part 1 (science)

- Covid-19 is the worst health crisis of our times
- Young far more likely to be infected (the carrier) but old more likely to die
- As young people tend to develop mild or no symptom, they are less contagious. But there are so many of them infected that young are responsible for the majority of infections in the population.
- Case fatality rate is probably much lower than currently reported because of the large number of asymptomatic cases.
- Infected case is probably an order of magnitude larger than recorded.
- Italy has a higher fatality rate in a combination of older population and older being more in contact with young than most of the other countries

Full set of slides available at https://sites.google.com/site/paolosurico/covid-19

This Lecture

1. Science

2. Health policies

3. Economics

4. Macroeconomic policies
The consensus: flattening the curve

How to minimize fatalities?

A. Expand intensive care capacity
(expand supply of health care)

B. Slowdown the speed of contagion
(contract demand for health care)

Goal: avoid excess of demand
How to achieve this more effectively?
Health system capacity constraints

- Danger in the lack of capacity of health systems
- Number of ICU beds in most countries cannot cope with the spread of disease if peak is high
- Lack of ventilators:
  - Italy asked its only domestic manufacturer to quadruple supply from 125 a month to 500 (each costs €17k)
  - Germany has ordered 10,000
  - VentilatorChallengeUK consortium including Airbus, BAE Systems, Ford, Rolls-Royce and Siemens partnered to produce ventilators for the NHS
  - UCLH and Mercedes formula one formed joint venture to produce CPAP machines

Source: Buck et al (15 March, ft.com), Walsh (30 March, bbc.co.uk)
Health system capacity constraints across Italian regions

Share of Intensive Care Units used for Covid-19 patients

Dati: Protezione Civile e Ministero della Salute.

Source: Matteo Villa (Istituto per gli studi di politica internazionale)
Whenever possible, use hotels, class rooms and barracks as Intensive Care Units (ICU).

Turn to manufacturing industry to produce or convert intensive care equipment (e.g. ventilators).

Pay for independent sector facilities: UK NHS deal added 8,000 beds, 1,200 ventilators, and 20,000 staff.

Even if the elasticity of supply for beds and equipment is high, how quickly can we train new medical personnel? Recall retired workers.

If cases regionally concentrated, spread non-contagious intensive care cases to other regions.

**Number of Intensive Care Units in Lombardy**

*Dati:* Protezione Civile e Regione Lombardia.

Source: Matteo Villa *(Istituto per gli studi di politica internazionale)*
A typical epidemiology model

\[ S_{(susceptible)}I_{(infected)}R_{(recovered)} \]

**Key parameter:** $R_0$ value (Replication number)
Average number of infected people per one contagious person

$R_0 < 1$: the speed of recovery is higher than the speed of contagion. Therefore, the virus dies out

$R_0 > 1$: first phase, virus spread fast and rate of infection grows exponentially; second phase, as people recover the population becomes immune, thereby pushing $R_0 < 1$ and the virus dies out

Very important channel. Very simplistic for the moment. More later.
What are the determinants of $R_0$?

1. Virus characteristics
   a. infectious period + high
   b. easiness of transmission + high

2. Social interaction/meeting rates +

3. Fraction of immune population
   a. vaccination - not yet available
   b. recovered with immunity - still unknown

Susceptible → Infected

- sign Covid-19

- Recovered

Very important channel. Very simplistic for the moment. More later
What policies can influence $R_0$?

A. **Mitigation**
   - lowering $R_0$ below 1 gradually
     - (attempted quarantine)

B. **Suppression**
   - lowering $R_0$ below 1 as fast as possible
     - (general social distancing)

Very important channel. Very simplistic for the moment. More later.
Contagion under laissez-faire

Mitigation vs suppression in theory…

U.K. style of approach (until mid-march)

China/Italy style of approach

1918 Influenza Pandemic:

- Philadelphia:
  - First cases reported in 17 September
  - Authorities downplayed significance; city-wide parade on 28 September
  - Social distancing measures implemented in 3 October

- St. Louis:
  - First cases in October 5
  - Social distancing measures in October 7

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**Fig. 1.** Excess P&I mortality over 1913–1917 baseline in Philadelphia and St. Louis, September 8–December 28, 1918. Data are derived from ref. 10.

But the trade-off is draconian!

- **Policies to mitigate** the virus (i.e. lowering replication number gradually) much less effective in flattening the curve, possible strong repercussion in the **short-run** because of limited health system capacity, immunity builds up faster and so population becomes less vulnerable in the medium term.

- **Policies to suppress** the virus (i.e. lowering replication number as fast as possible) effective in delay the spread of the virus in the short-run, but slow-down the build-up of herd immunity, population is vulnerable to new outbreaks in the **medium term**, not a problem if vaccination is soon available; if not, buys time to expand health system capacity.
The role of critical complications

S(susceptible)I(infected)R(covered)

Susceptible → Infected

Critical complications

- Deaths
- Asymptomatic
- Recovered/Immune

NOTE: All these transitions are highly heterogeneous across groups of demographics and health conditions.
Table 2: Summary of NPI interventions considered.

