London Business School

Wheeler Institute for Business and Development

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

Paolo Surico and Andrea Galeotti
Professors of Economics at London Business School

European Research Council
Established by the European Commission

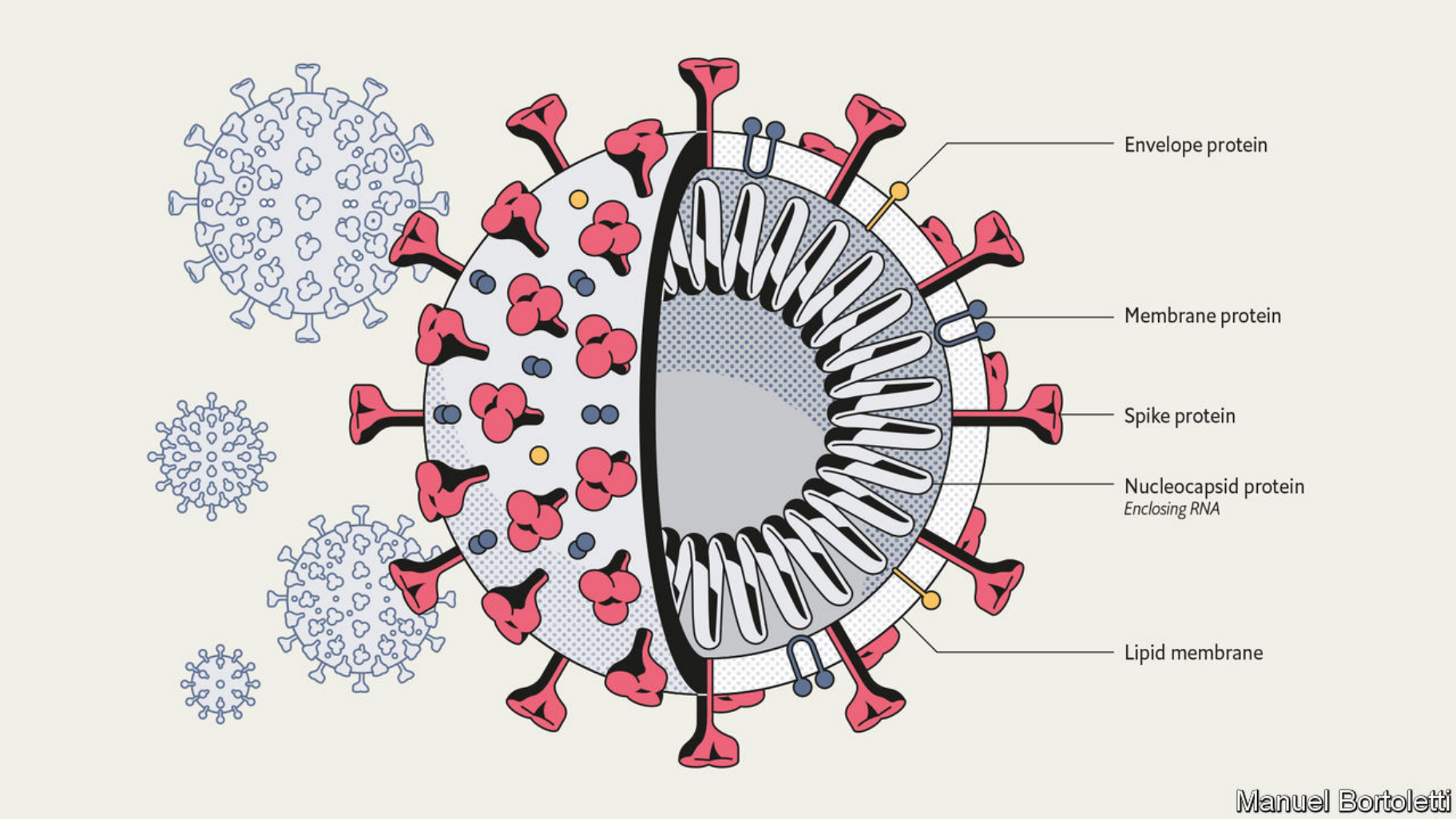
london.edu

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

Source: The Economist, 23rd January 2020; Nature: “Mystery deepens over animal source of coronavirus” https://www.nature.com/articles/d41586-020-00548-w

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

Source: The Economist, 23rd January 2020; https://www.bbc.co.uk/news/av/health-51883255/coronavirus-explained-in-60-seconds; https://www.nytimes.com/interactive/2020/03/11/science/how-coronavirus-hijacks-your-cells.html

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

Source: McKinsey & Company: Coronavirus COVID-19: Facts and Insight, updated 9th March 2020.

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

Testing, testing

Promising drugs to treat covid-19

Drug	Current use	Original mode of action	Being tested?
Chloroquine	Antimalarial	Heme polymerase inhibitor	Yes
Kaletra (ritonavir + lopinavir)	HIV	Protease inhibitor	Yes
Interferon alfa-2b	Hepatitis-C	Immune modulator	Yes
Remdesivir	Experimental	Nucleotide analogue	Yes
Favipiravir	Influenza	RNA polymerase inhibitor	Yes
Actemra (tocilizumab)	Rheumatoid arthritis; covid-19	Anti-inflammatory	Approved*
Kevzara (sarilumab)	Rheumatoid arthritis	Anti-inflammatory	Trials expected

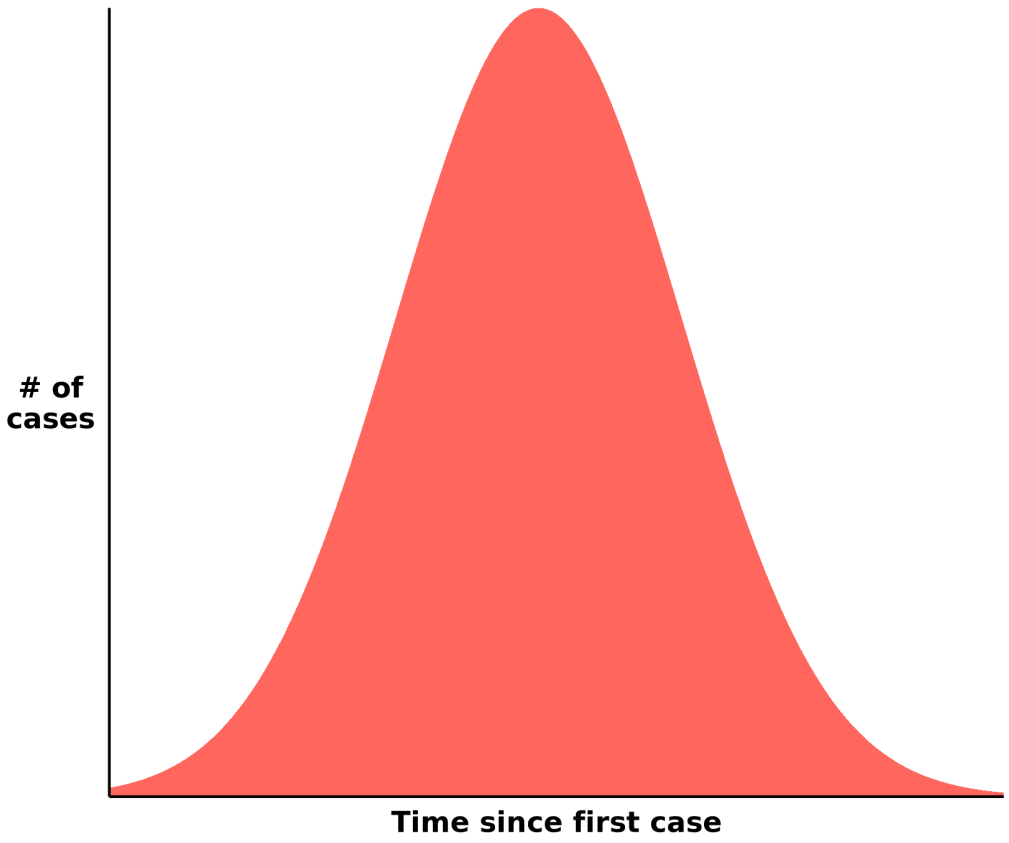
Source: WHO, adapted from landscape analysis, 17th February 2020

*For use on covid-19 in China, March 2020

The Economist

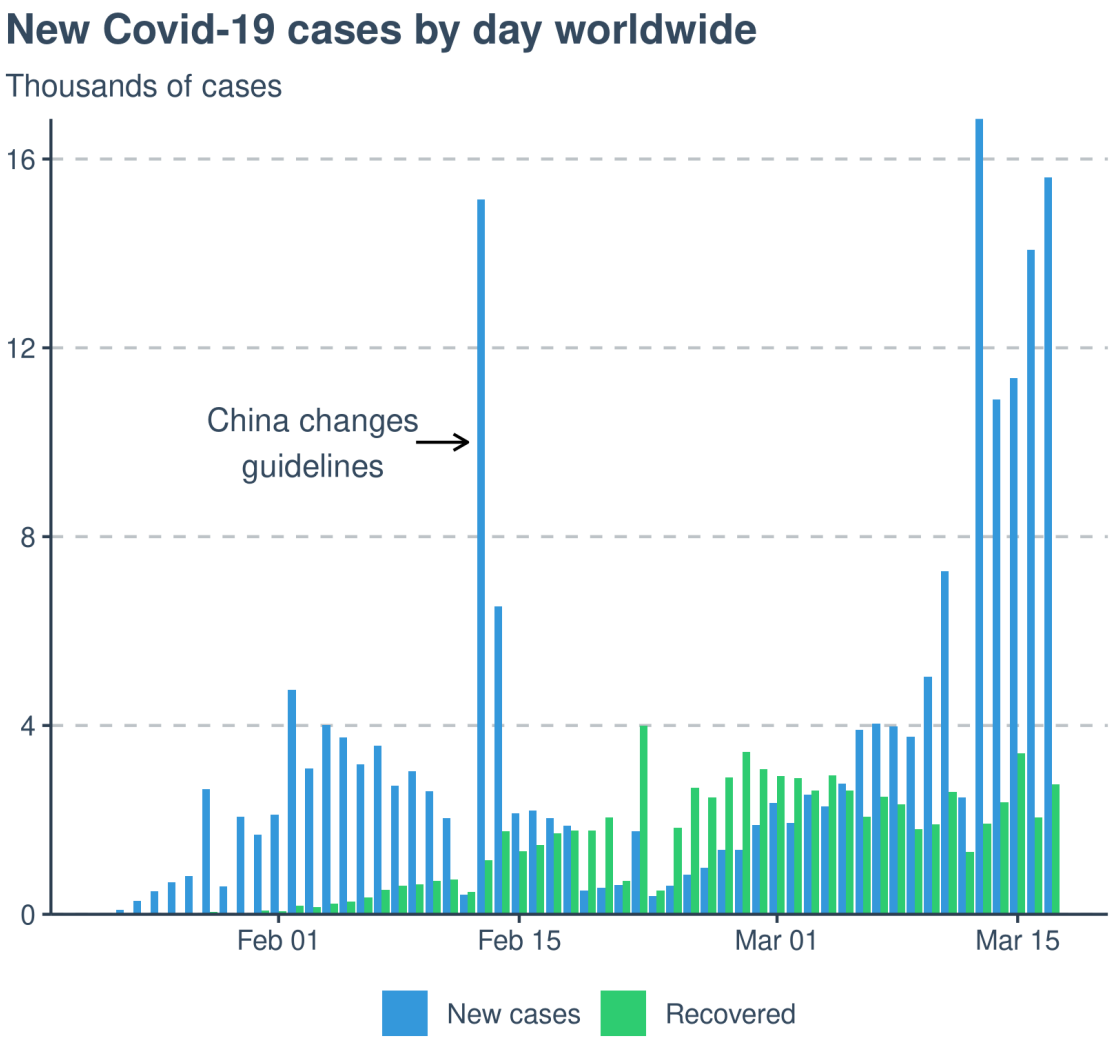
Source: The Economist, 14th March 2020

The theoretical contagion curve



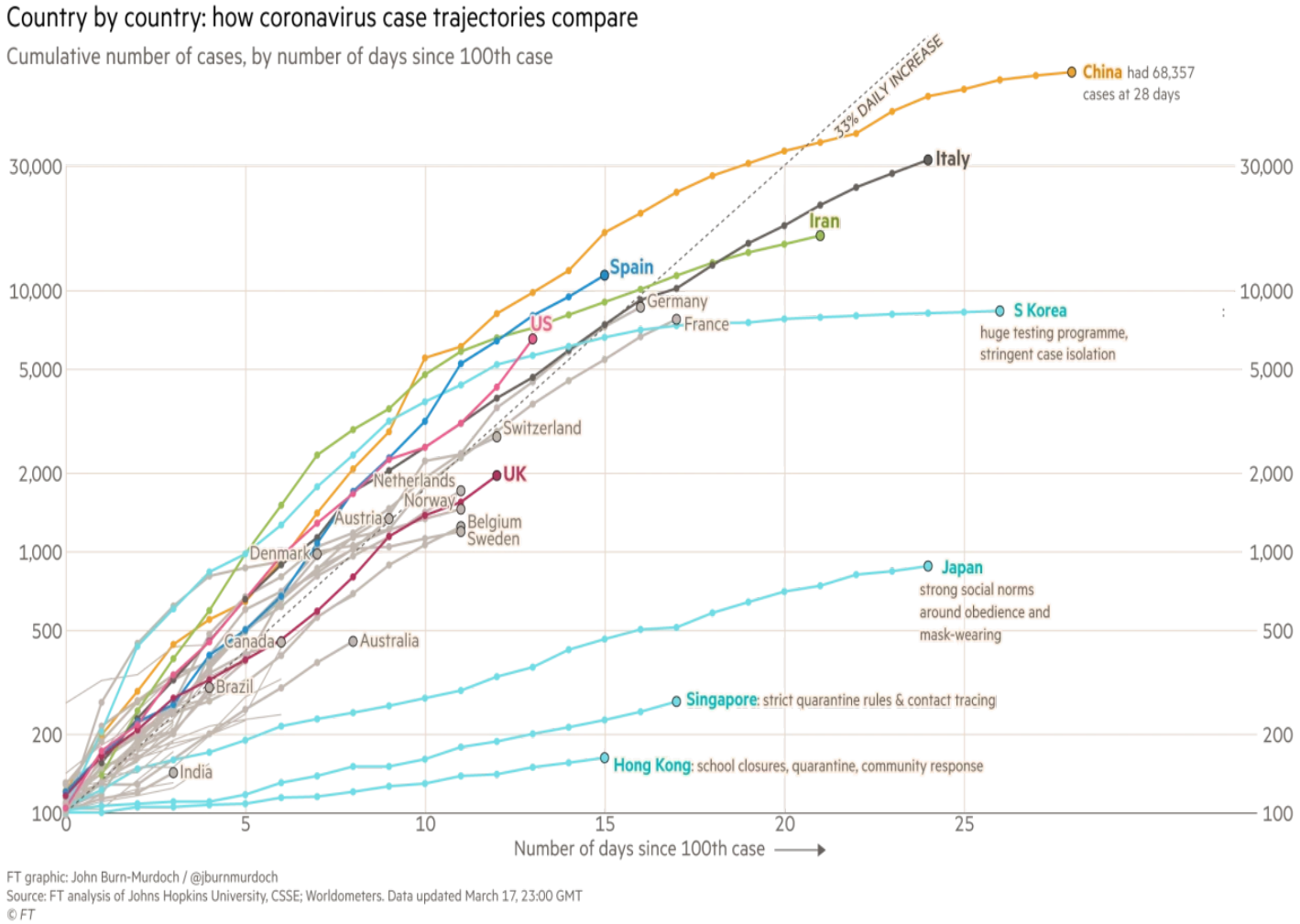
Adapted from the CDC and The Economist
Visit flattenthecurve.com

The empirical contagion curve(s)

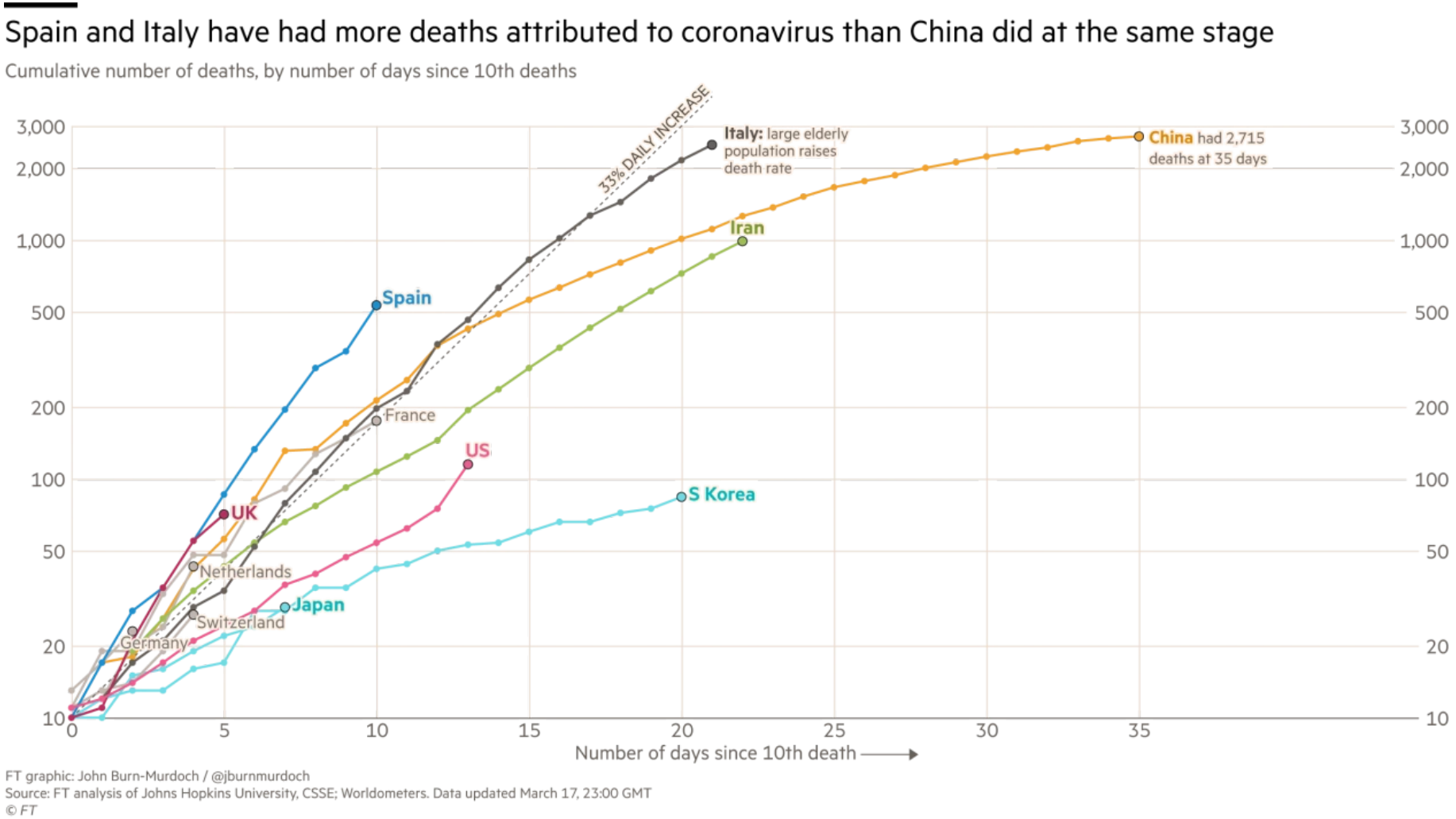


Last update: 2020-03-17
Source: Johns Hopkins University CSSE, own calculations.

