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

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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

- Focus on already existing drugs
- Many approaches, e.g.:
  - targeting replication ability of virus
  - stimulating immune system to shut down protein production
  - decreasing the overstimulation of other parts of the immune system
- Lower number of cases in China means trials are now being set in other places
  - Scientists planning trials in places that will face more cases soon
  - WHO working on protocol to pool patients from many countries in standardised trials
- Fast ramping-up of production can be challenging

Source: The Economist, 14th March 2020
The theoretical contagion curve

Adapted from the CDC and The Economist
Visit flattenthecurve.com
The empirical contagion curve(s)
Patterns of contagion in different countries

Country by country: how coronavirus case trajectories compare
Cumulative number of confirmed cases, by number of days since 100th case

FT graphic: John Burn-Murdock / @burnmurdock
Source: FT analysis of Johns Hopkins University, CSSE Worldometers. Data updated March 22, 19:00 GMT
© FT
Patterns of contagion in different countries

Italy, Spain and the UK have had more deaths attributed to coronavirus than China did at the same stage.

Cumulative number of deaths, by number of days since 10th death

Nationwide lockdowns: 

- Italy: large elderly population raises death rate
- China had 2,715 deaths at 35 days

More than 800 people had died in Italy before its nationwide lockdown began.

Spain locked down after around 200 deaths, France after around 175.

China began its strict lockdowns after around 30 deaths.

Belgium's lockdown

FT graphic: John Burn-Murdock / @burnmurdock
Source: FT analysis of Johns Hopkins University, CSSE, Worldometers. Data updated March 22, 19:00 GMT
© FT
The current situation worldwide

The rest of the world has surpassed China

Last update: 2020-03-22
Source: Johns Hopkins University CSSE, own calculations.
Europe is 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.
- 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).
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

Source: Notes by Flavio Toxvaraed; Baldwin and Weder di Mauro (2020), "Economics in the Time of COVID-19"
Comparison with other contagious diseases

- 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.
  - This implies that the measured fatality rates are likely to overstate grossly the actual fatality rate, especially in the light of the large number of suspected asymptomatic.

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


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1. As determined at the beginning of an outbreak, can be reduced by effective intervention.
2. Case-fatality numbers are reflective of the outbreak setting and depend on a number of factors, including patient’s age, community immunity, health-system capabilities, etc. This graphic aims to offer a broad comparison.

Source: Expert interviews; World Health Organization; McKinsey analysis.
Covid-19 infects more the young!

**KEY DIFFERENCE**

Korea has tested large share of the population ‘at random’

BUT

Italy has tested only (worst) symptomatic cases.

Comparison suggests that most carriers are actually in younger groups!


...but kills more 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>
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</thead>
<tbody>
<tr>
<td>South Korea</td>
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<td>China (^2)</td>
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</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

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
• Many countries are facing strong excess demand for health care: too many critical patients (not only Covid-19 cases) for too few ICU beds and ventilators
• Expanding health care supply requires turning hotels, barracks and possibly schools into ICU and converting selected manufacturers into ventilator makers
• Not enough medical personnel. Recall retired nurses and doctors. Train police officer and volunteers while the army carries out police duties

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

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The consensus: flattening the curve

How to flatten the curve?

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
  - Matt Hancock, UK health secretary: “We’re saying that if you produce a ventilator, then we will buy it. No number is too high”

Source: https://www.ft.com/content/5a2ffcc78-6550-11ea-b3f3-fe4680ea68b5
Health system capacity constraints across Italian regions

Share of Intensive Care Units used for Covid-19 patients

<table>
<thead>
<tr>
<th>Region</th>
<th>Share of ICUs Used for Covid-19 Patients</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lombardia</td>
<td>99%</td>
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<tr>
<td>Liguria</td>
<td>94%</td>
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<tr>
<td>Marche</td>
<td>90%</td>
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<tr>
<td>Valle d'Aosta</td>
<td>84%</td>
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<tr>
<td>Piemonte</td>
<td>67%</td>
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<tr>
<td>Emilia-Romagna</td>
<td>62%</td>
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<td>Trento</td>
<td>60%</td>
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<tr>
<td>Abruzzo</td>
<td>54%</td>
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<tr>
<td>Friuli-Venezia</td>
<td>50%</td>
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<td>Giulia</td>
<td>48%</td>
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<td>Toscana</td>
<td>43%</td>
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<td>Veneto</td>
<td>40%</td>
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<tr>
<td>Bolzano</td>
<td>35%</td>
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<tr>
<td>Umbria</td>
<td>20%</td>
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<tr>
<td>Campania</td>
<td>16%</td>
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<tr>
<td>Sicilia</td>
<td>16%</td>
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<tr>
<td>Basilicata</td>
<td>16%</td>
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<tr>
<td>Molise</td>
<td>13%</td>
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<tr>
<td>Lazio</td>
<td>13%</td>
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<tr>
<td>Sardegna</td>
<td>12%</td>
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<tr>
<td>Puglia</td>
<td>12%</td>
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<tr>
<td>Calabria</td>
<td>12%</td>
</tr>
<tr>
<td>Italy</td>
<td>51%</td>
</tr>
</tbody>
</table>

*Source: Matteo Villa (Istituto per gli studi di politica internazionale)*

*Dati:* Protezione Civile e Ministero della Salute.
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.