<table>
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<tr>
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<th>Policy</th>
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<tbody>
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<td>Case isolation in the home</td>
<td>Symptomatic cases stay at home for 7 days, reducing non-household contacts by 75% for this period. Household contacts remain unchanged. Assume 70% of household comply with the policy.</td>
</tr>
<tr>
<td>HQ</td>
<td>Voluntary home quarantine</td>
<td>Following identification of a symptomatic case in the household, all household members remain at home for 14 days. Household contact rates double during this quarantine period, contacts in the community reduce by 75%. Assume 50% of household comply with the policy.</td>
</tr>
<tr>
<td>SDO</td>
<td>Social distancing of those over 70 years of age</td>
<td>Reduce contacts by 50% in workplaces, increase household contacts by 25% and reduce other contacts by 75%. Assume 75% compliance with policy.</td>
</tr>
<tr>
<td>SD</td>
<td>Social distancing of entire population</td>
<td>All households reduce contact outside household, school or workplace by 75%. School contact rates unchanged, workplace contact rates reduced by 25%. Household contact rates assumed to increase by 25%.</td>
</tr>
<tr>
<td>PC</td>
<td>Closure of schools and universities</td>
<td>Closure of all schools, 25% of universities remain open. Household contact rates for student families increase by 50% during closure. Contacts in the community increase by 25% during closure.</td>
</tr>
</tbody>
</table>

Source: Ferguson et al. (2020), Impact of non-pharmaceutical interventions (NPIs) to reduce COVID-19 mortality and healthcare demand, Imperial College COVID-19 Response Team.
A. Policies to mitigate the virus

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Figure 2: Mitigation strategy scenarios for GB showing critical care (ICU) bed requirements. The black line shows the unmitigated epidemic. The green line shows a mitigation strategy incorporating closure of schools and universities; orange line shows case isolation; yellow line shows case isolation and household quarantine; and the blue line shows case isolation, home quarantine and social distancing of those aged over 70. The blue shading shows the 3-month period in which these interventions are assumed to remain in place.

Source: Ferguson et al. (2020), Impact of non-pharmaceutical interventions (NPIs) to reduce COVID-19 mortality and healthcare demand. Imperial College COVID-19 Response Team.
B. Policies to suppress the virus

<table>
<thead>
<tr>
<th>Label</th>
<th>Policy</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>CI</td>
<td>Case isolation in the home</td>
<td>Symptomatic cases stay at home for 7 days, reducing non-household contacts by 75% for this period. Household contacts remain unchanged. Assume 70% of household comply with the policy.</td>
</tr>
<tr>
<td>HQ</td>
<td>Voluntary home quarantine</td>
<td>Following identification of a symptomatic case in the household, all household members remain at home for 14 days. Household contact rates double during this quarantine period, contacts in the community reduce by 75%. Assume 50% of household comply with the policy.</td>
</tr>
<tr>
<td>SDO</td>
<td>Social distancing of those over 70 years of age</td>
<td>Reduce contacts by 50% in workplaces, increase household contacts by 25% and reduce other contacts by 75%. Assume 75% compliance with policy.</td>
</tr>
<tr>
<td>SD</td>
<td>Social distancing of entire population</td>
<td>All households reduce contact outside household, school or workplace by 75%. School contact rates unchanged, workplace contact rates reduced by 25%. Household contact rates assumed to increase by 25%.</td>
</tr>
<tr>
<td>PC</td>
<td>Closure of schools and universities</td>
<td>Closure of all schools, 25% of universities remain open. Household contact rates for student families increase by 50% during closure. Contacts in the community increase by 25% during closure.</td>
</tr>
</tbody>
</table>

![Figure 3: Suppression strategy scenarios for GB showing ICU bed requirements.](image)

Given that mitigation is unlikely to be achieved, the following policies are considered to prevent healthcare systems from being overwhelmed. Table 2 outlines the summary of NPI interventions considered.

**Table 2: Summary of NPI interventions considered.**

Source: Ferguson et al. (2020), Impact of non-pharmaceutical interventions (NPIs) to reduce COVID-19 mortality and healthcare demand. Imperial College COVID-19 Response Team.
The mortality curve during the 1918 influenza

Three weekly combined influenza and pneumonia mortality, United Kingdom, 1918–1919

A critique to Ferguson et al. (2020)

Imperial College report predicts that, under no policy measures or behavioural changes, 510k deaths in the UK, 2.2m in the US

- Suppression would still lead to >40k ICU beds needed at peak (vs actual capacity at ~5k);
  Expect second wave in the Fall when toughest restrictions are lifted.

- Summary: no great choices, but some worse than others

Shen, Taleb and Bar-Yam criticize some of the modelling assumptions in the previous simulations:

- Lack of additional transmission mechanisms or policy options:
  - Contact tracing and door-to-door monitoring (potentially useful for the second wave)
  - Geographical barriers and travel restrictions (helps contain localized outbreaks)
  - Super-spreader events (fat tail of infections per person; could lead to banning of large events)

- Summary: these aspects could lead to worse outcomes in case of no policy, but also a role for more effective policy.