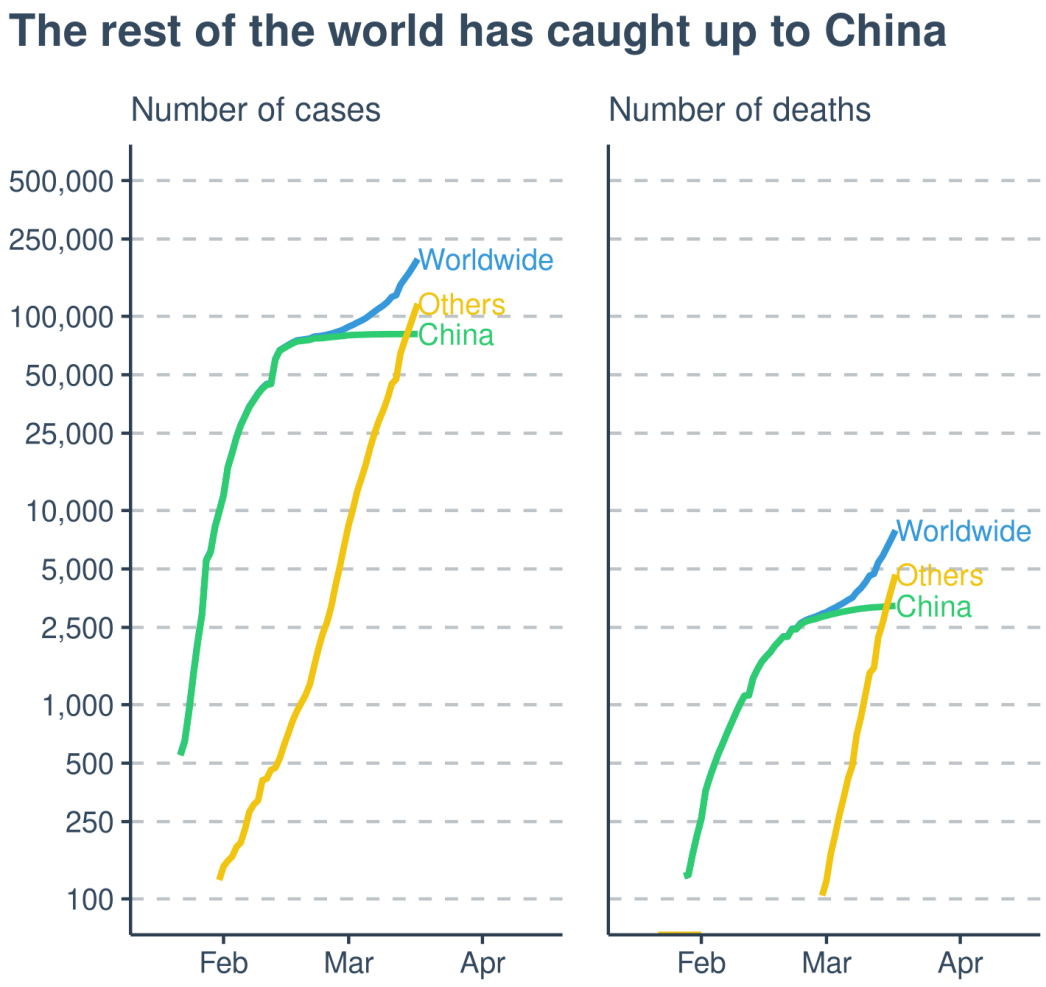
Patterns of contagion in different countries



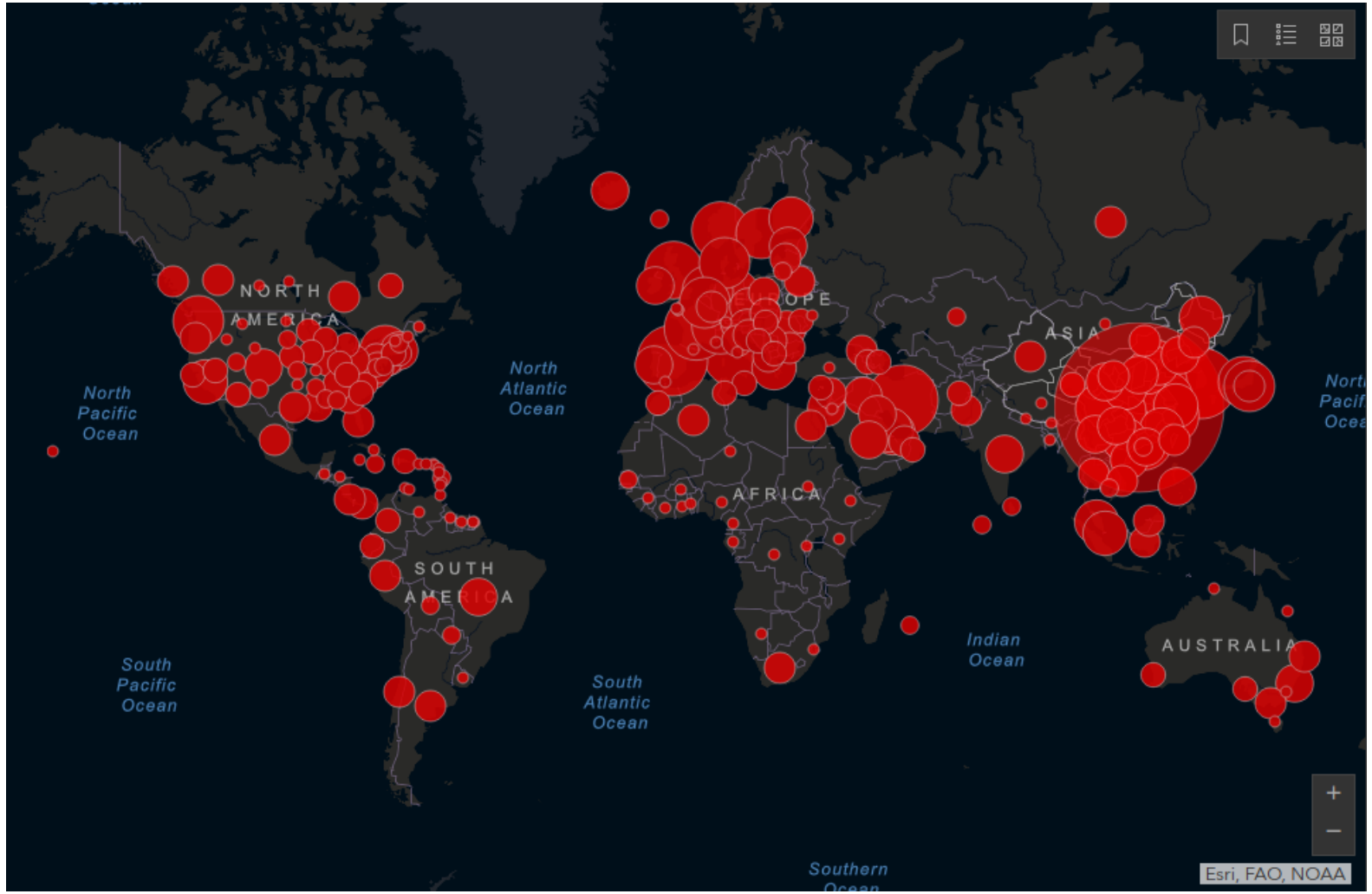
Patterns of contagion in different countries



The current situation worldwide



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).

Pandemic

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

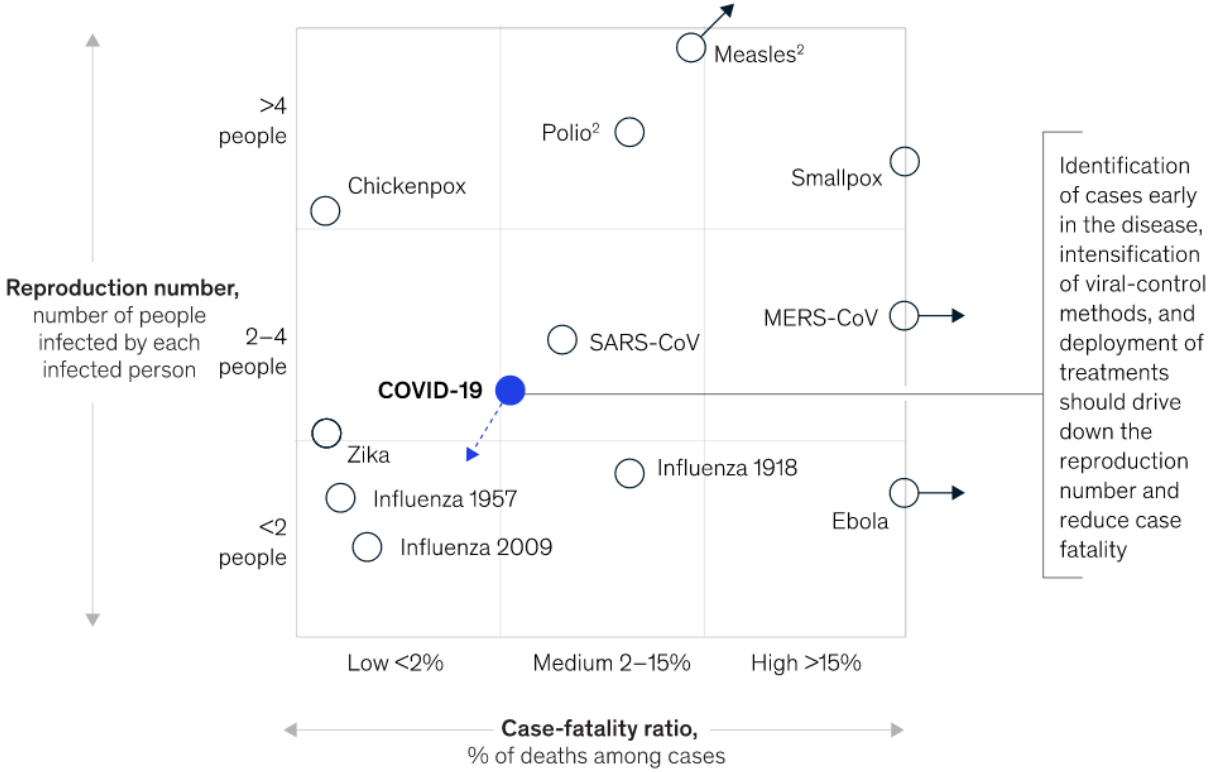
Source: Notes by Flavio Toxvaraed; Baldwin and Weder di Mauro (2020), “Economics in the Time of COVID-19”

Comparison with other contagious diseases

- Mortality rate = (Death / Population)
- Fatality rate = (Death / 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.

COVID-19 is more infectious than influenza.

Reproduction[1] and fatality[2] for selected human viruses



[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

Source: McKinsey & Company: Coronavirus COVID-19: Facts and Insight, updated 16th March 2020.

Covid-19 infects more the young!

KEY DIFFERENCE

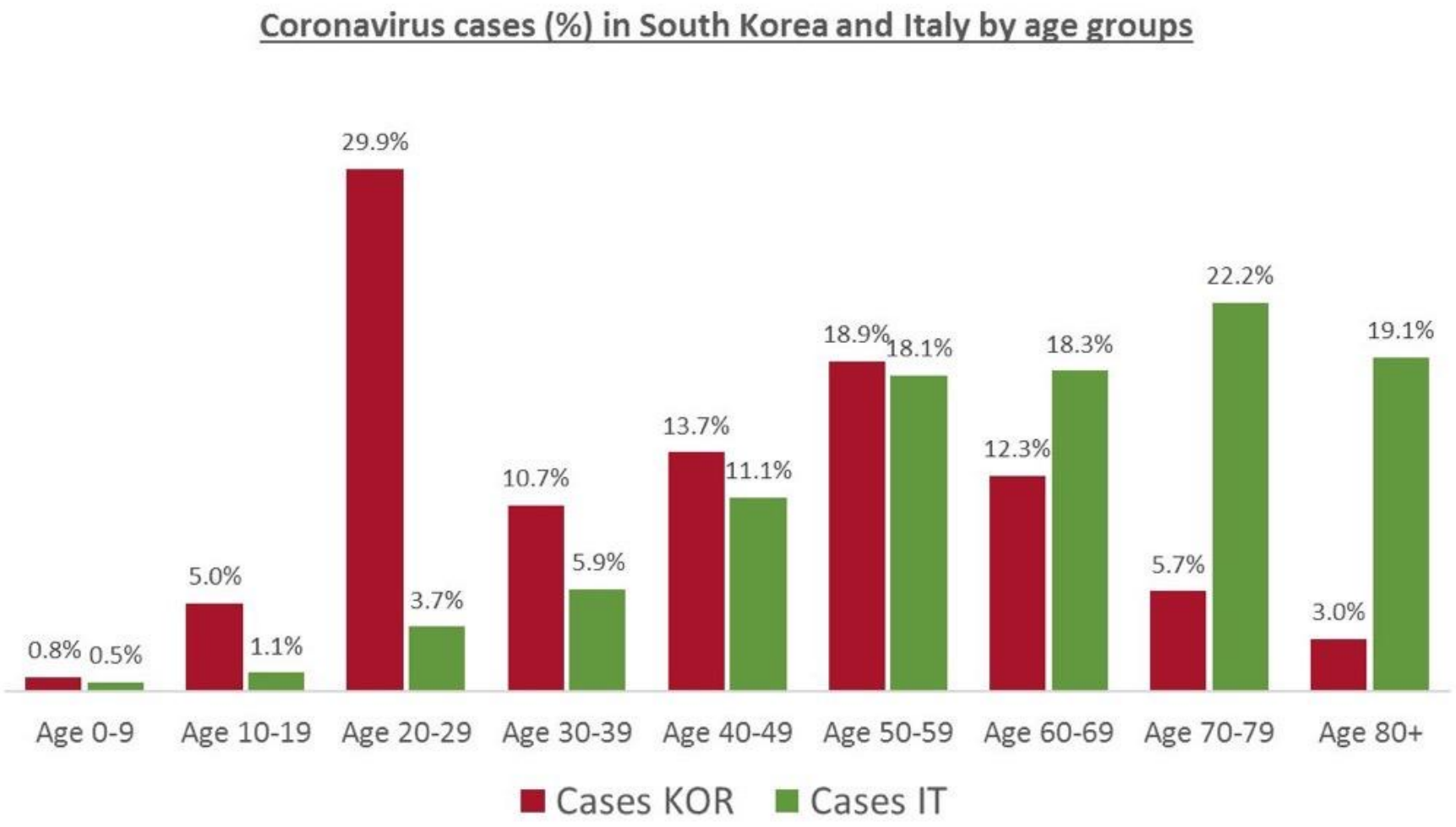
Korea has tested large share of the population 'at random'

BUT

Italy has tested only (worst) symptomatic cases.

Comparison suggests that most carriers are actually in younger groups!

A quasi-natural experiment: the case of the Italian town of Vo in Veneto (FT, March 17th).