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

\[ S_{\text{susceptible}} I_{\text{infected}} R_{\text{recovered}} \]

**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

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

A. **Containment**
   - lowering $R_0$ but keeping it above 1
     - (attempted quarantine)

B. **Suppression**
   - lowering $R_0$ below 1
     - (social distancing)

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

Containment 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

But the trade-off is draconian!

- Policies to **contain** the virus (i.e. lowering replication number **BUT NOT below 1**) 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 **below 1**) 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

\[ S_{\text{susceptible}} I_{\text{infected}} R_{\text{recovered}} \]

Susceptible \rightarrow Infected

NOTE: All these transitions are highly heterogeneous across groups of demographics and health conditions.

\[ \text{Susceptible} \rightarrow \text{Infected} \rightarrow \text{Critical complications} \rightarrow \text{Deaths} \lor \text{Asymptomatic} \rightarrow \text{Recovered/Immune} \]
Health care policies

Table 2: Summary of NPI interventions considered.

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<td>Voluntary home quarantine</td>
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<td>Reduce contacts by 50% in workplaces, increase household contacts by 25% and reduce other contacts by 75%. Assume 75% compliance with policy.</td>
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<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>
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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 contain 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.
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Figure 3: Suppression strategy scenarios for GB showing ICU bed requirements. The black line shows the unmitigated epidemic. Green shows a suppression strategy incorporating closure of schools and universities, case isolation and population-wide social distancing beginning in late March 2020. The orange line shows a containment strategy incorporating case isolation, household quarantine and population-wide social distancing. The red line is the estimated surge ICU bed capacity in GB. The blue shading shows the 5-month period in which these interventions are assumed to remain in place. (B) shows the same data as in panel (A) but zoomed in on the lower levels of the graph. An equivalent figure for the US is shown in the Appendix.
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.
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 2nd 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 March 22nd has been particularly low: 1.2% (vs 9.5% 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)

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: https://science.sciencemag.org/content/367/6484/1287.full
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
The economics of a pandemic: The case of Covid-19

Source: The Economist, 14th March 2020
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)

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

• Given existing capacity of health care systems, suppression policies are the only one that can help us in the short-run

• Please do follow government guidelines

• 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](https://sites.google.com/site/paolosurico/covid-19)

This Lecture

1. Science
2. Health policies
3. Economics
4. Macroeconomic policies
A major recession coming

IGM poll of top economists:

- Majority of European and US economists predict major recession
- Europeans have a stronger view than US
- Less clear in emerging markets

CHINA – NOWCAST AND FORECAST – in real-time, everyday!

Quarterly GDP growth, year-on-year, %

<table>
<thead>
<tr>
<th>Q1 2020</th>
<th>Q2 2020</th>
</tr>
</thead>
<tbody>
<tr>
<td>10-Mar</td>
<td>10-Mar</td>
</tr>
<tr>
<td>09-Mar</td>
<td>09-Mar</td>
</tr>
<tr>
<td>02-Mar</td>
<td>02-Mar</td>
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<tr>
<td>24-Feb</td>
<td>24-Feb</td>
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<tr>
<td>17-Feb</td>
<td>17-Feb</td>
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<tr>
<td>10-Feb</td>
<td>10-Feb</td>
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<tr>
<td>03-Feb</td>
<td>03-Feb</td>
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<tr>
<td>19-Jan</td>
<td>19-Jan</td>
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<tr>
<td>13-Jan</td>
<td>13-Jan</td>
</tr>
<tr>
<td>06-Jan</td>
<td>06-Jan</td>
</tr>
</tbody>
</table>

Source: live Now-Casting model, Reichlin (19th March 2020)
EURO AREA – NOWCAST AND FORECAST – in real time, everyday

Quarterly GDP growth, quarter-on-quarter, %

Q1 2020

Q2 2020

Source: new, international nowcasting model, Reichlin (19th March 2020)