Source: Ferguson et al. (2020), On behalf of the Imperial College COVID-19 Response Team.
Shen, Taleb and Bar-Yam (2020), "Review of Ferguson et al (...)". https://www.ft.com/content/16764a22-69ca-11ea-a3c9-1fe6fedcca75
The key role of the asymptomatic

“We estimate 86% of all infections were undocumented prior to 23 January 2020 travel restrictions. Per person, the transmission rate of undocumented infections was 55% of documented infections, yet, due to their greater numbers, undocumented infections were the infection source for 79% of documented cases.”

Source: Ruiyun Li et al. (2020), Substantial undocumented infection facilitates the rapid dissemination of novel coronavirus (SARS-CoV2), Science, 16 March 2020, DOI: 10.1126/science.abb3221

A few consequences:

1. Good news: existing estimates of case-fatality rates and alike might be over-estimated
2. Good news: some immunity already in the system (consistent with the trend in China where the virus did not pick up after restrictions have been relaxed)
3. Bad news: it is likely that when interventions started in Europe and USA the virus was widely spread. The estimates from simulation on how measures of suppression will flatten the curve in the short run may be over-optimistic

Bottom line: we are designing policies based on highly incomplete evidence/information
A simple policy proposal
Random testing, statistical analysis and surveillance

1. Test a representative sample of the population (independently of symptoms), recording socio, economical, demographic and locational characteristics at the household level

2. Use standard statistical methods to infer the household characteristics most likely to predict whether someone is infected or not in the whole population

3. Develop surveillance strategies based on the information revealed in (2): nation-wide contact tracing, targeted social distancing.

Collecting the right data and conducting extensive statistical analysis can save MANY lives!!!
Goal: prevent a 2\textsuperscript{nd} peak and flatten the contagion curve that may spike again in the Fall 2020.
An early success: the case of South Korea

- South Korea had a sharp increase in cases during February but has managed to slow the spread in March.
- In addition, the death rate as of April 1st has been particularly low: 1.7% (vs 11.7% in Italy).
- Additional measures in South Korea:
  - Rapid scaling of testing, (e.g., 5,500 test for every one million people; U.K.: 750 for every one million people)
  - Readily available tests (e.g., free with doctor prescription, available privately, but reimbursed by the government is positive)
  - Contact tracing, targeted testing and monitoring infected (e.g., government app to locate people)

Source: Cowling et al (13 March, nytimes.com)
What tactics have been used across countries

Different strategies and associated policies have been devised across nations, with varying effects. It can be argued that there is some flexibility in the policies put in place, but there is a consistent call for more policies, more measures, and more severe suppression tactics.


“At this point 100% of nations that got it under control did so based on testing and tracing, isolation, quarantining” Marcel Slaathe, epidemiologist at the Federal Institute of Technology of Lausanne.

Source: Cohen et al (20 March, ScienceMag.org)

<table>
<thead>
<tr>
<th>SOCIAAL DISTANCING</th>
<th>TESTING &amp; ISOLATION</th>
</tr>
</thead>
<tbody>
<tr>
<td>Slow response to barring large gatherings (UK, US)</td>
<td>Dispersed responsibility creating a variable response 74 tests / million (US)</td>
</tr>
<tr>
<td>Shutting theatres, restaurants, cinemas, and gyms</td>
<td>Scaled up testing</td>
</tr>
<tr>
<td>Closing schools</td>
<td>Drive-through testing, separated sick and well centres</td>
</tr>
<tr>
<td>Lockdown except essential trips with police enforcement (China, Italy)</td>
<td>Testing program, isolation of infected, contact tracing and quarantining 5200 tests / million (SK)</td>
</tr>
</tbody>
</table>

Mitigation: More relaxed measures. May allow for the less vulnerable to get sick to build up immunity

Suppression: Deploying all available tactics. May allow for relaxing and re-strengthening measures over time

Flexible policies such as:

- Keeping schools open for students of vital workers (Austria, Netherlands)
- Halving capacities in schools and increasing cleaning procedures (Singapore)
- Closing non-essential stores, extending market hours to reduce congestion (Germany)

Flexible policies such as:

- Engaging and activating the public to report cases, self-isolate, and inform contacts to get tested
Managing a heterogeneous population

• Goal: to avoid binding health system capacity and thus flatten the curve for high risk individuals

• Homogenous interventions are likely to be sub-optimal. If supply of tests is limited: who should we target these tests to in order to implement most efficiently the suppression/containment policy?