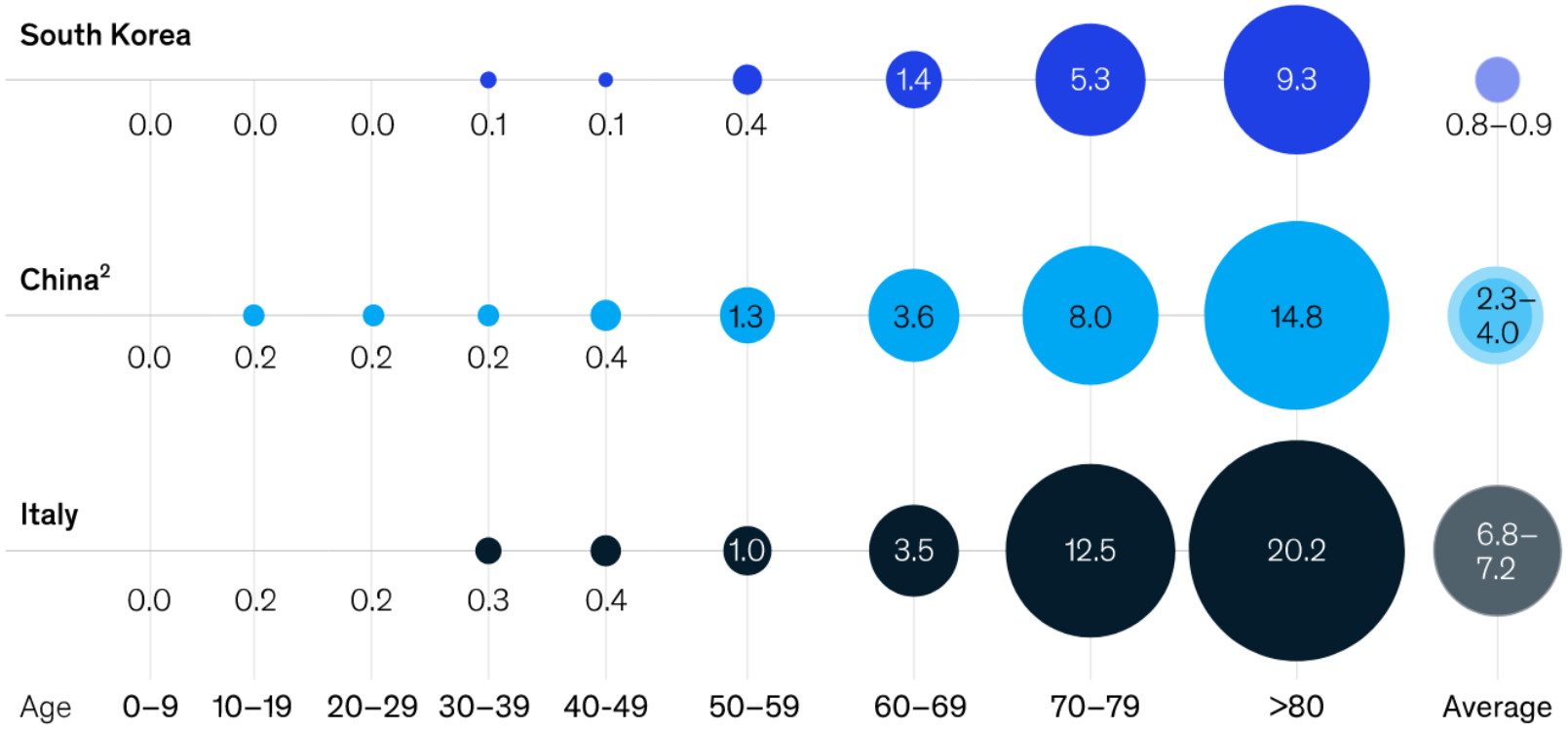


Source: https://medium.com/@andreasbackhausab/coronavirus-why-its-so-deadly-in-italy-c4200a15a7bf

…but kills more the old

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

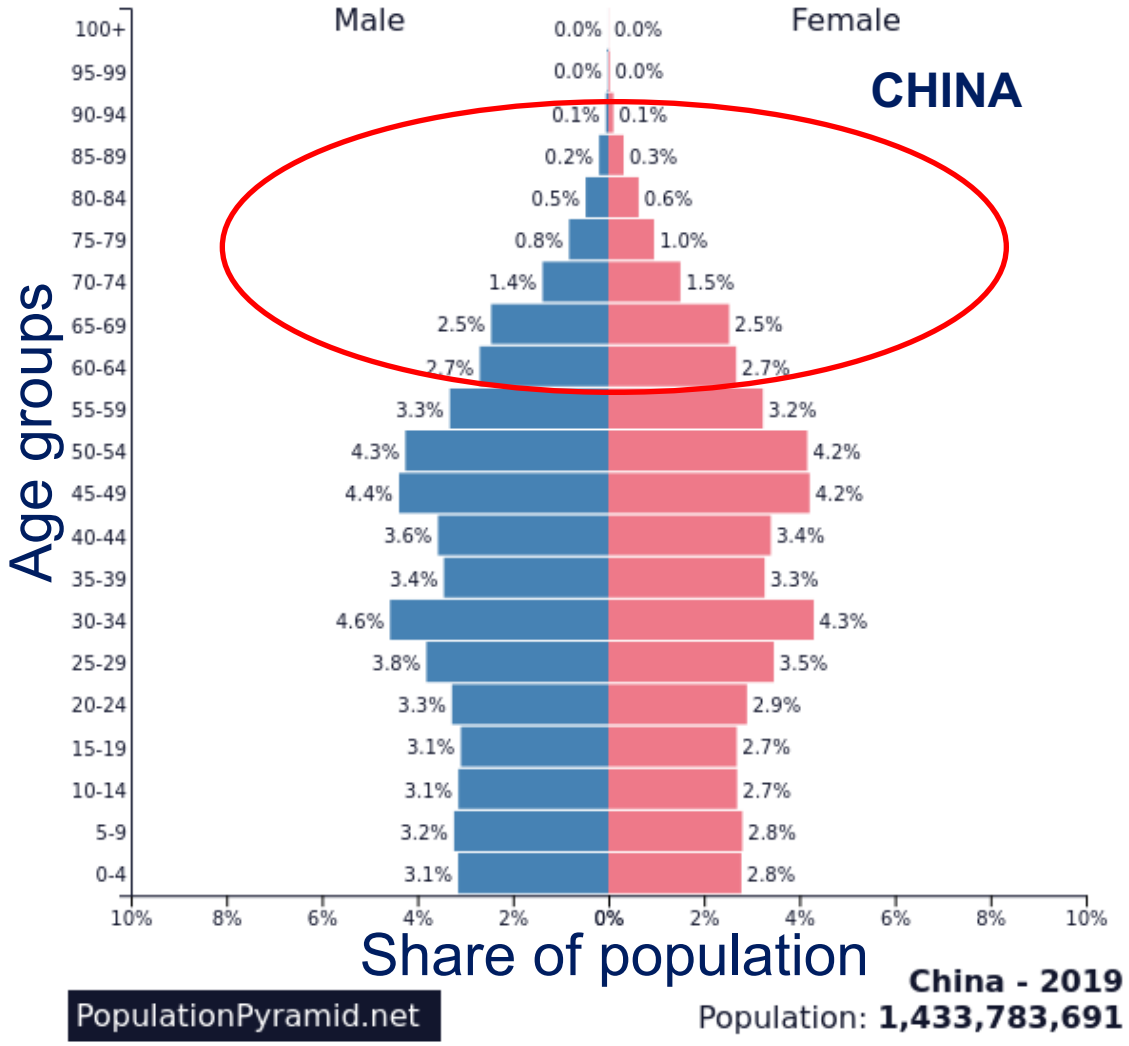
Case-fatality rate by age segment,[1] % mortality

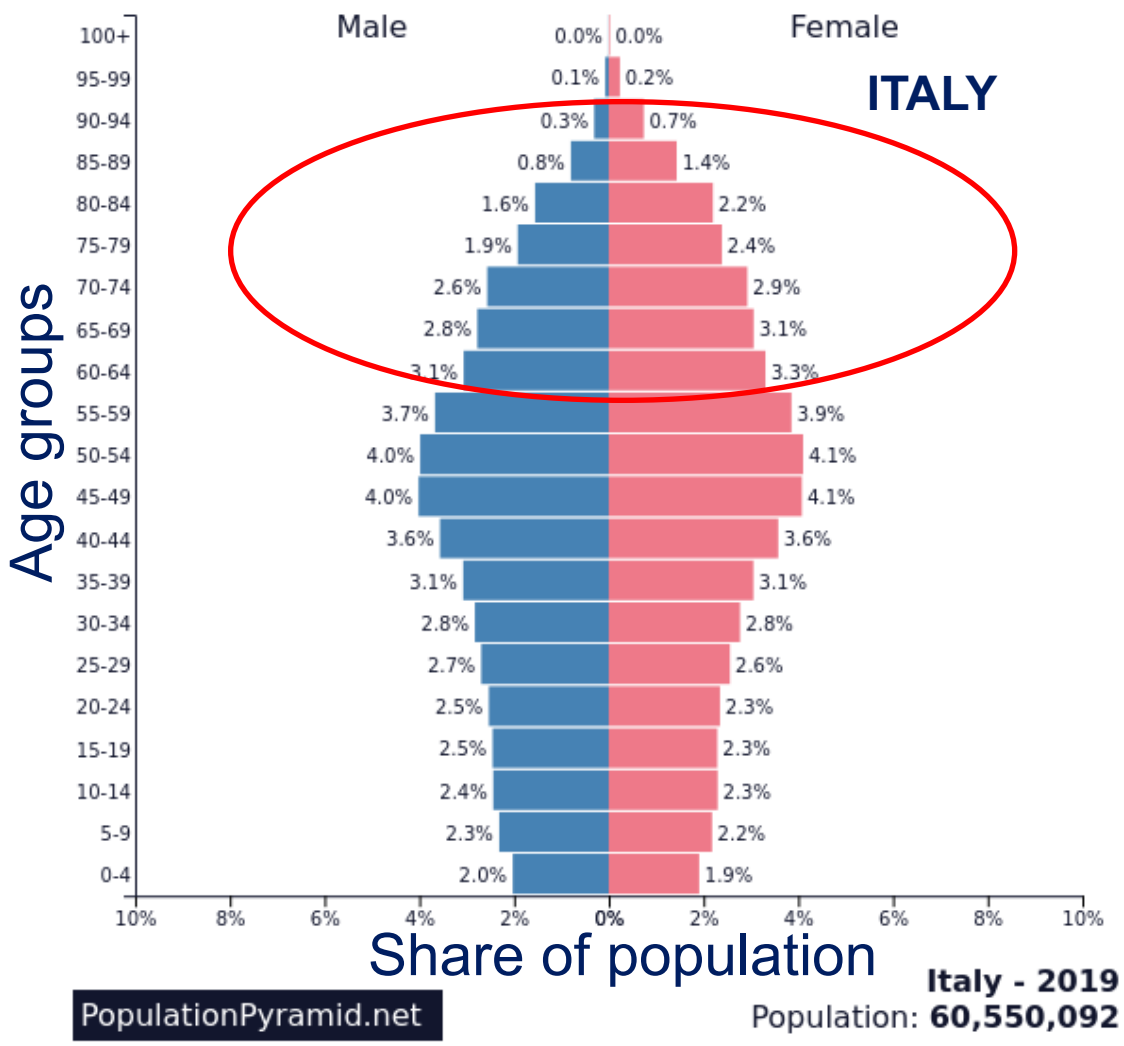


[1]As of data from Feb 11, 2020, in China and as of March 16 and 15, 2020, in South Korea and Italy, respectively.
[2]Data reported from China Feb 11, 2020, reports 2.3%, however latest deaths/cases from WHO indicate this may be higher.
Source: China CDC; Korea CDC; L'Istituto Superiore di Sanità (ISS) Italy; WHO; McKinsey analysis

Source: McKinsey & Company: Coronavirus COVID-19: Facts and Insight, updated 16th March 2020.

Italians are older

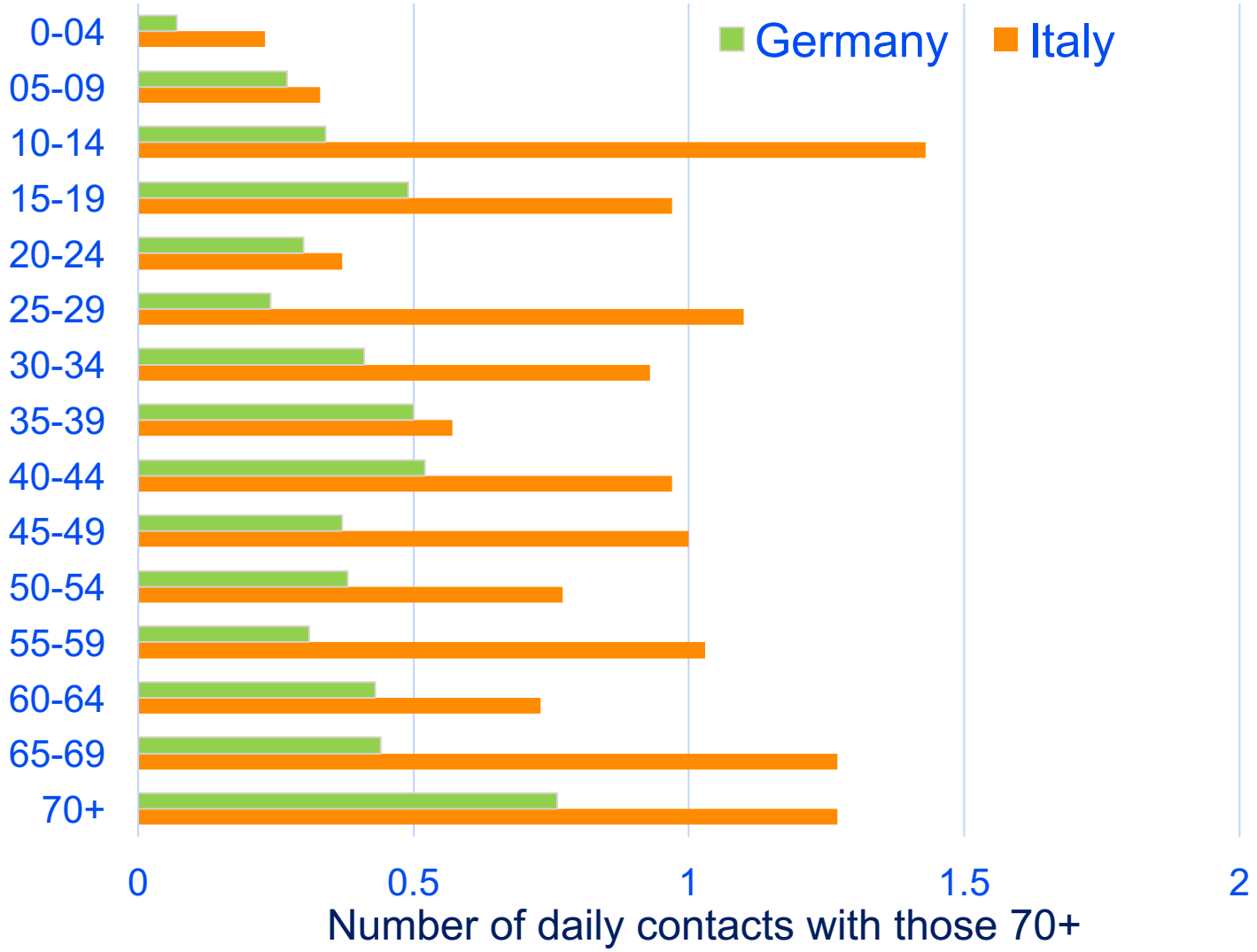




Source: https://www.populationpyramid.net/, based on United Nations Data

Old Italians are more connected to the young

Average daily contacts with those 70+ by age group



Source: Mossong et al. (2008, PLoS Med), “Social Contacts and Mixing Patterns Relevant to the Spread of Infectious Diseases”

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

Next video: A user guide to Covid-19. Part ii – epidemiology for dummies

This Lecture

1. Science
2. **Health policies**
3. Economics
4. Macroeconomic policies

The consensus: flattening the curve

How to flatten the curve?

A. Expand intensive care capacity

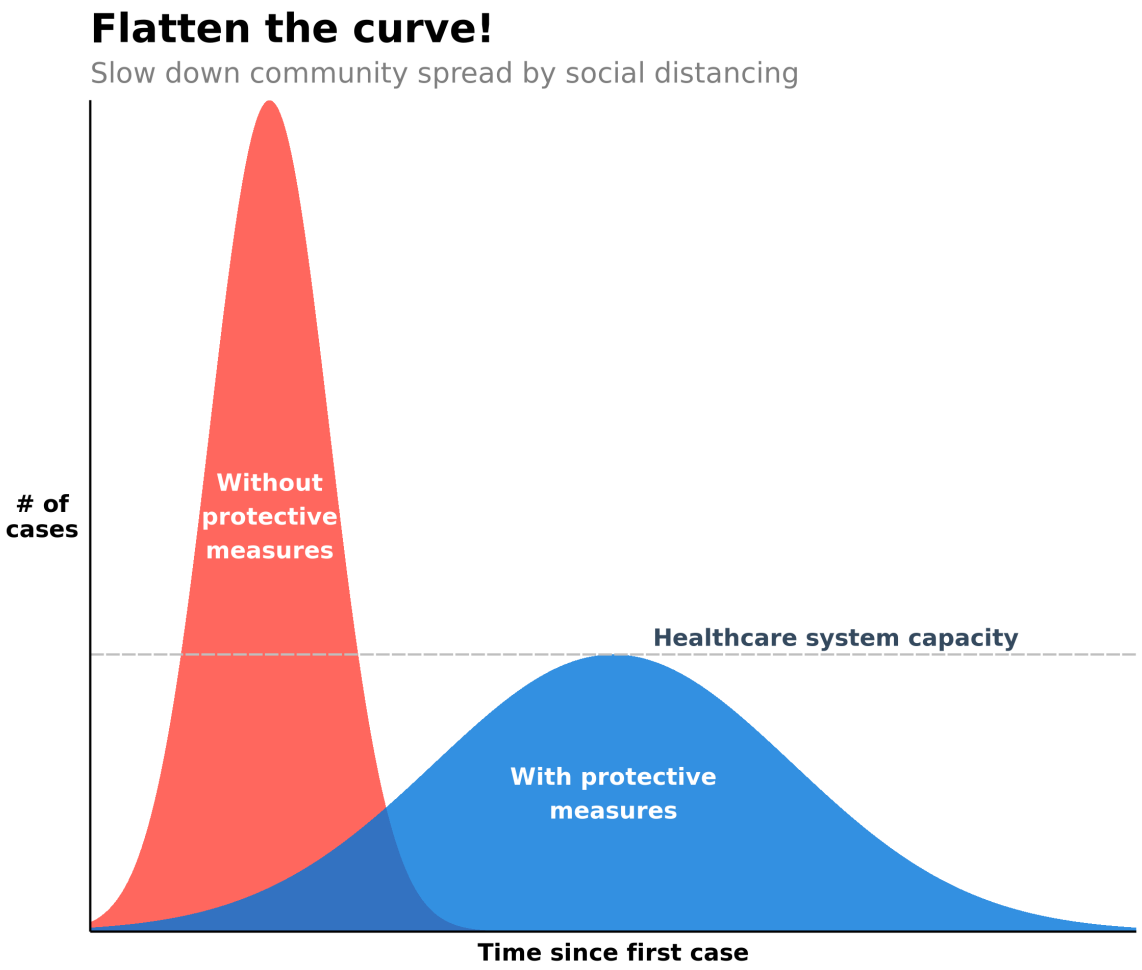
(expand supply of health care)

B. Slowdown the speed of contagion

(contract demand for health care)

Goal: avoid excess of demand

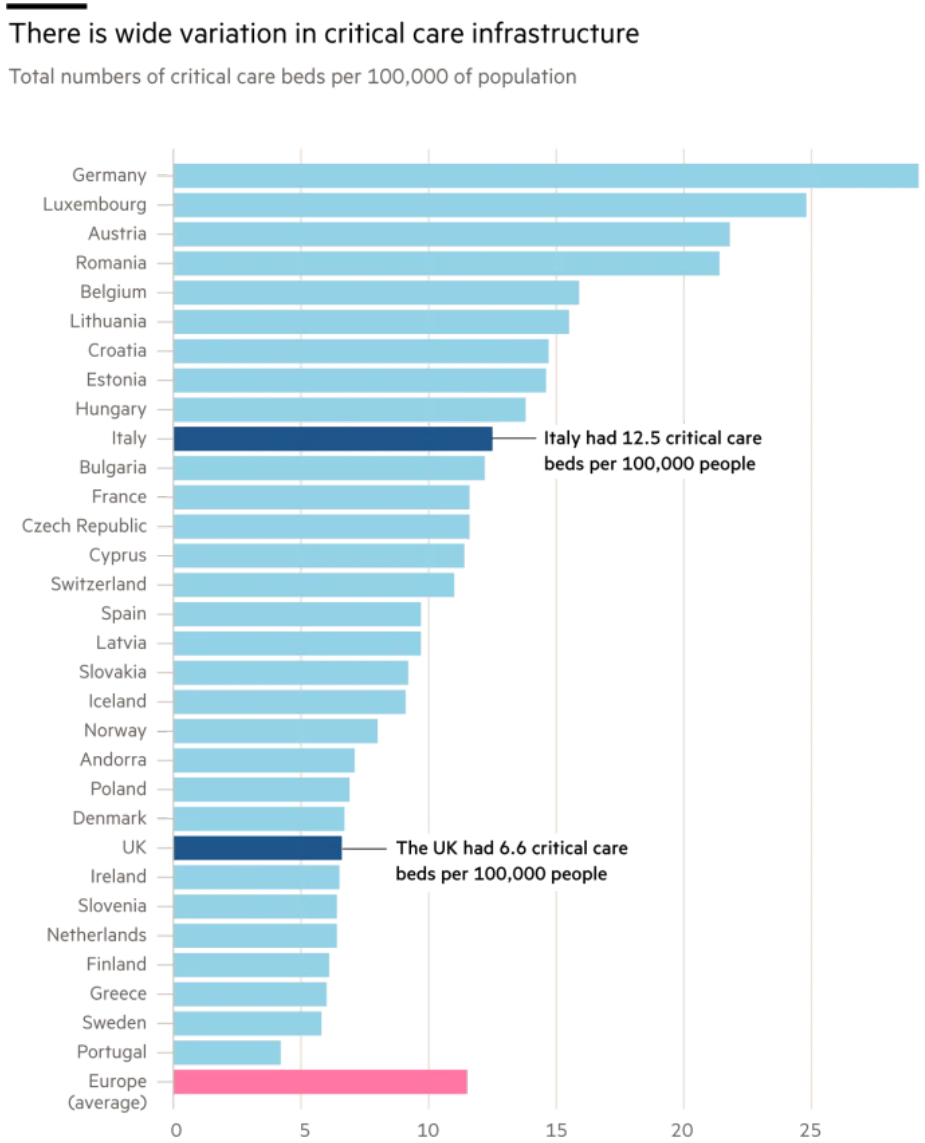
How to achieve this more effectively?