The economics of a pandemic: The case of Covid-19
Impact on stock markets

Large declines in the stock markets in 2020

% change since beginning of 2020

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

Last update: 2020-03-23
Impact on travel services

Airlines most at risk from EU travel ban

Total number of seats on scheduled flights between EU and non-EU countries in the 30 day period

- Air France: 815,000
- Lufthansa: 573,000
- Emirates: 544,000
- KLM: 507,000
- Wizz Air: 468,000
- Qatar Airways: 372,000
- Ryanair: 369,000
- Turkish Airlines: 354,000
- Delta Air Lines: 338,000
- Aeroflot: 322,000

Note: EU restrictions envisage some skeleton services may continue to operate

Source: ForwardKeys
Impact on restaurants

Large declines in the restaurant industry

Year-on-year chg. restaurant reservations + walk-ins on OpenTable

Source: OpenTable.
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.
Impact on the supply chain

Smartphone shipments in China are expected to recover quickly

- Forecast before outbreak
- Forecast with coronavirus effect included

Source: Bloomberg
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
- Inventory ‘whiplash’. 7-8 wks auto, 2-4 wks high-tech
- GDP impact
  - Sharp rebound
  - Demand shift

Source: WHO Situation Reports; CDC travel notice; IATA, Reuters, TomTom traffic index, press searches; HSBC Business School, Tencent News, Sina news, Beijing 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>Longest</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>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>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</td>
<td>Market structure shifts accelerated (e.g., strategic moves to diversify supply chain)</td>
<td></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 ~5-4 quarters)</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>Headwinds to persist into Q3 given tight inventories (&lt;6 weeks), supply chain complexity (therefore, minimal ability to shift)</td>
<td>Demand for certain product segments (e.g., food, produce) resilient; significant online growth (though hampered by labor shortage)</td>
<td>Downstream impact due to supply chain challenges in China, rest of Asia (esp. South Korea), causing delays in 5G, product development</td>
<td></td>
</tr>
<tr>
<td>Potential of more localized impact, containing negative demand hit</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Pace of recovery to differ by sub-sector (e.g., semiconductor likely faster)</td>
<td></td>
</tr>
</tbody>
</table>

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

McKinsey Global report (9th march 2020)
The search for a safe haven

The value of gold is now plummeting

Source: Bloomberg, 19 March 2020, 13:00 GMT
Meanwhile in Russia and Saudi Arabia

**Sharp decline in the price of oil since January**

Price of oil in US dollars per Barrel

Source: FRED.
Short-run effects: pollution levels decline

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

January 1 to 20

February 10 to 25

Source: Nasa, ESA/Copernicus
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

Opinion

Coronavirus and the Isolation Paradox

“Social distancing” is required to prevent infection. But loneliness can make us sick.

By Abdullah Shihipar
Mr. Shihipar studies public health.

March 13, 2020

High-skilled more likely to work from 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.

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 across the world decreasing labour supply

Aggregate Supply (AS) move from $AS^0$ to $AS^1$

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.
The race between supply and demand

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.
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)
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

<table>
<thead>
<tr>
<th>European IGM Panel’s responses</th>
<th>US IGM Panel’s responses</th>
</tr>
</thead>
<tbody>
<tr>
<td>Strongly agree</td>
<td>0%</td>
</tr>
<tr>
<td>Agree</td>
<td>44%</td>
</tr>
<tr>
<td>Uncertain</td>
<td>52%</td>
</tr>
<tr>
<td>Disagree</td>
<td>3%</td>
</tr>
<tr>
<td>Strongly disagree</td>
<td>0%</td>
</tr>
</tbody>
</table>

Source: https://voxeu.org/article/economic-impact-pandemic-igm-forum-survey
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

<table>
<thead>
<tr>
<th>UK BHPS: 2005</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>
<tr>
<td><strong>Net Housing wealth</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Outright owners</td>
<td>150,000</td>
<td>[100,000 , 220,000]</td>
</tr>
<tr>
<td>Mortgagors</td>
<td>97,000</td>
<td>[56,250 , 152,000]</td>
</tr>
<tr>
<td>Renters</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

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.
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
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
Health policies and health expenditure

• At the FIRST sign of a highly contagious disease, isolate immediately the more vulnerable (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.
Designing an efficient testing strategy

Once the curve is flatten out, how can social distancing be relaxed without a spike in infections?

• Only available option: identify the infected fast, isolate them and trace the source.

• But how? A three-step approach.
  a. Scale up availability of tests for infection.
  b. Develop simulation for optimal testing strategy.
  c. Stratify tests across population to identify the key observable characteristics of diffusion.
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.
The economics of a pandemic: The case of Covid-19

TREASURY

CORONAVIRUS

Try not to put your head in your hands after looking at the latest economic figures.
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!
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.
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**. 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.
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)
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