• At the moment, tests are primarily be given to:
  all patients in critical care for pneumonia, acute respiratory distress syndrome (ARDS) or flu like illness
  all other patients requiring admission to hospital for pneumonia, ARDS or flu like illness
  where an outbreak has occurred in a residential or care setting, for example long-term care facility or prisons

• The value to distribute some of those tests to asymptomatic population is very large.
  In Korea, testing the asymptomatic proved key to limit very significantly the death toll.
Externalities

Each individual choice affects the whole system: contagious diseases are rife with “negative externalities”

Low-risk category individuals have low incentives to self-isolate or take precautionary measures

Is it enough to tell people to self-isolate?
Taiwan strict fines up to 33k USD for non-compliants of home-quarantine
16th of March, 8 thousand Italian people reported by police for non-compliants of social-distance law
See Rowthorn and Toxvaerd (2018) for theoretical analysis

Social distance for high-risk individuals requires providing services to them: food, medicine, and alike.
Will the market provide these services efficiently? Congestion problem for online food delivery services

Similar problems for any services related to bandwidth. Most sectors will suffer (see later), but for services like digital services and home-delivery, this phase will spike demand and make it very inelastic. Are those services provided competitively? If not, market power will destroy surplus. Should companies offering those services (and benefitting by the virus) subsidize who will suffer most from the incoming recession? Goal is to avoid social unrest!

Non-Covid-19 patients will be crowded out in intensive care unit
WARNING ON INTERPRETATIONS

If a vaccine can be found in the next six months (and the scientific community seems to agree this looks very unlikely), then suppression (i.e. countries lock down) is a dominant strategy

If six months are NOT enough, there will be a very significant death toll, either way:

- **Containment** fronts load causalities: the curve does not flatten but people develop immunity (big unknown: will recovered cases be actually immune from being infected again?)
- **Suppression** backs load causalities: the curve flattens but people exposed when policy ends (big unknown: will be a vaccine developed sufficiently fast? Strategy buys time to expand health system capacity)

Alternative is **Conditional Suppression**, until a vaccine for mass production is ready. Not a free lunch, though, as likely to generate pervasive social unrest if the policy lasts over prolonged period

**DISCLAIMER:** we take no view on which policy is (second)-best. Our analysis is meant to highlight the social and economic trade-offs inherently involved with **any** policy option
Summary of part 2 (health policies)

• All Covid-19 health policies have one objective: decreasing the replication number of the disease

• Given existing health system capacity, suppression policies are the only one that can help us in the short-run. Please, do follow government guidelines.

• Health system capacity can be expanded in the short-run relying on the private sector (e.g. ICU beds, ventilator parts) and retired medical workers.

• Let’s use the time bought by suppression policies effectively:
  • Test a representative sample of the population to gather reliable and unbiased information about the prevalence of Covid-19
  • Extensive statistical analysis within and across countries (that are in different phases)
  • Develop surveillance strategies based on this reliable information

Full set of slides available at https://sites.google.com/site/paolosurico/covid-19

This Lecture

1. Science

2. Health policies

3. Economics

4. Macroeconomic policies
CHINA – NOWCAST AND FORECAST – in real-time, everyday!
Quarterly GDP growth, year-on-year, %

Source: live Now-Casting model (30th March 2020)
EURO AREA – NOWCAST AND FORECAST – in real time, everyday

Quarterly GDP growth, quarter-on-quarter, %

Source: live Now-Casting model (30th March 2020)
ITALY – NOWCAST AND FORECAST – in real time, everyday

Quarterly GDP growth, \textit{quarter-on-quarter}, %

Source: live Now-Casting model (30th March 2020)
Historic surge in US unemployment benefits

More than 3 million people file claims as coronavirus hits

Impact on stock markets

Large declines in the stock markets in 2020

% change since beginning of 2020

SSEC (China)
S&P500 (USA)
FTSE (UK)
FTSE MIB (Italy)

Jan Feb Mar Apr May

Source: Yahoo Finance, Investing.com, own calculations.

Last update: 2020-04-01
Impact on travel services

Far fewer flights
Number of total daily flights in March

- 2017
- 2018
- 2019
- 2020

Source: Flightradar24, 31 March 2020, 10:45 GMT
Impact on restaurants

Large declines in the restaurant industry
Year-on-year change in restaurant reservations and walk-ins on OpenTable

Source: OpenTable State of Industry.
Impact on durables expenditure

In face of negative income shocks, one of the first and strongest response of households with high marginal propensity to consume is to postpone vehicle purchases. Increase in uncertainty is likely to have a similar effect that works via a precautionary motive.

Evidence (from projects funded by ERC grants):
U.S. - Misra-Surico (2014, AEJM),
Italy - Surico-Trezzi (2019, JEEA),
U.K. - Cloyne-Ferreira-Surico (2020, ReStud)

Data on China suggests overall impact will be extraordinary large! Unfortunately, this is only the direct effect. More on this later.
The impact of the coronavirus and the associated lockdowns can be seen in the economic output in China.

China’s National Bureau of Statistics reported year-on-year industrial value added growth falling 4.3% in January and 25.9% in February.