Adapted from the CDC and The Economist
Visit flattenthecurve.com

Health system capacity constraints

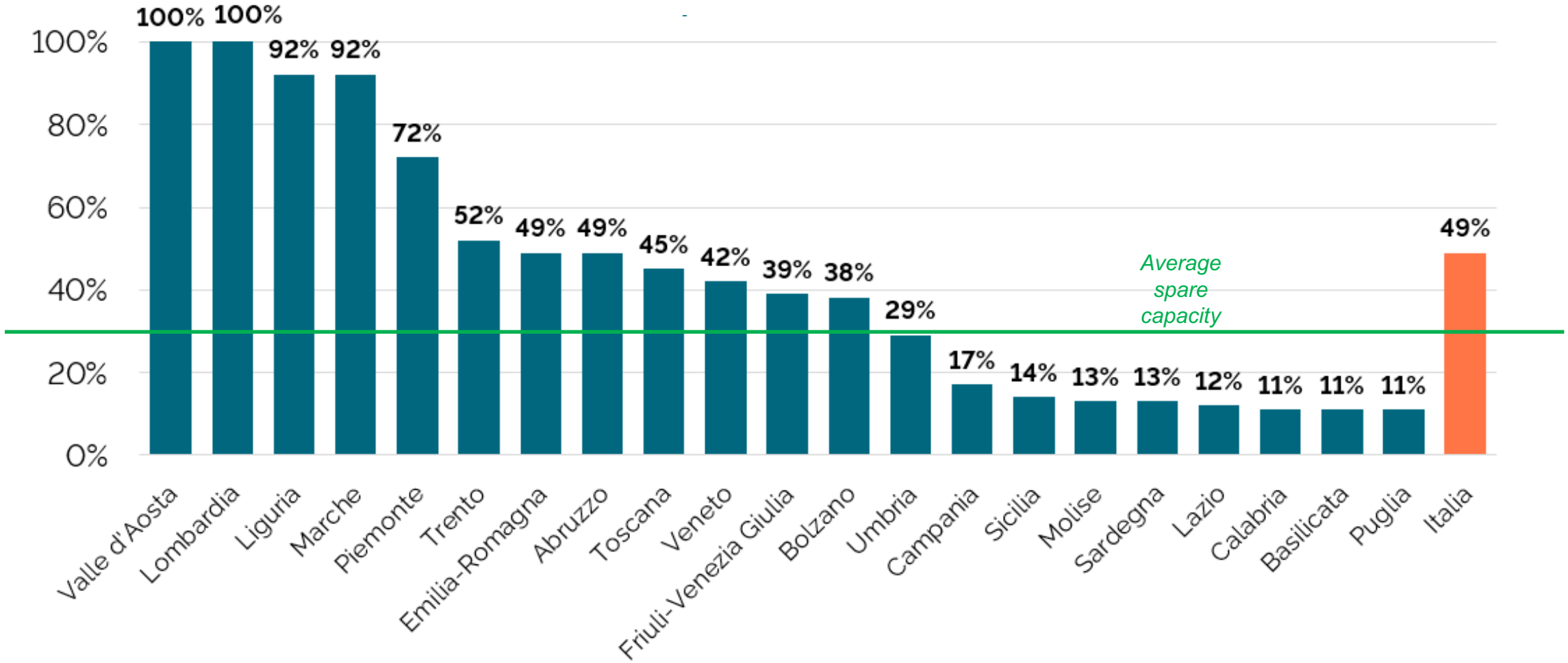
- Danger in the lack of capacity of health systems
- Number of ICU beds in most countries cannot cope with the spread of disease if peak is high
- Lack of ventilators:
  - Italy asked its only domestic manufacturer to quadruple supply from 125 a month to 500 (each costs €17k)
  - Germany has ordered 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/5a2ffc78-6550-11ea-b3f3-fe4680ea68b5

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)

The short-run elasticity of health care supply

Whenever possible, use hotels, class rooms and barracks as Intensive Care Units (ICU).

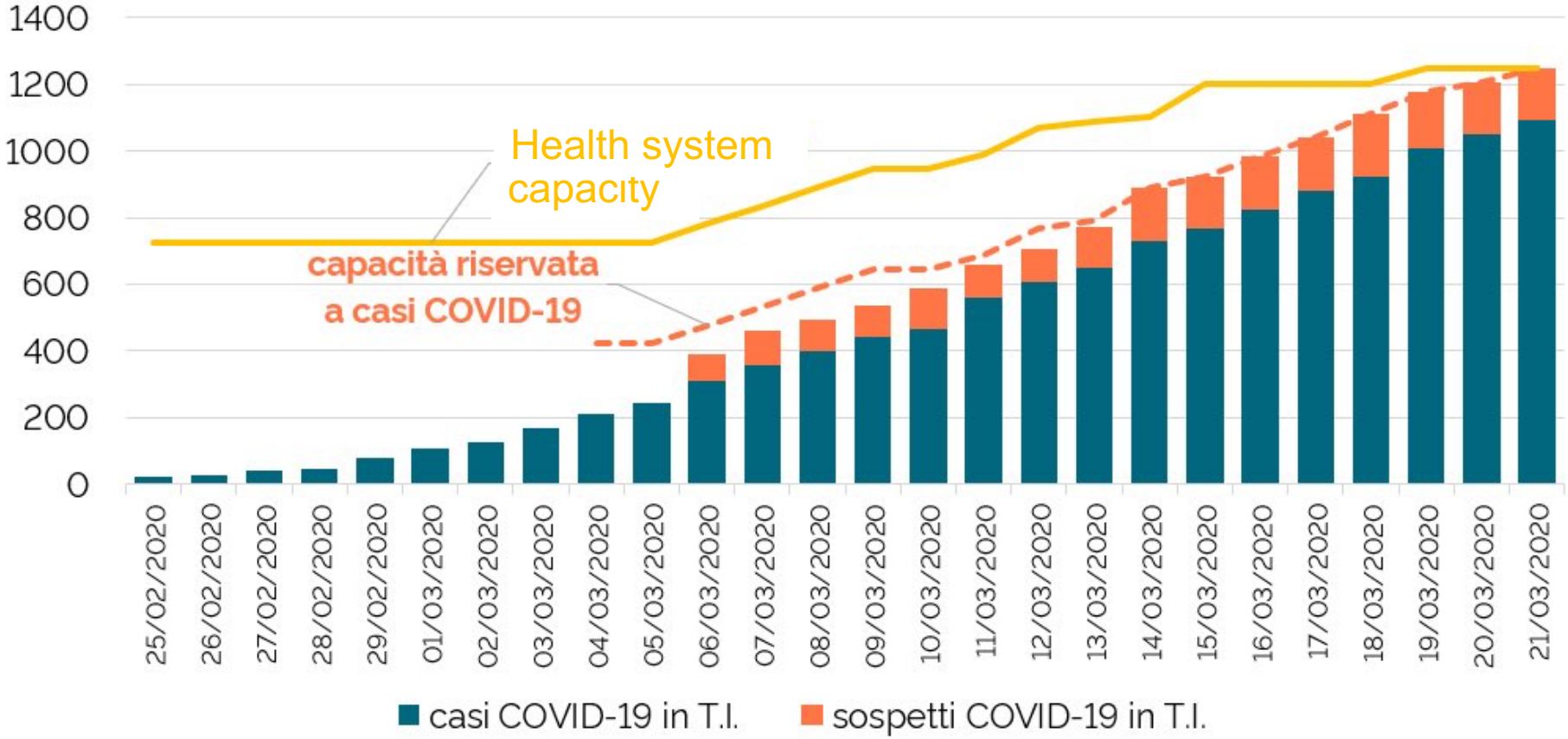
Turn to manufacturing industry to produce or convert intensive care equipment (e.g. ventilators).

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(usceptible)**I**(nfected)**R**(ecovered)

Susceptible → **Infected** → **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?

Susceptible → **Infected** → **Recovered**

	sign	Covid-19
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?

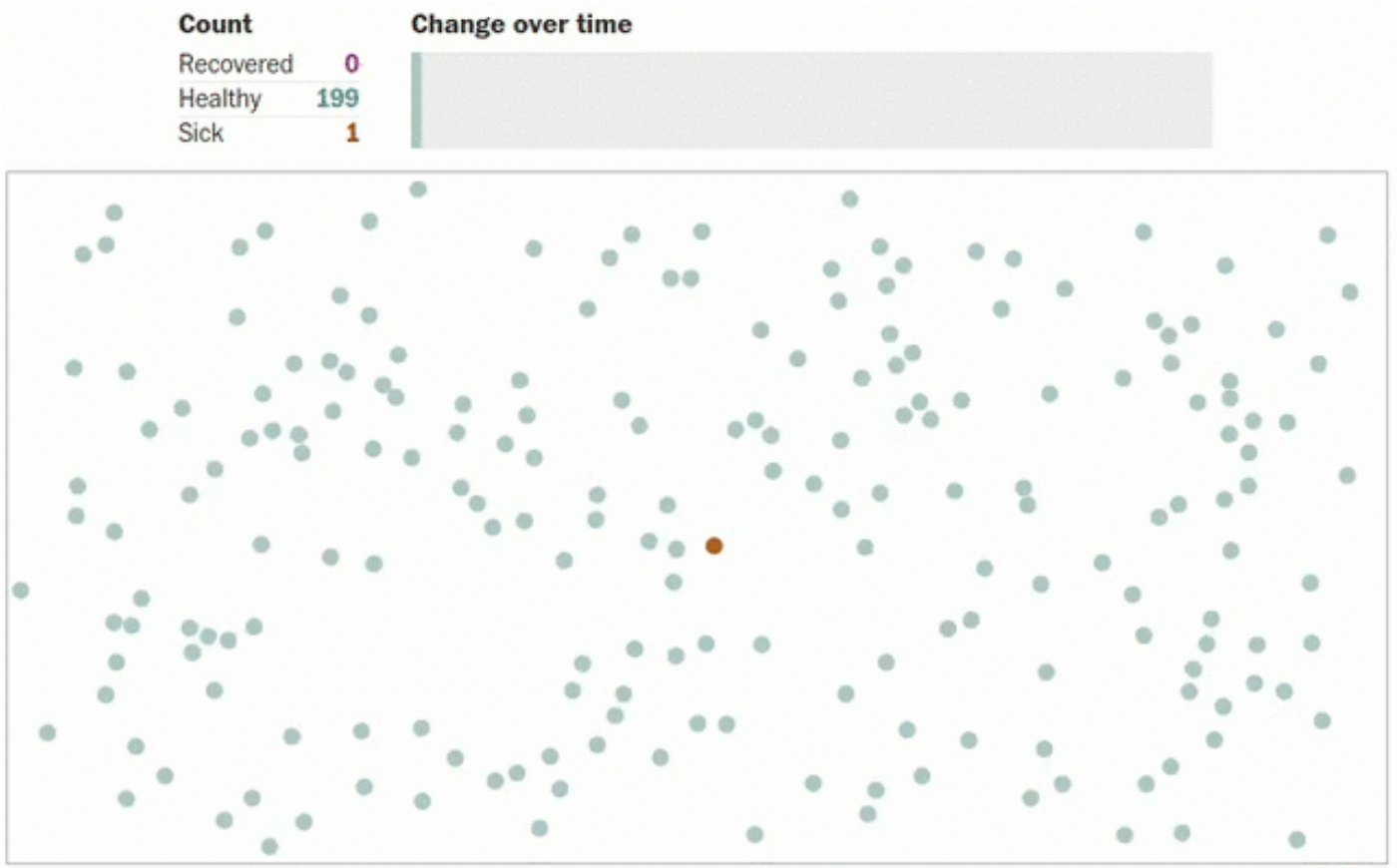
Susceptible → **Infected** → **Recovered**

A. <u>Containment</u>
lowering R_0 but keeping it above 1
(attempted quarantine)

B. <u>Suppression</u>
lowering R_0 below 1
(social distancing)

Very important channel. Very simplistic for the moment. More later

Contagion under laissez-faire

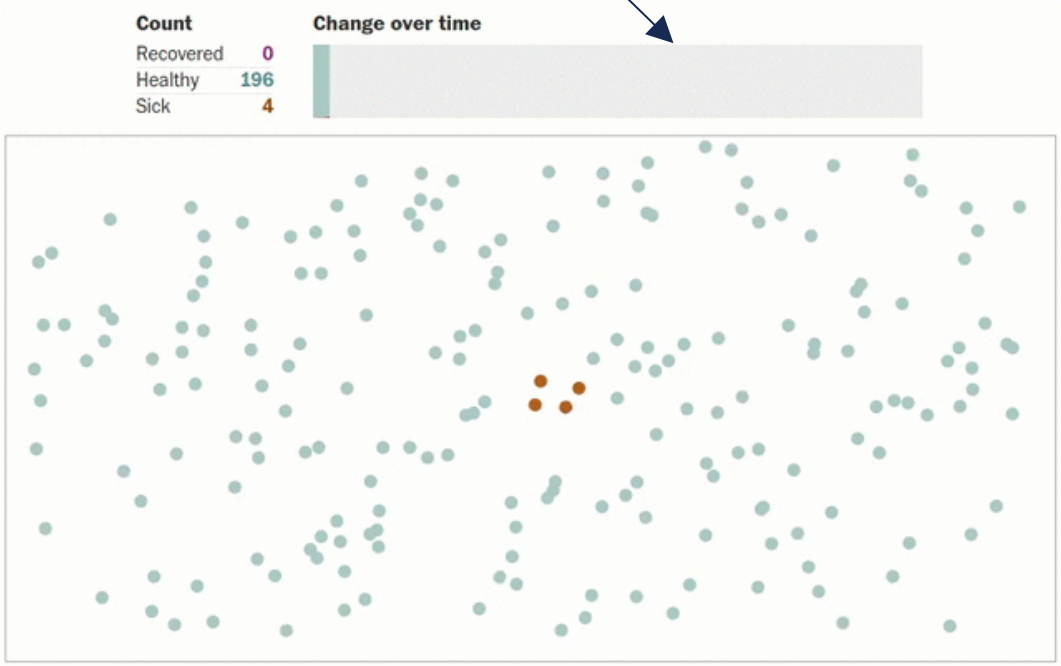


Source: Harry Stevens, Washington Post (https://www.washingtonpost.com/graphics/2020/world/corona-simulator/)

Containment vs suppression in theory…

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

China/Italy style of approach



Source: Harry Stevens, Washington Post (https://www.washingtonpost.com/graphics/2020/world/corona-simulator/)

…and in practice!