Even more striking compared to an average growth of 5.7% in 2019

Source: He et al (27 March, bfi.uchicago.edu)
Impact on the supply chain

Smartphone shipments in China are expected to recover quickly

- Forecast before outbreak
- Forecast with coronavirus effect included

Source: Bloomberg
Impact on the supply chain cont’d

Many disruptions exist across the supply chain, but the full impact has yet to be felt

Situation today
- **4X** fatality ratio
  - Hubei still in early recovery
- **50%** truck capacity
  - 10+ day delay to get goods to port
- **28%** BDI increase
  - Baltic Dry Index 28% higher since end LNY, but 13% below 2/2019
- **15%** higher TAC
  - TAC index 15% below 2/2019; passenger a/c cargo constraint
- **90%** car sales decrease
  - China consumer sentiment sharply lower
- **80%** plants restarted
  - Restart underway
  - Workers still returning

What to expect
- Hubei recovers early Q2
- Trucking capacity constraints ease
- Logistics capacity returns, but faces constraints; near-term price increase
- Inventory ‘hoarding’ behavior
- GDP impact
  - Sharp rebound
  - Demand shift
- Inventory ‘whiplash’; 7-8 wks auto, 2-4 wks high-tech

Source: WHO Situation Reports; CDC travel notice; IATA, Reuters, TomTom traffic index, press searches; HSBC Business School, Tencent News, Sina news,
 Boiler Environmental Protection Monitoring Center, Shenzhen Environment Network.
The most affected sectors

All sectors are impacted, with several seeing severe consequences
Preliminary views based on base case – Subject to change as the COVID-19 outbreak evolves

<table>
<thead>
<tr>
<th>Estimated degree of impact, in terms of duration</th>
<th>Tourism and hospitality</th>
<th>Aviation / airlines</th>
<th>Oil and gas</th>
<th>Automotive</th>
<th>Consumer products</th>
<th>Consumer electronics, semi-conductors</th>
</tr>
</thead>
<tbody>
<tr>
<td>Estimated global restart (Global slowdown scenario)</td>
<td>Q4</td>
<td>Late Q3 / early Q4</td>
<td>Q3</td>
<td>Late Q2 / Q3</td>
<td>Q2</td>
<td>Q2</td>
</tr>
<tr>
<td>Severe ripple effects (e.g., closures in Paris, tourism down 50% in Vietnam, despite lack of local transmission)</td>
<td>Severe impact; travel acutely impacted; summer season missed – forward bookings for Mar-April down significantly; reports of over 40% in certain airlines</td>
<td>Sustained headwinds, with global travel acutely impacted; summer season missed – forward bookings for Mar-April down significantly; reports of over 40% in certain airlines</td>
<td>Oil price decline driven by both longer-term demand impact and short-term supply overhang</td>
<td>Rebound expected with resumption of consumer demand, but long-term impact likely if situation persists and depresses prices beyond a year</td>
<td>Existing vulnerabilities (e.g., trade tensions, declining sales) amplified by acute decline in Chinese demand, continued supply chain and production disruption in China, rest of Asia, now EU</td>
<td>Overall moderate decline in private consumption and exports of services Demand for certain product segments (e.g., food, produce) resilient; significant online growth (though hampered by labor shortage)</td>
</tr>
<tr>
<td>Delayed recovery until winter season, when disease might surge again</td>
<td>Pace of recovery faster for domestic travel (~2 quarters); slower pace of recovery for long-haul and/or international travel (up to ~3-4 quarters)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Market structure shifts accelerated (e.g., strategic moves to diversify supply chain) Downstream impact due to supply chain challenges in China, rest of Asia (esp. South Korea), causing delays in 5G, product development</td>
</tr>
<tr>
<td>Potential of more localized impact, containing negative demand hit</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Pace of recovery to differ by sub-sector (e.g., semiconductor likely faster)</td>
</tr>
</tbody>
</table>

Source: IHS Markit; McKinsey Global Institute Analysis; Subject matter experts; Press reports

McKinsey Global report (9th March 2020)

The economics of a pandemic: The case of Covid-19

McKinsey & Company 11
The search for a safe haven

Price of gold in US dollars per troy ounce

Source: FRED.
Meanwhile in Russia and Saudi Arabia

Oil price hits 18-year low
Brent crude, US dollars per barrel

Source: Bloomberg, 30 March 2020, 08:30 GMT
Short-run effects: pollution levels decline

Satellite images show pollution clear amid lockdown
Nitrogen dioxide levels in the lower atmosphere

Source: ESA/Copernicus, 27 March 2020
Social isolation will increase

• Increase in social isolation during social distancing/quarantine phase

• Costly across demographics..

• .. And particularly so for elderly, whose families are more likely to distance from to minimize chances of contagion

• Older population is both:
  • vulnerable to the disease
  • AND vulnerable to the side effect of the disease

High-skilled more likely to work form home

- Firms may reconsider and increase acceptance of remote work going forward
  - More flexibility for workers
  - Lower congestion in cities

- Unequal opportunity:
  - More high-skilled individuals can work from home (education, financial services, corporate jobs; not health professionals) than low-skilled workers (drivers and deliverers, cleaners, distribution supply chain, retail workers, etc.)
  - Skills may correlate with liquidity to sustain brief unemployment spell during the health crisis

High earners more likely to work from home

- 29% of American workers could work from home according to a BLS survey in 2017-18
- Proportions vary widely across occupation (see chart) and industry
- Income is also a crucial factor:
  - 0-25th percentile: 9.2%
  - 25-50th percentile: 20.1%
  - 50-75th percentile: 37.3%
  - 75-100th percentile: 61.5%

Source: BLS (https://www.bls.gov/news.release/flex2.t01.htm)
Most workers in manufacturing, retail, leisure, construction and transportation and utilities can hardly work from home.