- 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

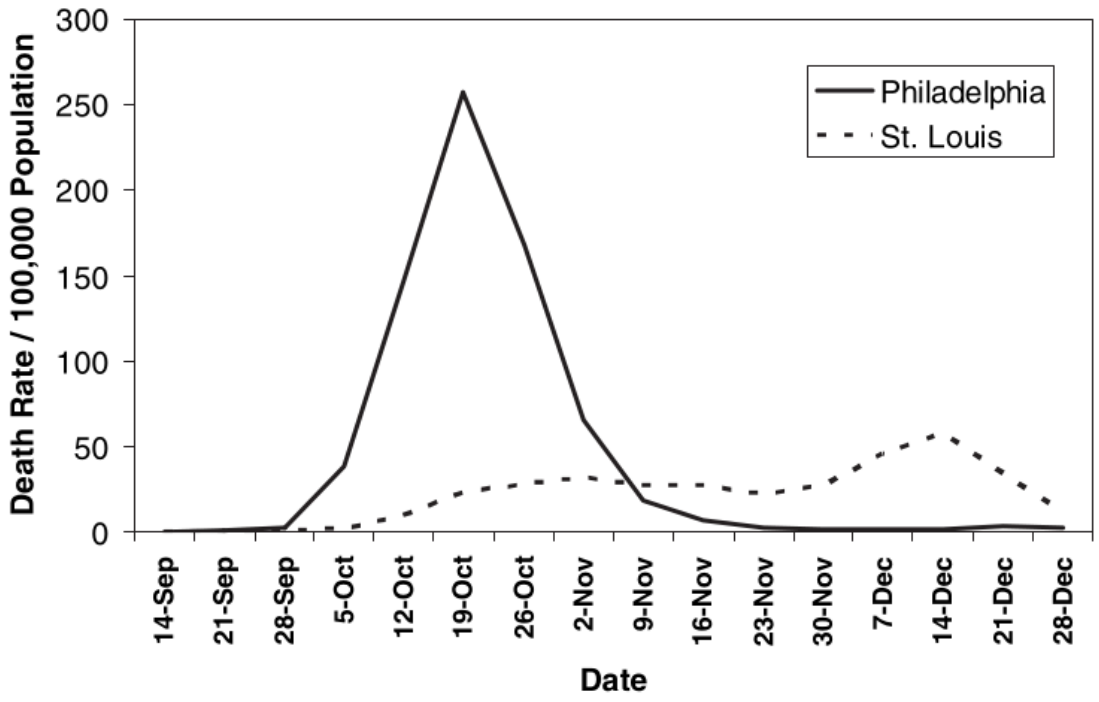


Fig. 1. Excess P&I mortality over 1913–1917 baseline in Philadelphia and St. Louis, September 8–December 28, 1918. Data are derived from ref. 10.

Source: Hatchett, Mecher and Lipsitch. Proceedings of the National Academy of Sciences May 2007, 104 (18) 7582-7587; DOI: 10.1073/pnas.0610941104

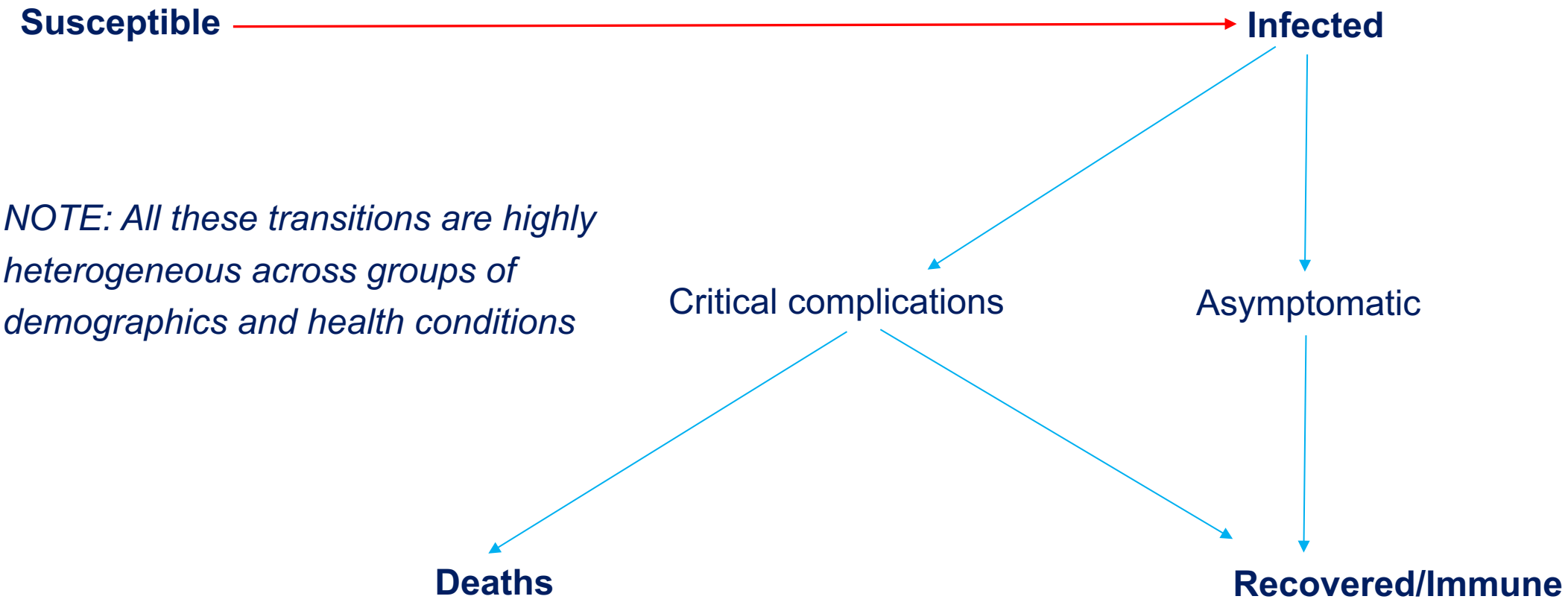
But the trade-off is draconian!

- 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(usceptible)**I**(nfected)**R**(ecovered)



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

Health care policies

Table 2: Summary of NPI interventions considered.

Label	Policy	Description
CI	Case isolation in the home	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.
HQ	Voluntary home quarantine	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.
SDO	Social distancing of those over 70 years of age	Reduce contacts by 50% in workplaces, increase household contacts by 25% and reduce other contacts by 75%. Assume 75% compliance with policy.
SD	Social distancing of entire population	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%.
PC	Closure of schools and universities	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.

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

Table 2: Summary of NPI interventions considered.

Label	Policy	Description
CI	Case isolation in the home	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.
HQ	Voluntary home quarantine	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.
SDO	Social distancing of those over 70 years of age	Reduce contacts by 50% in workplaces, increase household contacts by 25% and reduce other contacts by 75%. Assume 75% compliance with policy.
SD	Social distancing of entire population	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%.
PC	Closure of schools and universities	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.

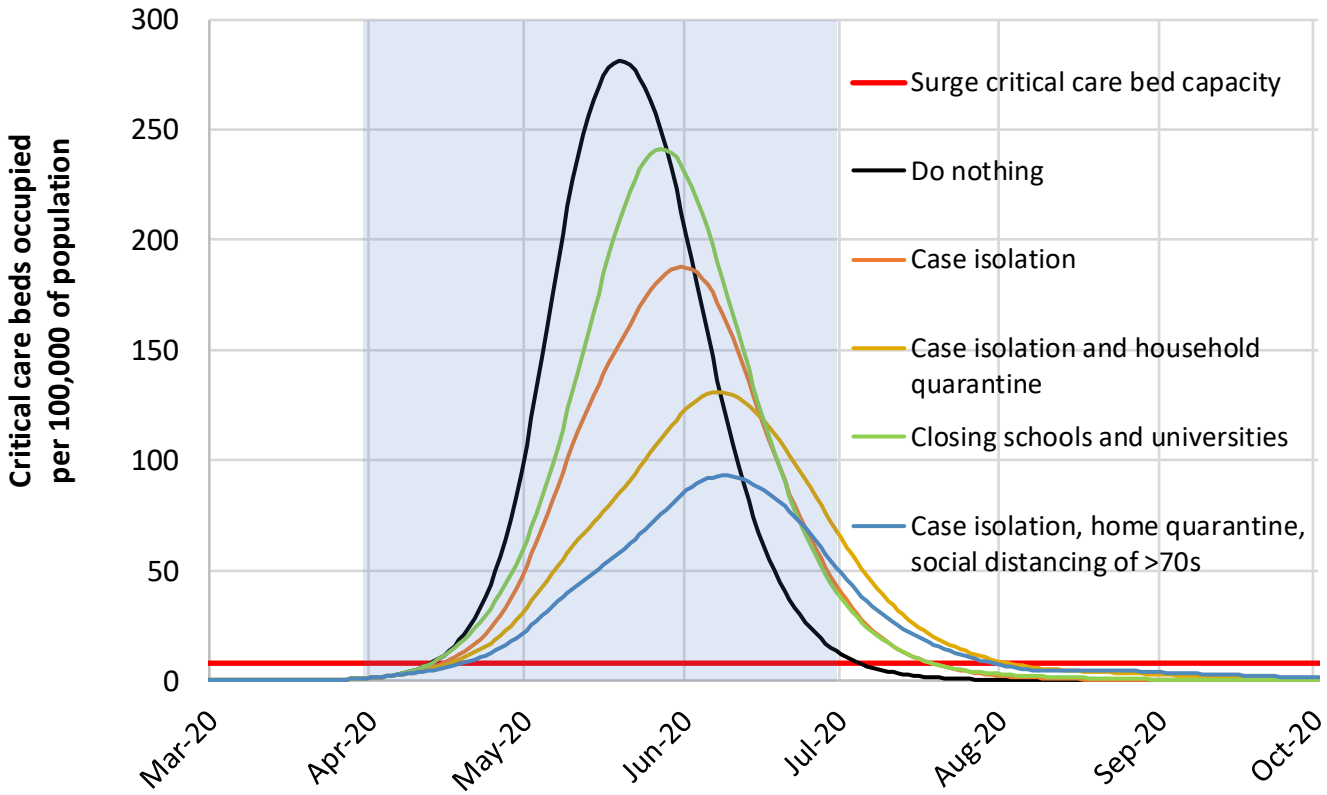


Figure 2: Mitigation strategy scenarios for GB showing critical care (ICU) bed requirements. The black line shows the unmitigated epidemic. The green line shows a mitigation strategy incorporating closure of schools and universities; orange line shows case isolation; yellow line shows case isolation 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 2: Summary of NPI interventions considered.

Label	Policy	Description
CI	Case isolation in the home	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.
HQ	Voluntary home quarantine	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.
SDO	Social distancing of those over 70 years of age	Reduce contacts by 50% in workplaces, increase household contacts by 25% and reduce other contacts by 75%. Assume 75% compliance with policy.
SD	Social distancing of entire population	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%.
PC	Closure of schools and universities	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.

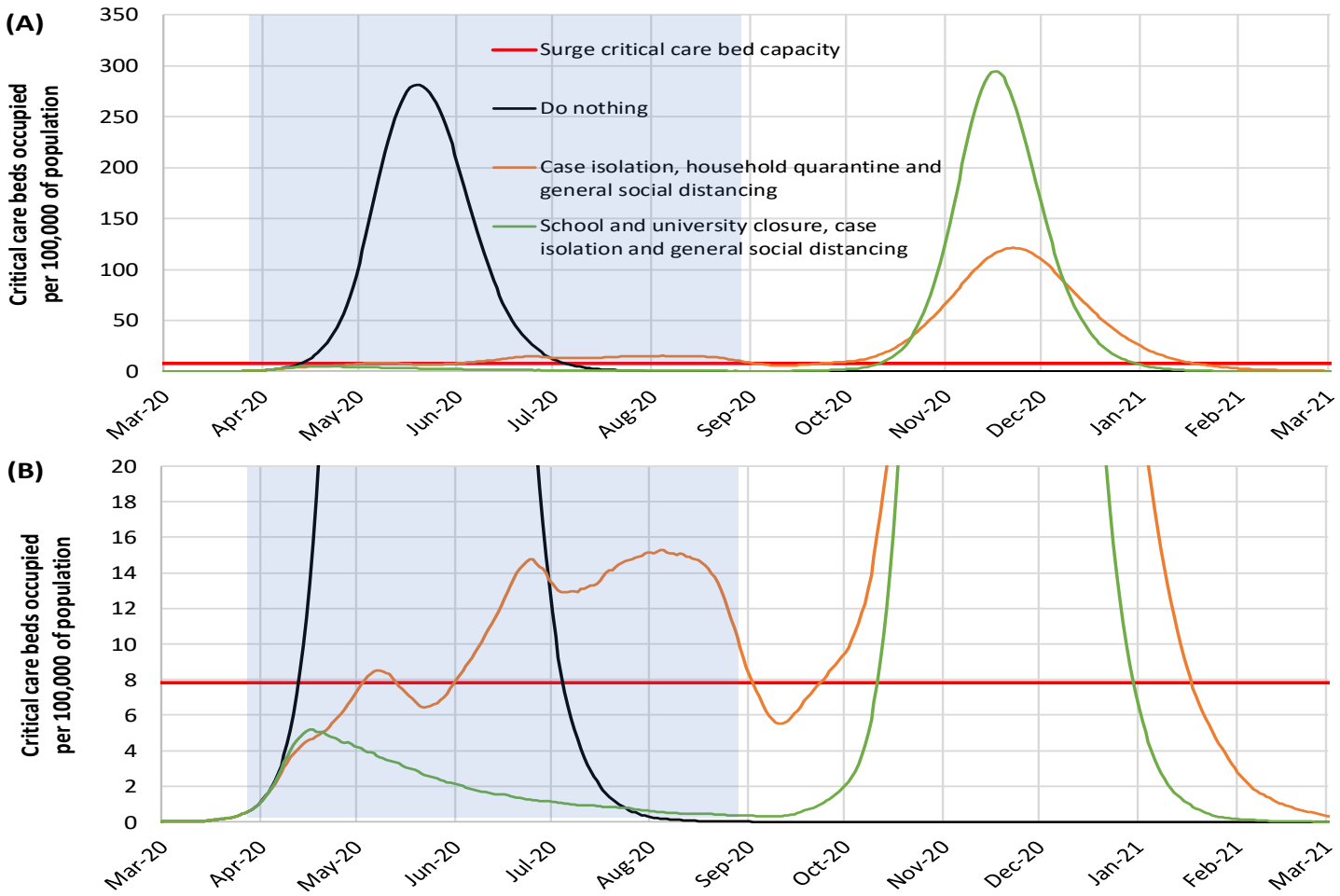
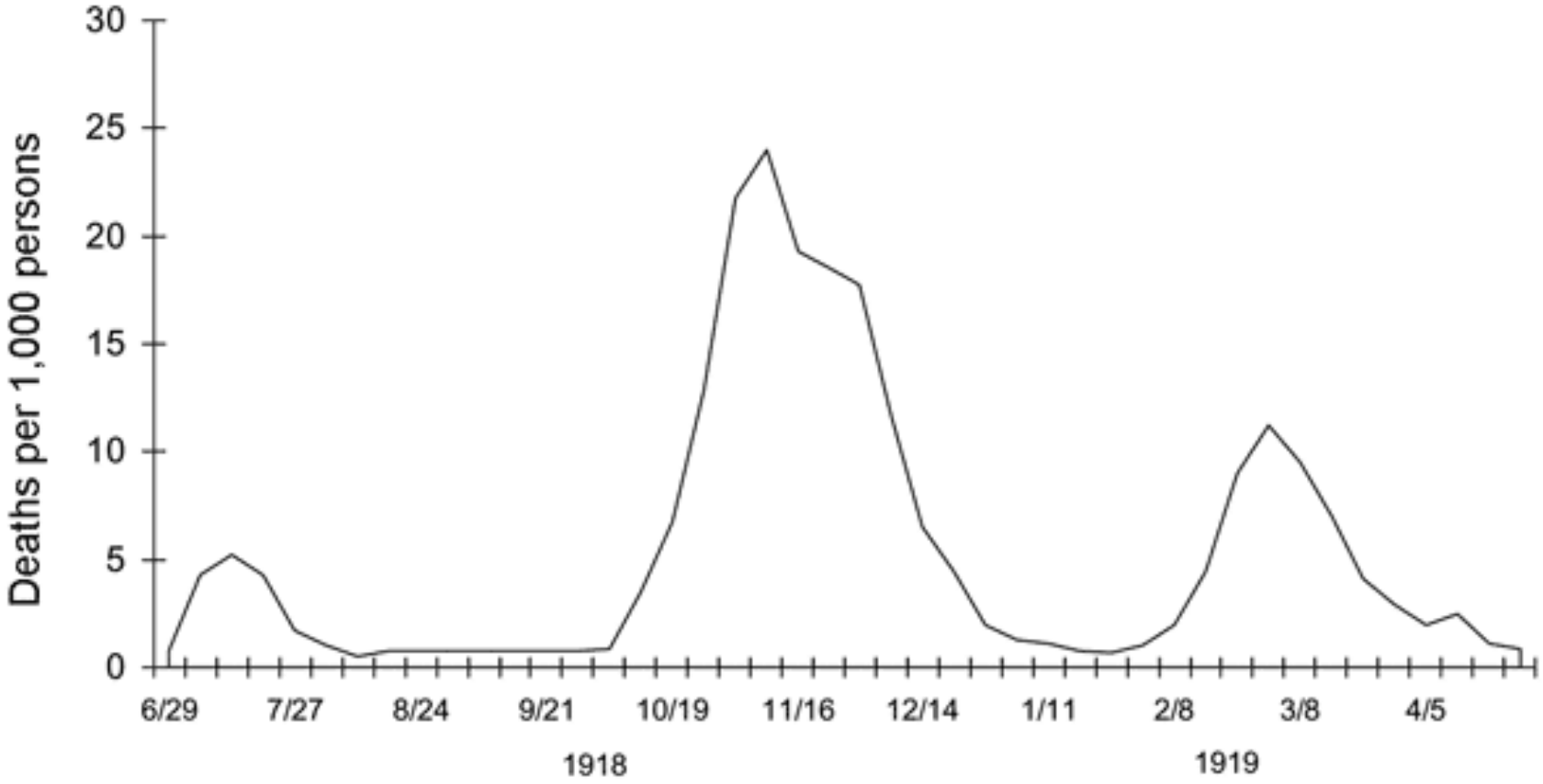


Figure 3: Suppression strategy scenarios for GB showing ICU bed requirements. The black line shows the unmitigated epidemic. Green shows a suppression strategy incorporating closure of schools and universities, case isolation and population-wide social distancing beginning in late March 2020. The orange 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.

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

Source: Taubengerger and Morens (2006), **1918 Influenza: the Mother of All Pandemics**. Emerging Infectious Diseases, vol. 12, issue 1.

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

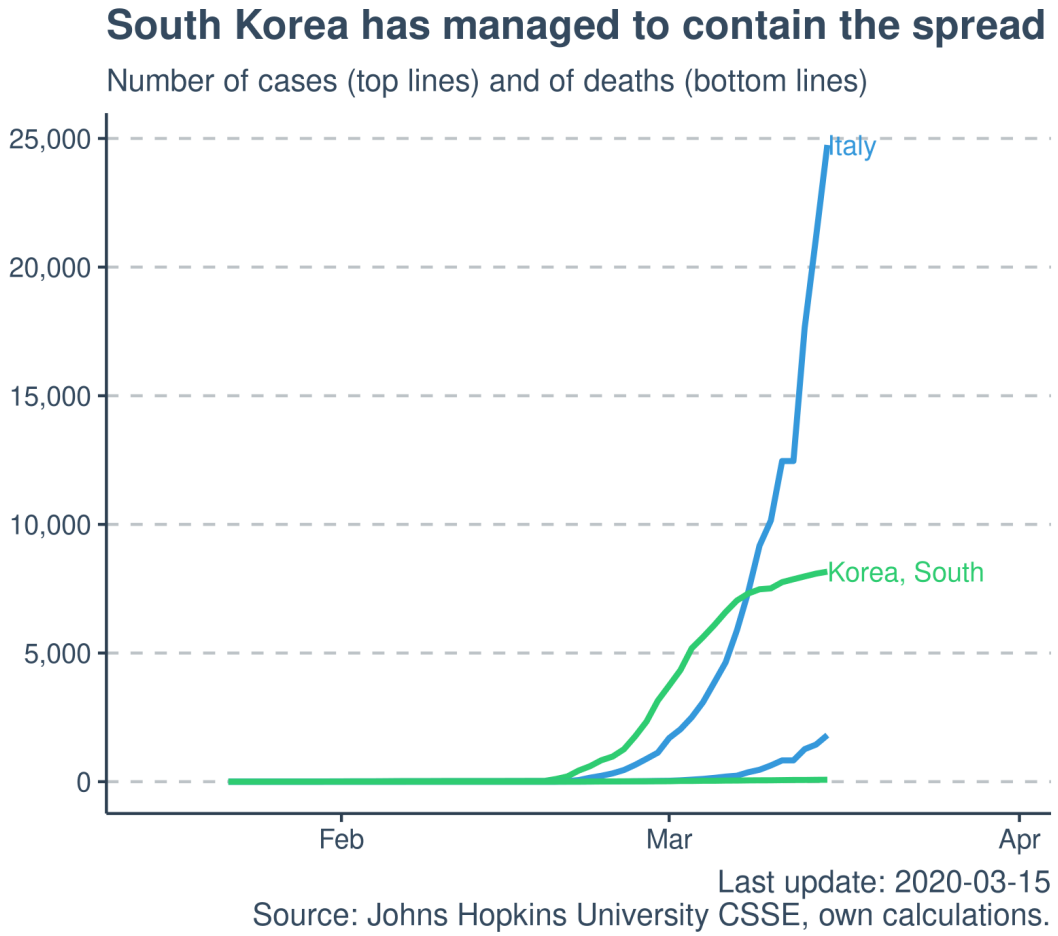
3. Develop surveillance strategies based on the information revealed in (2): nation-wide contact tracing, targeted social distancing.

Collecting the right data and conducting extensive statistical analysis can save MANY lives!!!
Goal: prevent a 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 15th has been particularly low: 0.9% (vs 7.2% 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: https://www.nytimes.com/2020/03/13/opinion/coronavirus-best-response.html

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

Source: The Economist, 14th March 2020

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 <u>any</u> 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

Next video: A user guide to Covid-19. Part iii – economics for dummies

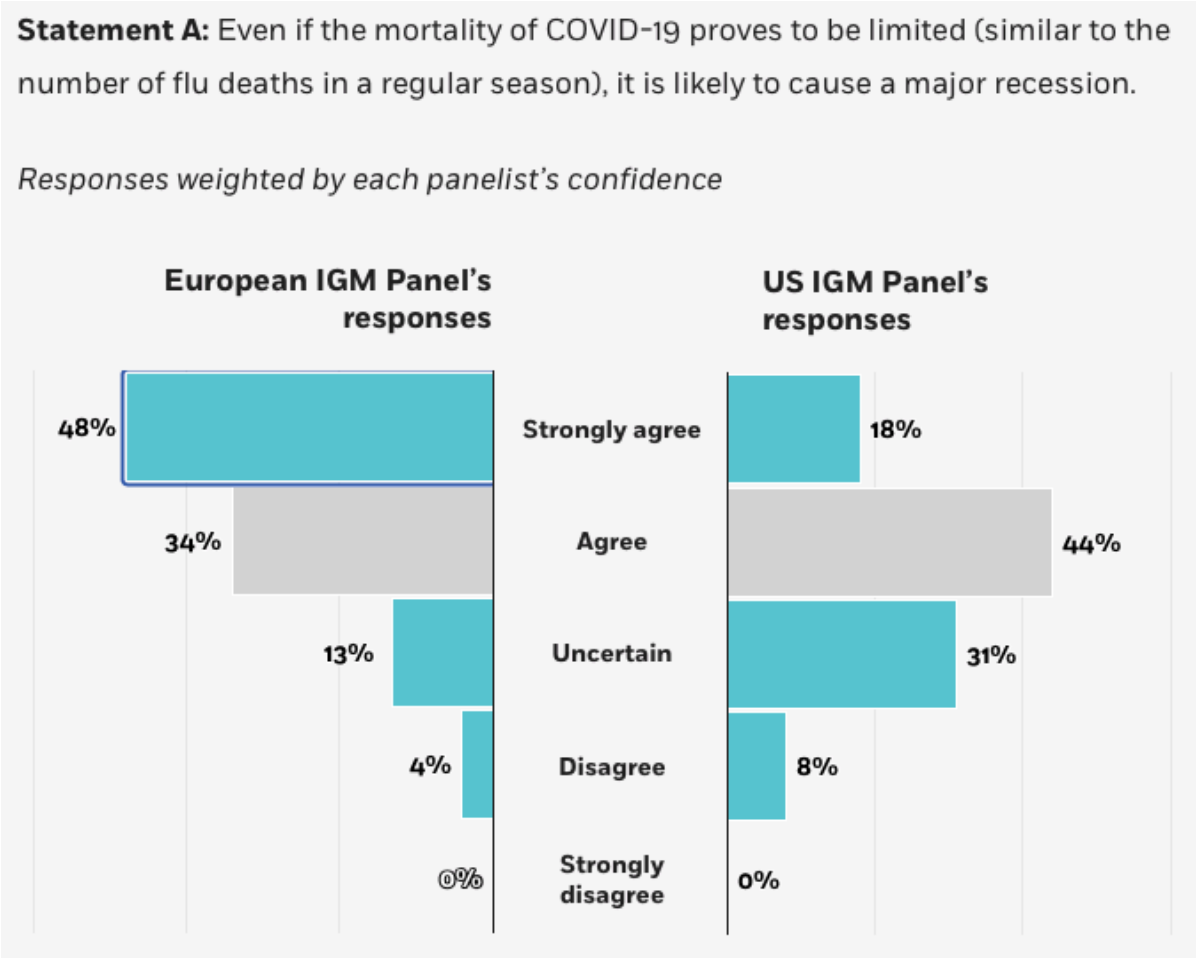
This Lecture

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

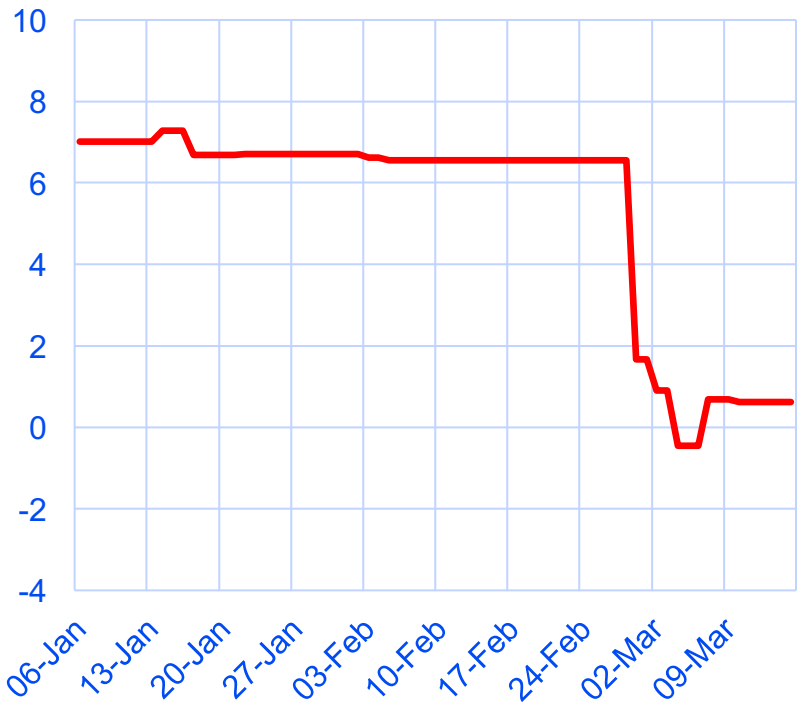


Source: https://voxeu.org/article/economic-impact-pandemic-igm-forum-survey (12th March)

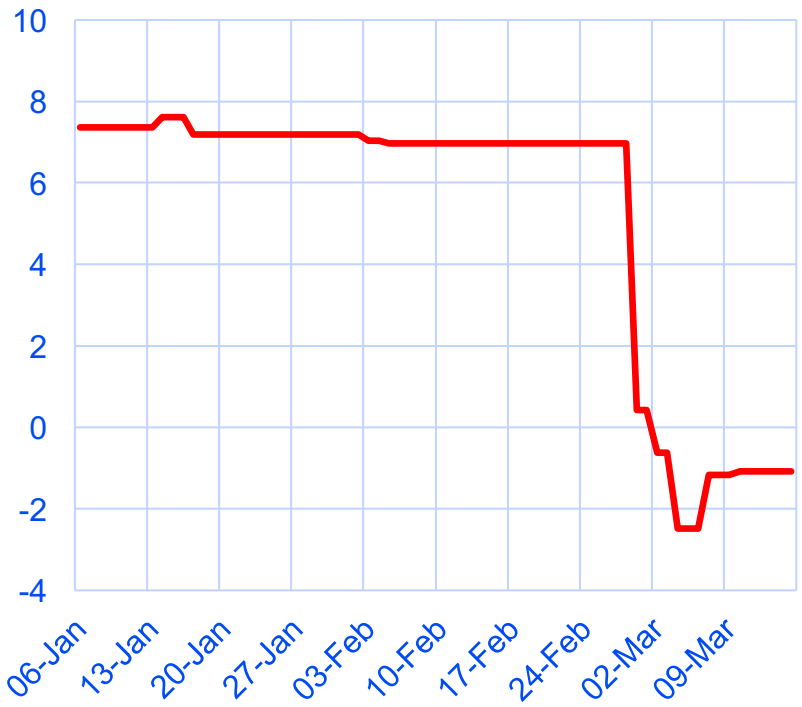
CHINA – NOWCAST AND FORECAST – in real-time, everyday!

Quarterly GDP growth, year-on-year, %

Q1 2020



Q2 2020

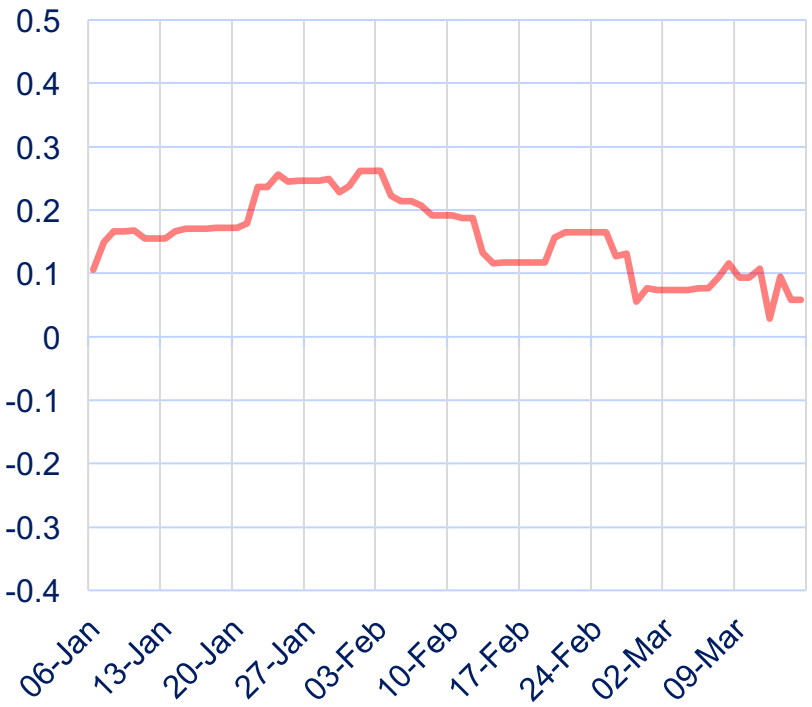


Source: live Now-Casting model, Reichlin (19th March 2020)

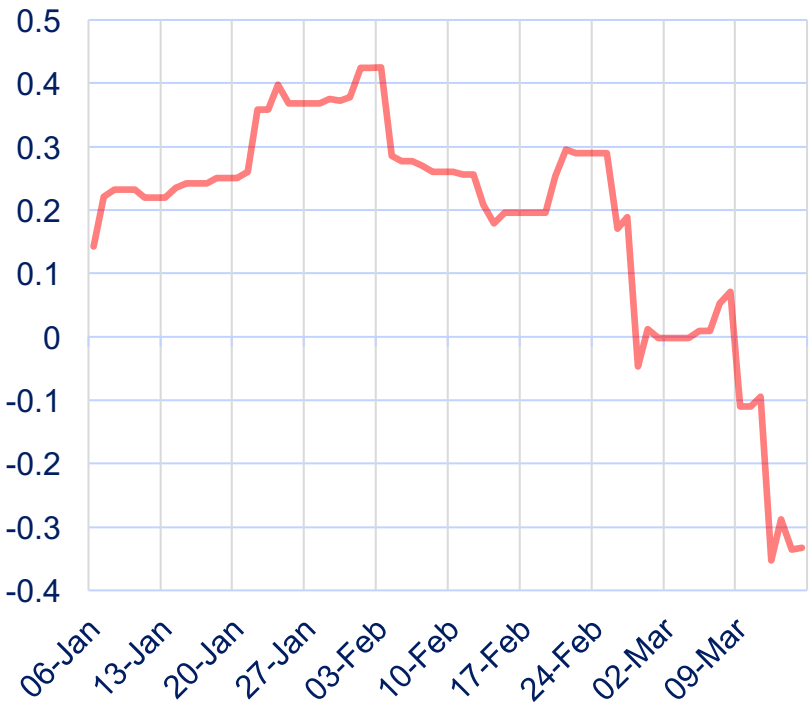
EURO AREA – NOWCAST AND FORECAST – in real time, everyday