Source: BLS (https://www.bls.gov/news.release/flex2.t01.htm)
Potential long-term changes

- Universities and business worldwide have quickly moved towards remote working and learning for the remainder of the school year.
- Despite the disruption, this event has been seen as a critical opportunity for digital learning.
- Companies hope this can become a persistent change.
- Zoom, a popular remote conferencing software, has seen a sharp increase in its stock price during the first few months of 2020.

Source: Lorenz et al (17 March, nytimes.com), Bary (18 March, marketwatch.com)
Home schooling, internet access and education

More than 770 million learners are now being affected by school and university closures (United Nations).

School closing: “home-schooling” and on-line tutorial

- Empirical studies show strong impacts of quality of parental education on pupil educational attainment and long-term outcomes (Heckman, 2006) Science

Hence, School closing will reinforce this inequality

- Access to on-line resources not universal:

Between 56 million and 80 million people in China reported lacking either an internet connection or a web-enabled device in 2018 (NY Times, March 17)

10% of Households in UK have no internet connection.

- The closures could disproportionately affect children from poor and low-income families, many of whom receive their weekday breakfast and lunch and, in some cases, dinner on campus (LA Times, March 13).

The race between supply and demand

At first, covid-19 may look like a supply shock:

- Disruption in global supply chains
- Quarantine and social distancing decrease the number of hours worked

Aggregate Supply (AS) move from $\text{AS}^0$ to $\text{AS}^1$

Different from previous crises:

- Great recession of 2007-09: origin of supply shock was in the financial sector
- War/natural disaster: origin of the supply shock is destruction of infrastructure or large-scale permanent loss in labour force.
Then, demand effects materialize:

- Uncertainty about the progress of disease
- Uncertainty about economic policies that will alleviate
- Non-permanent workers will lose income, particularly in affected industries (e.g. hospitality, manufacturing)
- Households increase precautionary savings
- Firms wary of investing until situation clears; also lack liquidity to do so
The race between supply and demand

Feedback loop into supply:

• Firms (especially those more dependent on cash flows) lack liquidity to fulfill commitments while facing lower demand and thus are forced to file for bankruptcies.

Demand and supply loop similarly to financial crisis, though uncertainty is about the disease.

Different from war/disaster: there, demand might increase as governments redirect war efforts towards fight/rebuild and so potentially inflationary.
The race between supply and demand

Feedback loop into demand:

- Workers who lose jobs from closing businesses do not have an income anymore and therefore lower consumption, eventually depressing aggregate demand.
Covid-19 virus is not ‘just’ a (large) shock on real economic fundamentals; it is a shock on the frictionless of the market; it introduces ‘a wall between demand and supply’ with strong complementary feedbacks in the real economy; contraction in supply, leading to a contraction in demand, leading to contraction in supply…..leading to a large destruction of economic surplus (red shaded area in the chart on the right)
Supply vs demand

- IGM poll of top economists suggest that impact of demand shock will be larger than that of supply.

**Statement B:** The economic effects of COVID-19 coming from reduced spending will be larger than those coming from disruptions to supply chains and illness-related workforce reductions.

*Responses weighted by each panelist’s confidence*

Many small businesses rely on cash flows

- Firms with cash flows to asset ratio above 0.5 account for about 10% of employment among private businesses.

- All private businesses account for more than 60% of total employment. So (small) firms with cash flows to assets > 0.5 account for some 6% of total employment in the economy.

Source: based on calculations from Bahaj, Foulis, Pinter and Surico (2019) on the universe of private non-financial firms in the U.K. The research in this paper has been funded by an ERC Consolidation Grant, whose support is gratefully acknowledged.
Many mortgagors and renters have little cash-on-hands

UK BHPS: 2005

<table>
<thead>
<tr>
<th></th>
<th>Median</th>
<th>[p25 , p75]</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Net Liquid wealth</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Outright owners</td>
<td>3,050</td>
<td>[0 , 17,034]</td>
</tr>
<tr>
<td>Mortgagors</td>
<td>0</td>
<td>[-3,250 , 5,000]</td>
</tr>
<tr>
<td>Renters</td>
<td>0</td>
<td>[-455 , 500]</td>
</tr>
</tbody>
</table>

|                  |         |             |
| **Net Housing wealth** |      |             |
| Outright owners   | 150,000 | [100,000 , 220,000]|
| Mortgagors        | 97,000  | [56,250 , 152,000]|
| Renters           | 0       | 0           |

Figures in the table refer to £pounds value at 2005 prices

About 30-35% of the population (1/2 mortgagors + 1/2 renters) spend most of the cash flows they receive

Source: Cloyne, Ferreira and Surico (2020) on the U.K. household data
The research in this paper has been funded by an ERC Consolidation Grant, whose support is gratefully acknowledged.
Adding economics into an epidemiology model

• Goal: reassess the health and economic trade-offs of different containment policies.