Quarterly GDP growth, quarter-on-quarter, %

Q1 2020

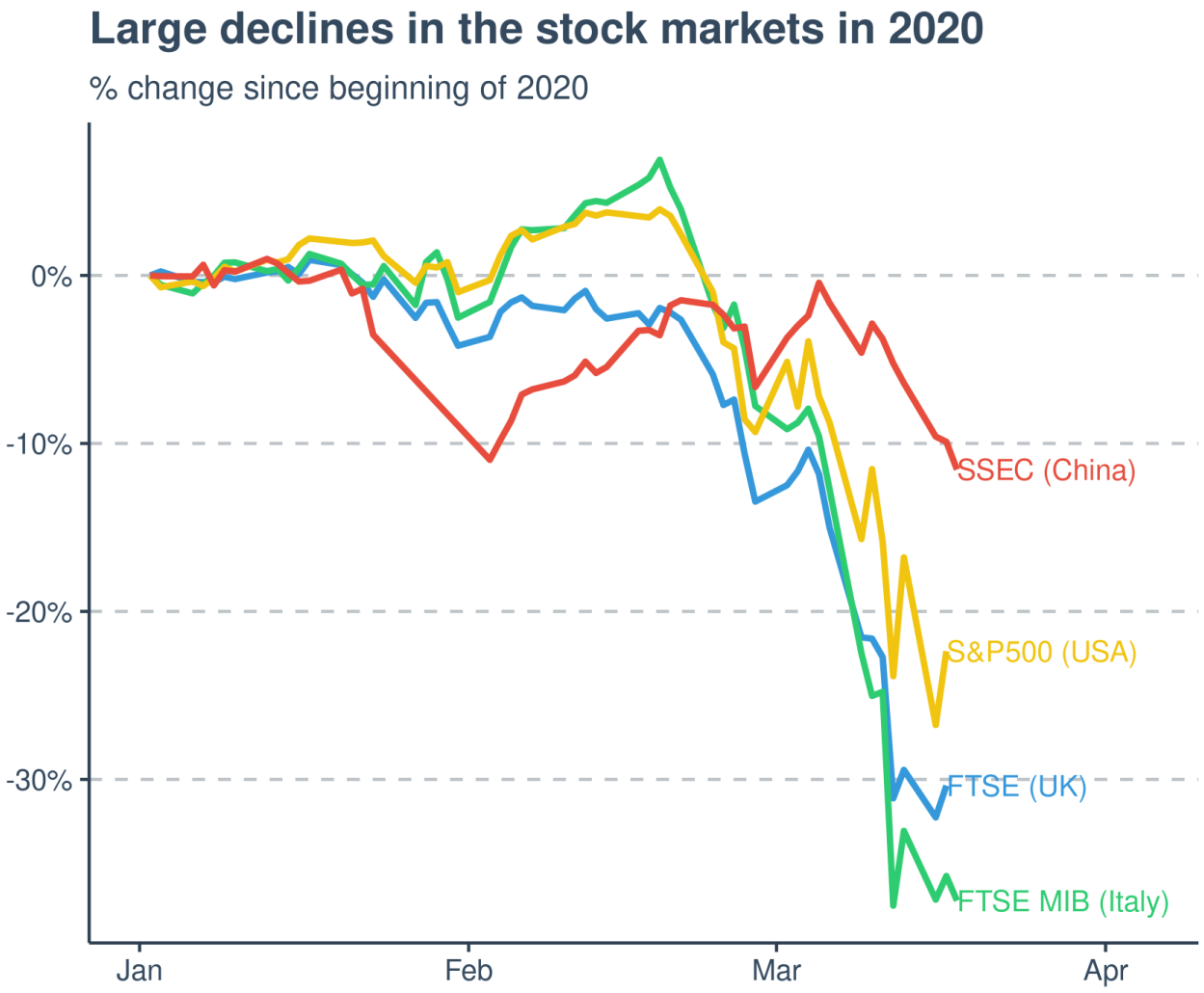


Q2 2020



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

Impact on stock markets

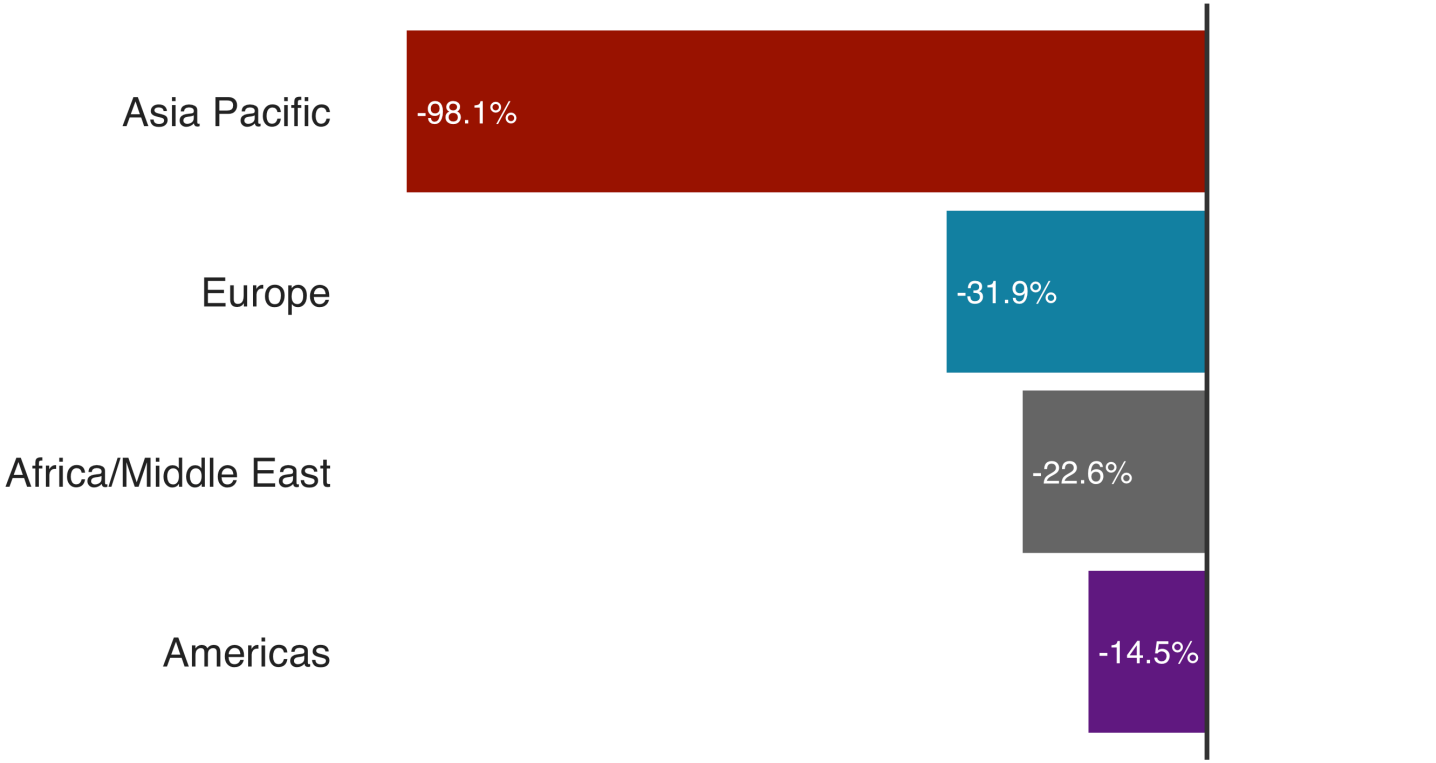


Last update: 2020-03-18
Source: Yahoo Finance, Investing.com, own calculations.

Impact on travel services

US flight bookings to all regions of the world have fallen sharply

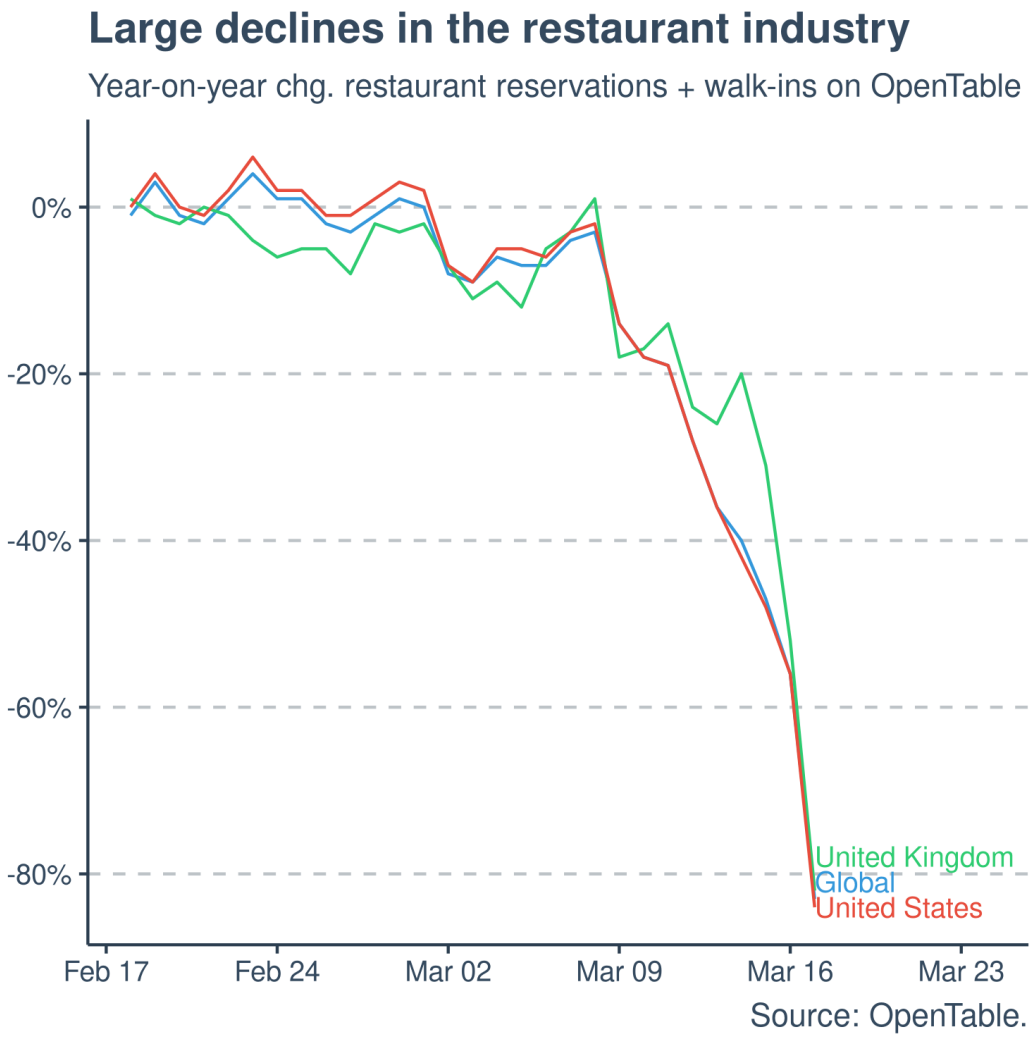
Change in bookings 6 January to 8 March, year on year



Source: ForwardKeys

BBC

Impact on restaurants



Source: https://www.opentable.com/state-of-industry

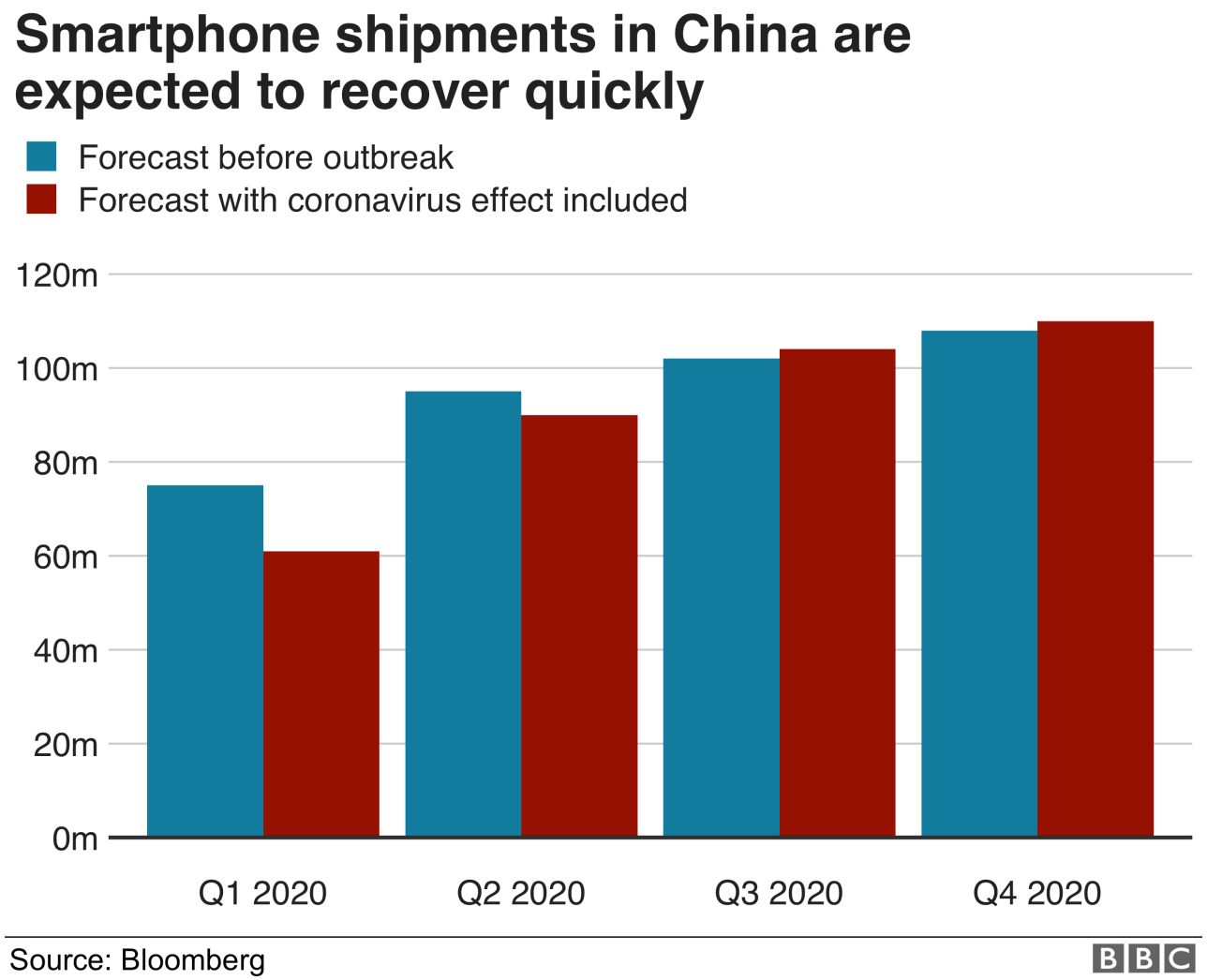
Impact on durables expenditure

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.

Impact on the supply chain



Impact on the supply chain cont'ed

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

Impact: HI MED LO

Situation today	**4X** fatality ratio Hubei still in early recovery **80%** plants restarted Restart underway Workers still returning	**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 Europe & US sentiments evolving, but currently localized
What to expect	Hubei recovers early Q2 Parts shortages ex Hubei Customer pressure for prioritization	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

McKinsey & Company 12

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

	Tourism and hospitality	Aviation / airlines	Oil and gas	Automotive	Consumer products	Consumer electronics, semi-conductors
Estimated degree of impact, in terms of duration	Longest					
Estimated global restart (Global slowdown scenario)	Q4	Late Q3 / early Q4	Q3	Late Q2 / Q3	Q2	Q2
	Severe ripple effects (e.g., closures in Paris, tourism down 50% in Vietnam, despite lack of local transmission) Delayed **recovery until winter season**, when disease might surge again Potential of more **localized** impact, containing negative demand hit	**Sustained headwinds**, with global travel acutely impacted; summer season missed – **forward bookings** for Mar-April down significantly; reports of over 40% in certain airlines 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)	**Oil price decline** driven by both longer-term demand impact and short-term supply overhang Rebound expected with resumption of consumer demand, but **long-term impact likely** if situation persists and depresses prices beyond a year	**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) Headwinds to persist into Q3 given **tight inventories** (<6 weeks), **supply chain complexity** (therefore, minimal ability to shift)	**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) Potential of **localized** impact, containing negative demand hit	**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 Pace of recovery to **differ by sub-sector** (e.g., semiconductor likely faster)

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

McKinsey & Company 11

McKinsey Global report (9th march 2020)

The search for a safe haven

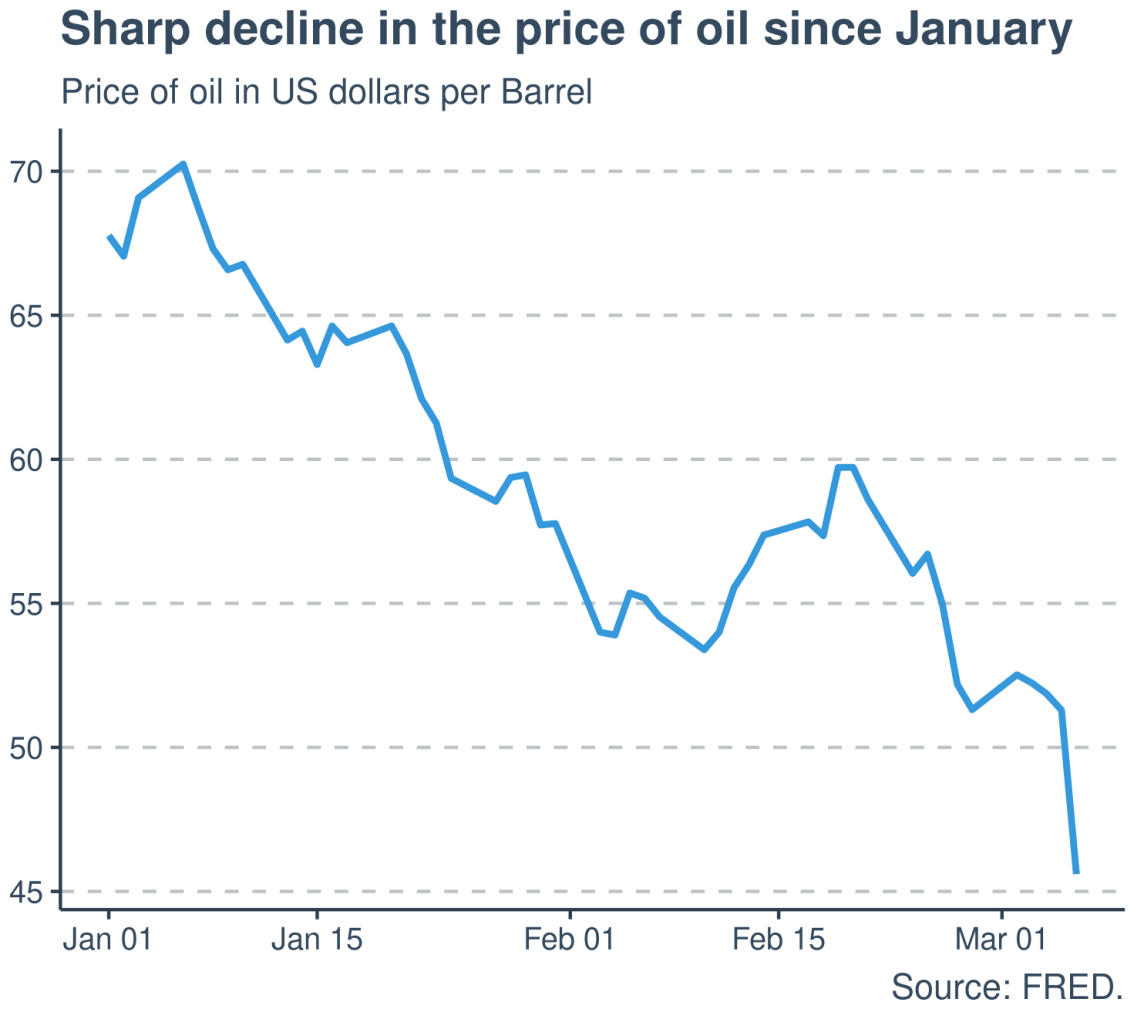
Gold trading at highest price since 2013