• The SIR-Macro model assumes that individual transition from susceptible to infected is not exogeneous, but depends upon the economic decisions that are made:
  • **Supply effect**: people get sick resulting in less labour
  • **Demand effect**: people consume less because going out puts them at risk

• Incorporating a reduction in consumption and labour hours results in predictions of a larger and more persistent recession, but fewer deaths than when individuals’ health statuses are assumed to be exogenous to economic conditions
  • Larger decline in consumption of 9.1%, versus 2% when consumption reduction is not a factor
  • Peak percent of population that suffers infection is 5.1% versus 8.4%
  • 52.8% of population gets infected versus 65%, equating to 500k fewer deaths in the U.S. alone

## The health and economic policy trade-offs

<table>
<thead>
<tr>
<th>Scenario</th>
<th>Optimal Policy</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Base Case</strong></td>
<td><strong>Gradual Ramp-Up</strong></td>
</tr>
<tr>
<td>Economic decisions have an impact on an individuals likelihood of contracting the virus</td>
<td>Build up a fraction of population to be immune, curtailing consumption when infection rates spike, and slowly retracting as critical immunity level is reached</td>
</tr>
<tr>
<td><strong>Medical preparedness</strong></td>
<td><strong>More Aggressive Containment</strong></td>
</tr>
<tr>
<td>If the mortality rate depends on the number of infected people (e.g. healthcare systems are overwhelmed)</td>
<td>As more people die from the disease, the cost to everyone is higher. People further reduce consumption and less people recover from the disease</td>
</tr>
<tr>
<td><strong>Discovery of Treatment</strong></td>
<td><strong>Gradual Ramp-Up</strong></td>
</tr>
<tr>
<td>Probability of discovering a treatment (e.g. a cure for infected people, not a prevention for future infections)</td>
<td>Similar results to the base case, with a smaller recession given people are more willing to engage in market activities</td>
</tr>
<tr>
<td><strong>Discovery of Vaccine</strong></td>
<td><strong>Immediate and Severe Containment</strong></td>
</tr>
<tr>
<td>Probability of discovering a vaccine (e.g. a prevention for susceptible people from becoming infected)</td>
<td>Minimizes deaths, cause a large recession, hoping that a vaccination is found before infections rise</td>
</tr>
</tbody>
</table>

The economics of a pandemic: The case of Covid-19

Health and economic outcomes by scenario

Medical preparedness

Discovery of Treatment

Discovery of Vaccine

Summary of part 3 (economics)

• Global recession seems inevitable, possibly in emerging markets too.
• Overall, demand effects probably much larger than the initial supply shock.
• Uncertainty, panics and lock-down policies key to drive large drop in demand.
• The investment of many firms (esp. small and young) and spending of many households (esp. renters and mortgagors) depend largely on cash flows.
• Large drop in demand thus force these firms to close. This leads to a rise in lay-offs and a further drop in consumption. Economy enters a depressing loop!

Full set of slides available at https://sites.google.com/site/paolosurico/covid-19

This Lecture

1. Science

2. Health policies

3. Economics

4. Macroeconomic policies
A four stage strategy?

Link: https://www.youtube.com/watch?v=nSX1etP5iak
Health policies and health expenditure

• At the FIRST sign of a highly contagious disease, isolate immediately the more vulnerables (e.g. the old) and test ‘at random’ representative samples of the population to identify the most contagious groups.

• Those who test positive need to self-isolate, independently of the symptoms.

• Trace the positive case and keep testing and isolating (more on next slide).

• Expand intensive care capacity (both beds and equipment) by building new units or convert available estates (e.g. hotel, barracks, etc)

• If the contagion is geographically concentrated, spread non-pandemic-related intensive care cases to other regions.
A simple policy proposal
Random testing, statistical analysis and surveillance

1. Test a representative sample of the population (independently of symptoms), recording socio, economical, demographic and locational characteristics at the household level.

2. Use standard statistical methods to infer the household characteristics most likely to predict whether someone is infected or not in the whole population.

3. Develop surveillance strategies based on the information revealed in (2): nation-wide contact tracing, targeted social distancing.

Collecting the right data and conducting extensive statistical analysis can save MANY lives!!!
Goal: prevent a 2nd peak and flatten the contagion curve that may spike again in the Fall 2020.
Direct and Indirect Effects on the economy

- Round 1: supply side disruptions and large death toll generates heightened uncertainty and panic for households and businesses

- Round 2: heightened uncertainty and panic leads to drop in consumption and investment.
- Round 3: large drop in demand dries up corporate cashflows, triggering firms’ bankruptcies
- Round 4: layoffs and exiting firms generate sharp rise in unemployment
- Round 5: Labour income fall significantly and non-performing loans spike up, which weakens demand and increases uncertainty further. Back to round 2 for another loop!

Indirect effects 2-to-5 potentially very large but not unprecedented by historical standards. Major macroeconomic cost is associated with the suppression strategy to solve the health crisis.
Flattening the recession curve

- Short-run trade-off between flattening the epidemic curve and the size of the recession. Slowing down the peak of infections is likely to prolong the time that the economy is not at full capacity.

- Economy is complex, made of interconnected agents (suppliers, customers, consumers, workers, banks).

- Individually rational decisions can cause a catastrophic chain reaction:
  
  i. Consumers not spending because self-isolated
  
  ii. Firms cut costs and reduce workers, default on loans and suppliers
  
  iii. Banks with non-performing loans will cut lending

For health, isolation has positive externalities. For the economy, isolation has negative externalities.

Source: Gourinchas: “Flattening the Pandemic and Recession Curves”, 13 March 2020
Economic costs of a suppression strategy

Assume only a temporary drop in economic activities: 50% for a month and 25% in the two following months. Then, GDP drop of almost 10% of annual output! (Gourinchas, 2020).

Make the countries lock down longer and add the supply/demand downward spiral, then the actual costs (without policy interventions) could exceed 15% of GDP!

Output loss associated with the Great Recession was about 4.5% and still unrecovered.

Output loss associated with the Covid-19 crisis likely to be permanent. A global recession in the advanced world is inevitable and a recession in China seems now likely already in 2020Q2!
The economics of a pandemic: The case of Covid-19
What macroeconomic objectives?

1. Ensure households delay mortgage/rental payments and have cash-on-hands.

2. Ensure workers receive paychecks even in quarantine or if temporarily laid off.

3. Ensure firms have enough cash flows (to pay workers and suppliers), especially small and young businesses, and can avoid bankruptcy.

4. Support financial system to avoid the health crisis becomes a financial crisis.
What macroeconomic policies?

A. Government spending on public health sector.

B. Tax relieves, tax cuts, tax holidays, tax incentives.

C. Tax rebates and temporary universal income to households; cash grants to firms.

D. Cut interest rates, launch QE programmes and lending schemes.

All would help but (C) most likely to stop immediate economic collapse.
What microeconomic policies?

Most sectors suffer from the Covid-19 shock generating unemployment.

Other sectors, like shipping and delivery services, grocery stores, online learning companies, digital businesses cannot cope with the hike in demand. e.g., Amazon announces 100000 new hires (March 16), The U.K.’s largest supermarket chains are leading the call for over 45,000 new staff (March 24).

Industrial policies:

• Facilitate labour market adjustment by relaxing regulations and creating matching platforms for re-deployment.

• Incentivise deployment of labour from hold-up sectors to booming sectors.

Example: Taxi drivers in Italy are put on hold and, at the same time, delivery services are congested. Taxi drivers should be deployed towards the delivery service.
Whatever mix is chosen, policies need to:

i. be **now and** be **massive**, of the same order of magnitude of the output loss. UK announced a package worth about 15% of GDP. Unprecedented!

ii. start from **health expenditure**: invest in testing and expansion of supply. Too late now for the first peak but still time to contain the second peak in the Fall of 2020.

iii. be about **cash disbursements to households and businesses, and incentivise labour deployment**. Tax incentives or cuts, emergency loans and borrowing on better terms, by their own, are unlikely to prevent a collapse in aggregate demand.

iv. use a **coordination of fiscal and monetary interventions** to maximize and multiply impact and provide financial backing to each other policy.

v. be **global**: interconnected society and economy requires global coordination.
Governments have started responding

Stimulus surge
Global stimulus measures as a percentage of GDP

Source: Macro Insights from Blackrock Investment Institute (26 Mar, blackrock.com)
How to finance these macroeconomic policies?

Debt is attractive, especially given the ultra-low interest rates. But guaranteed by whom?

UK/US governments have sufficient credibility to afford it without too much sovereign risk but would still require coordination with the central bank (more on next slide)...

But Italy can’t! Lack both government credibility and independent national central bank. An Italian problem? Not really. Just timing is different: “Europeans are all Italians”

Source: Ellison-Scott (2020, AEJM)
A Governance Crisis in the EU. Again!

Common shocks require common policy.
von Der Leyen: “We will give Italy all it asks for”

Question is how? A few options:

A) Eurobonds via (an empowered) ESM
B) Coordinated sovereign debt issuance, ‘coronavirus bond’
C) Helicopter money

All require ECB backing by some form of public debt monetisation: the last economic taboo!
ECB launched a €750bn Pandemic Emergency Purchase Programme to buy government and corporate debt until Covid-19 crisis is over. Fed launched a similar $700 bn programme.
Summary of part 4 (macroeconomic policies)

• With little or no government interventions, economic costs will be immense!
• Government priority should be on health expenditure but need a strategy to flatten the contagion curve that may spike back in the Fall of 2020.
• Simple proposal: ‘random testing’ to identify individual treats that predict being infected and then targeted testing and surveillance on the ‘most likely’ infected.
• Government spending should be now and as large as the predicted economic costs, focusing directly on cash disbursement to firms and households.
• Central banks should provide financial backing to the government, not just through their own reserves but also by printing money if necessary.
• Global shock needs global response. No country has fiscal capacity to stand alone.

Full set of slides available at https://sites.google.com/site/paolosurico/covid-19
Thank you!

# ANDRÀ TUTTO BENE