Price per ounce in US dollars

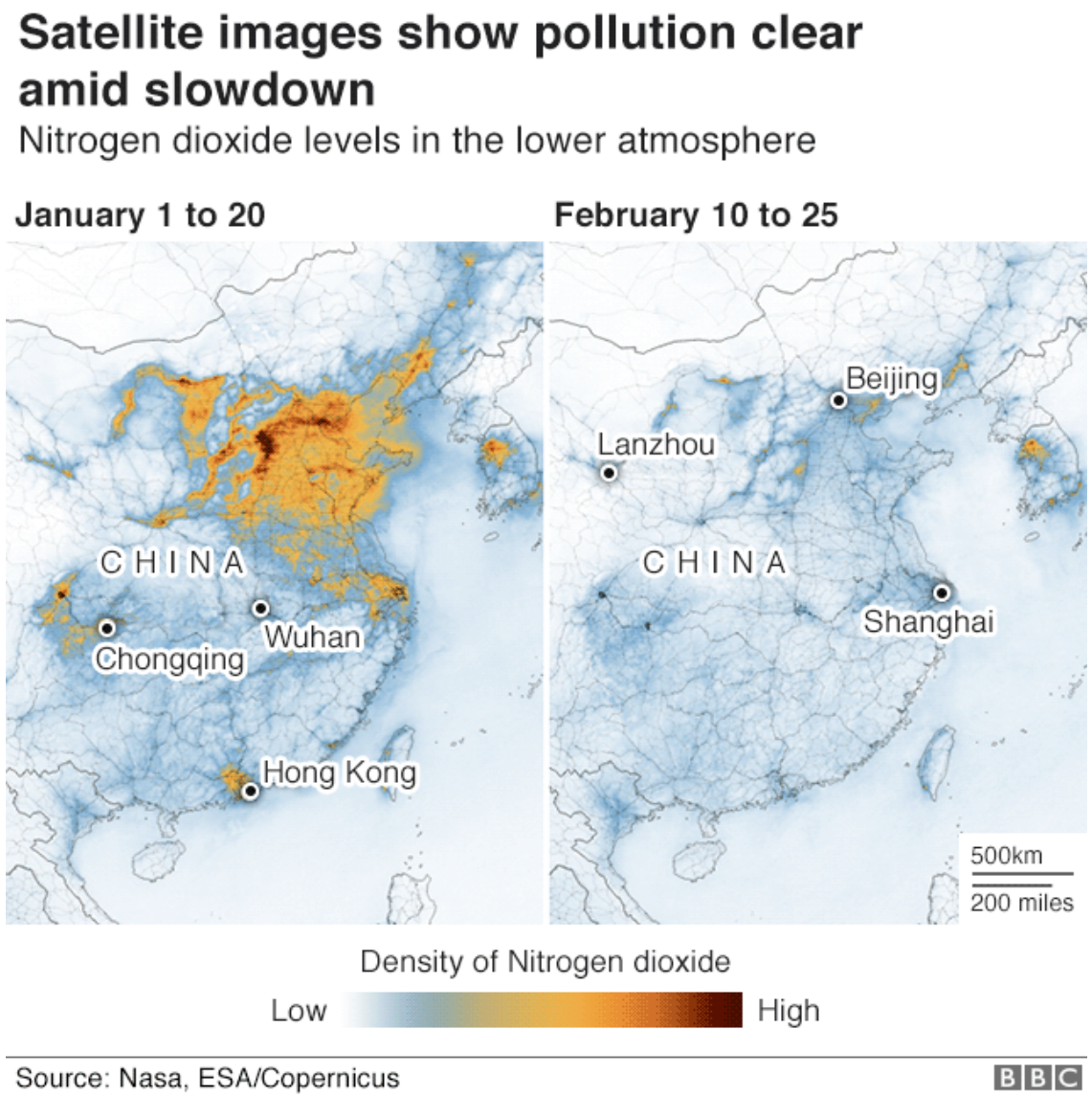
Source: Bloomberg, 13 March 2020

BBC

Meanwhile in Russia and Saudi Arabia



Short-run effects: pollution levels decline



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

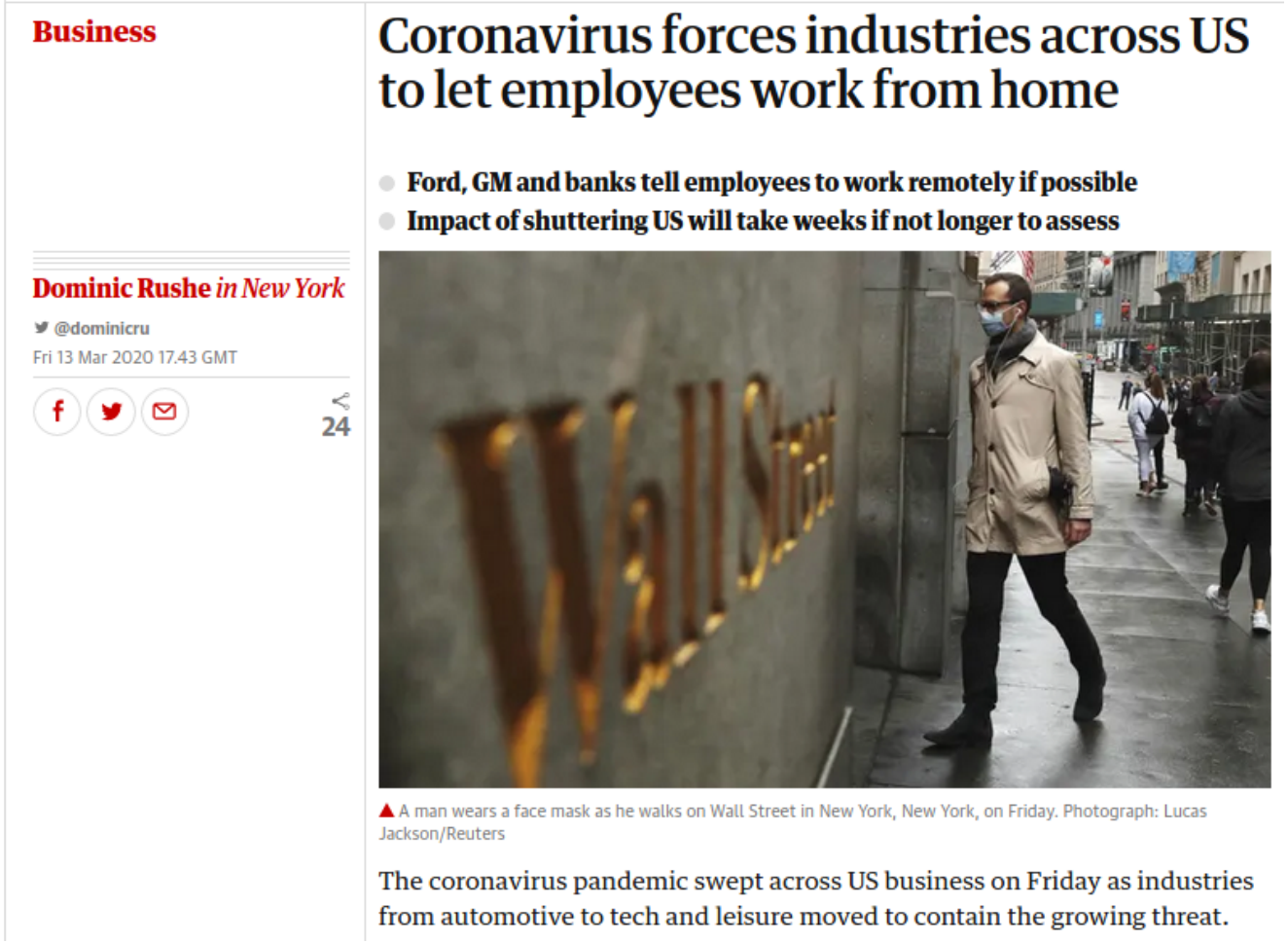
Mr. Shihipar studies public health.

March 13, 2020

Source: New York Times (https://www.nytimes.com/2020/03/13/opinion/coronavirus-social-distancing.html)

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



Business

Coronavirus forces industries across US to let employees work from home

- Ford, GM and banks tell employees to work remotely if possible
- Impact of shuttering US will take weeks if not longer to assess

Dominic Rushe *in New York*

@dominicru

Fri 13 Mar 2020 17.43 GMT

24

A man wears a face mask as he walks on Wall Street in New York, New York, on Friday. Photograph: Lucas Jackson/Reuters

The coronavirus pandemic swept across US business on Friday as industries from automotive to tech and leisure moved to contain the growing threat.

Source: The Guardian (https://www.theguardian.com/business/2020/mar/13/us-companies-work-from-home-policy-ford-general-motors)

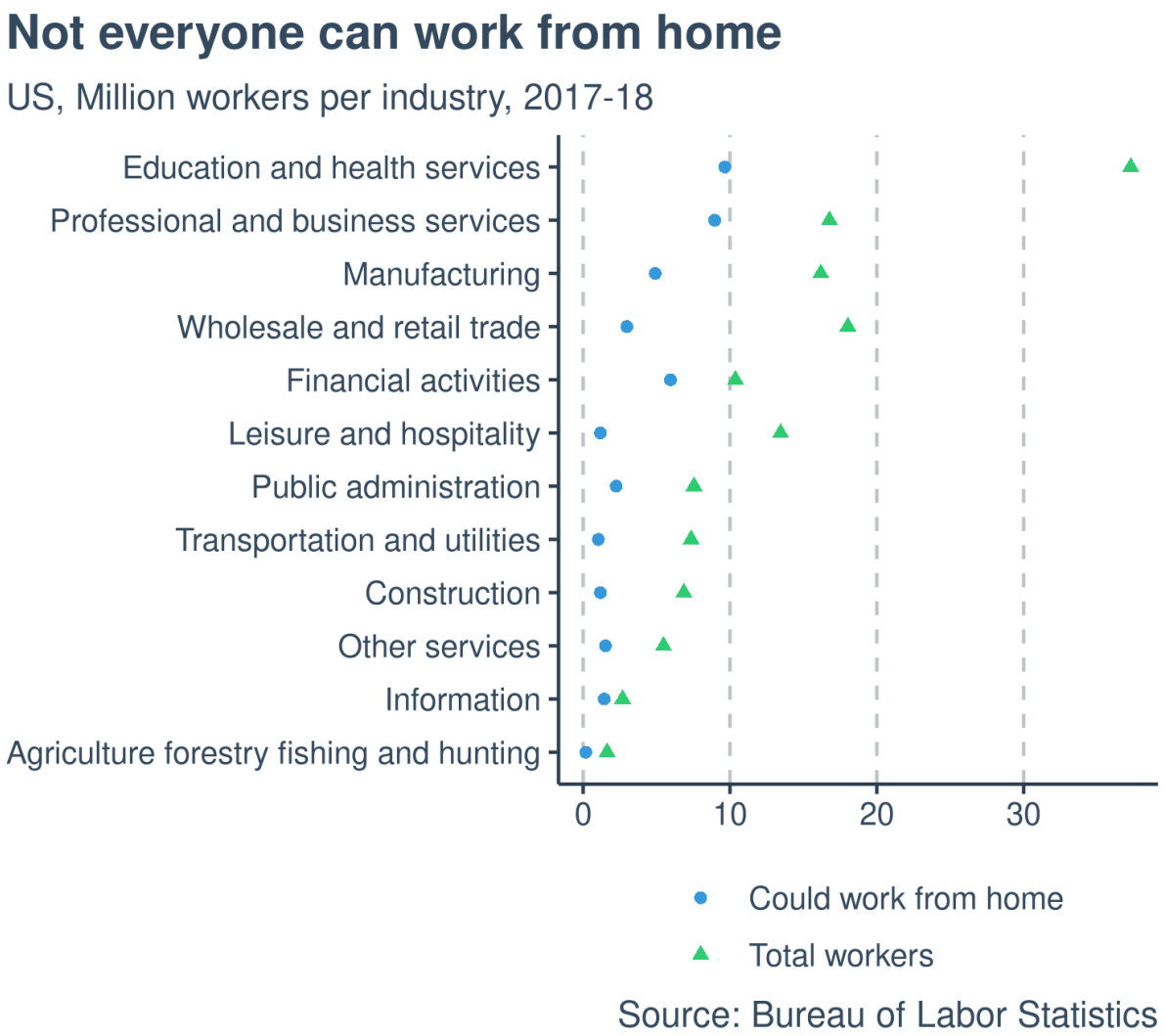
High earners more likely to work from home

- 29% of American workers could work from home according to a BLS survey in 2017-18
- Proportions varies 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)

Strong heterogeneity across sectors

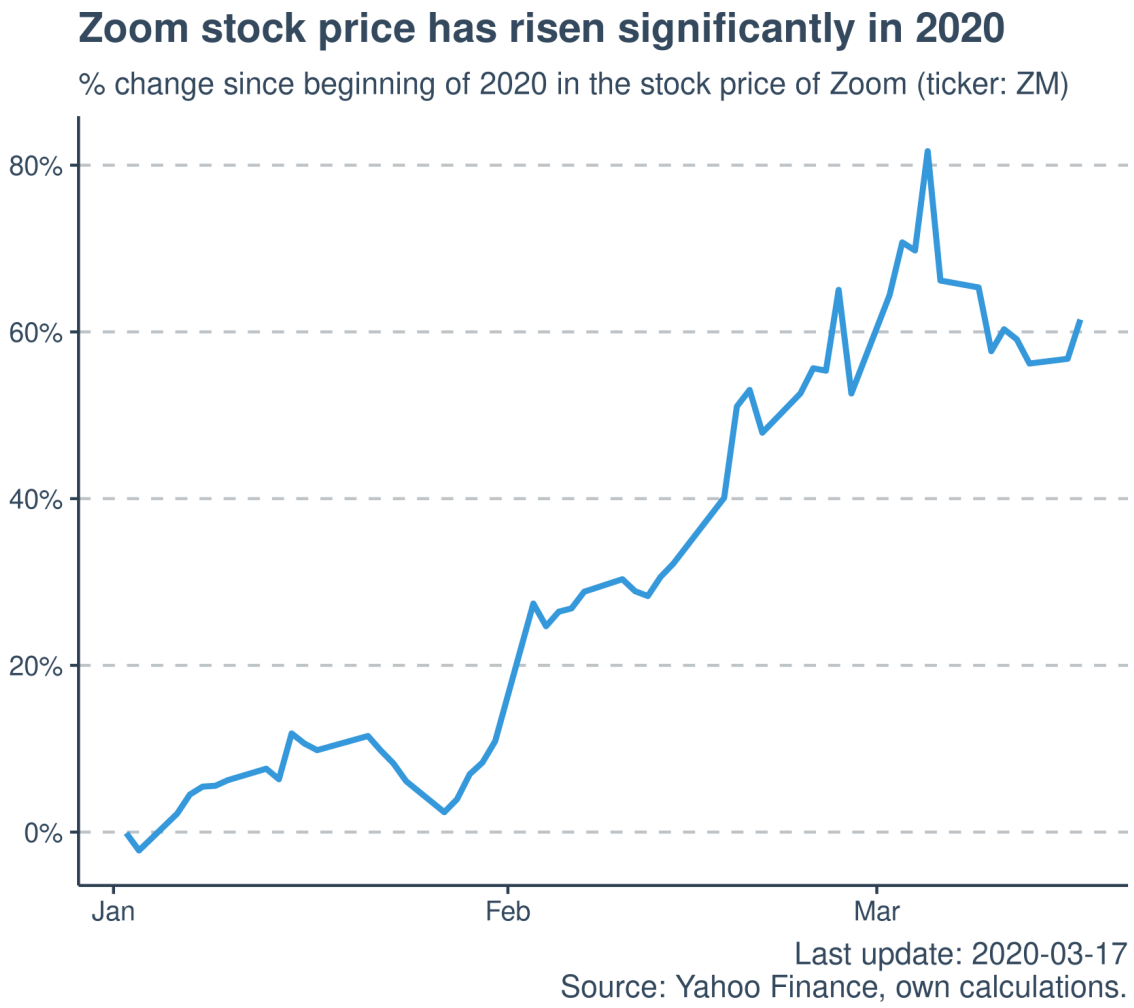
Most workers in manufacturing, retail, leisure, construction and transportation and utilities can hardly work from home.



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: https://www.nytimes.com/2020/03/17/style/zoom-parties-coronavirus-memes.html; https://www.marketwatch.com/story/this-is-online-educations-moment-as-colleges-close-during-coronavirus-pandemic-2020-03-17

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

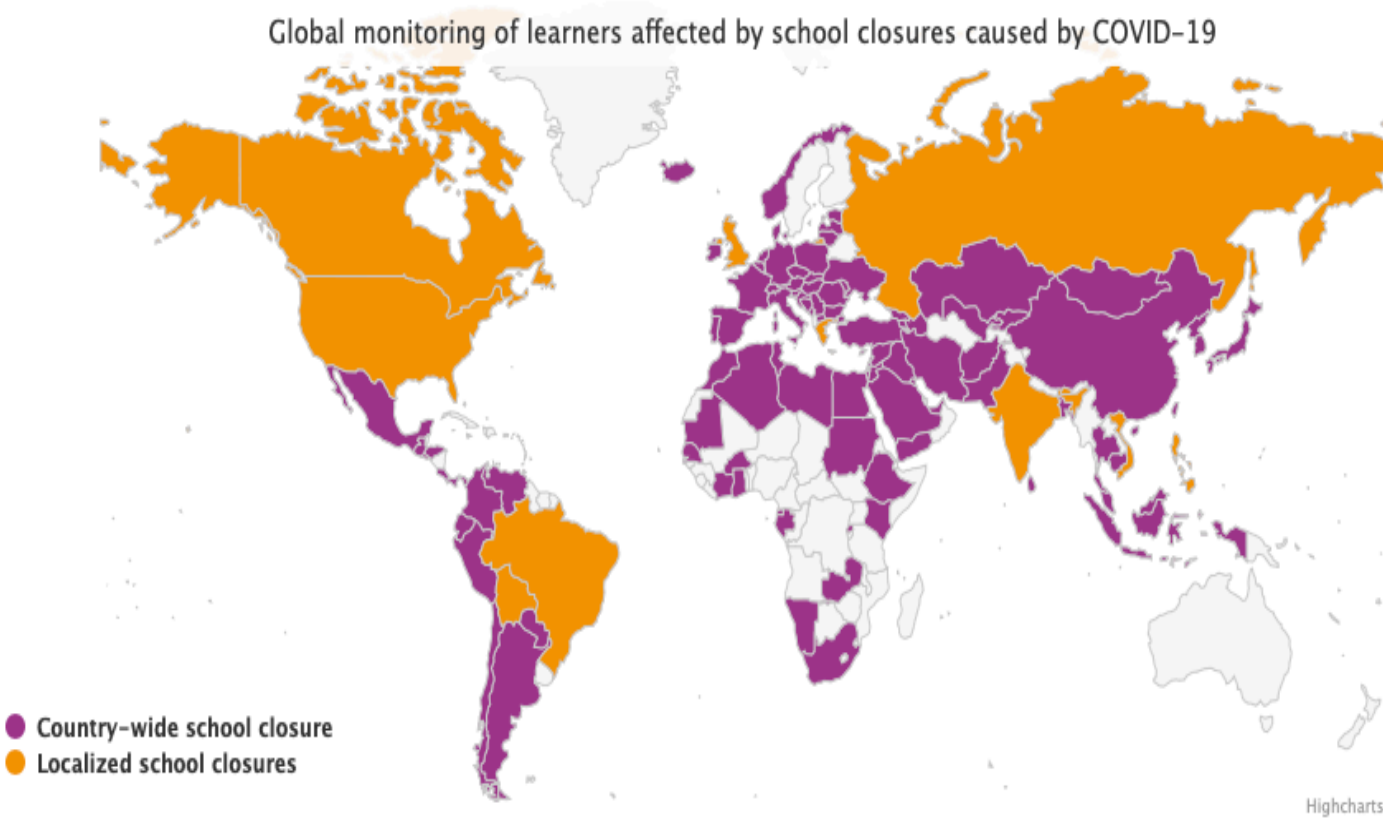
- Empirical studies show strong impacts of quality of parental education on pupil educational attainment and long-term outcomes (Heckman, 2006) Science

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).

Source: World Economic Forum (https://www.weforum.org/agenda/2020/03/3-ways-coronavirus-is-reshaping-education-and-what-changes-might-be-here-to-stay/)

The race between supply and demand

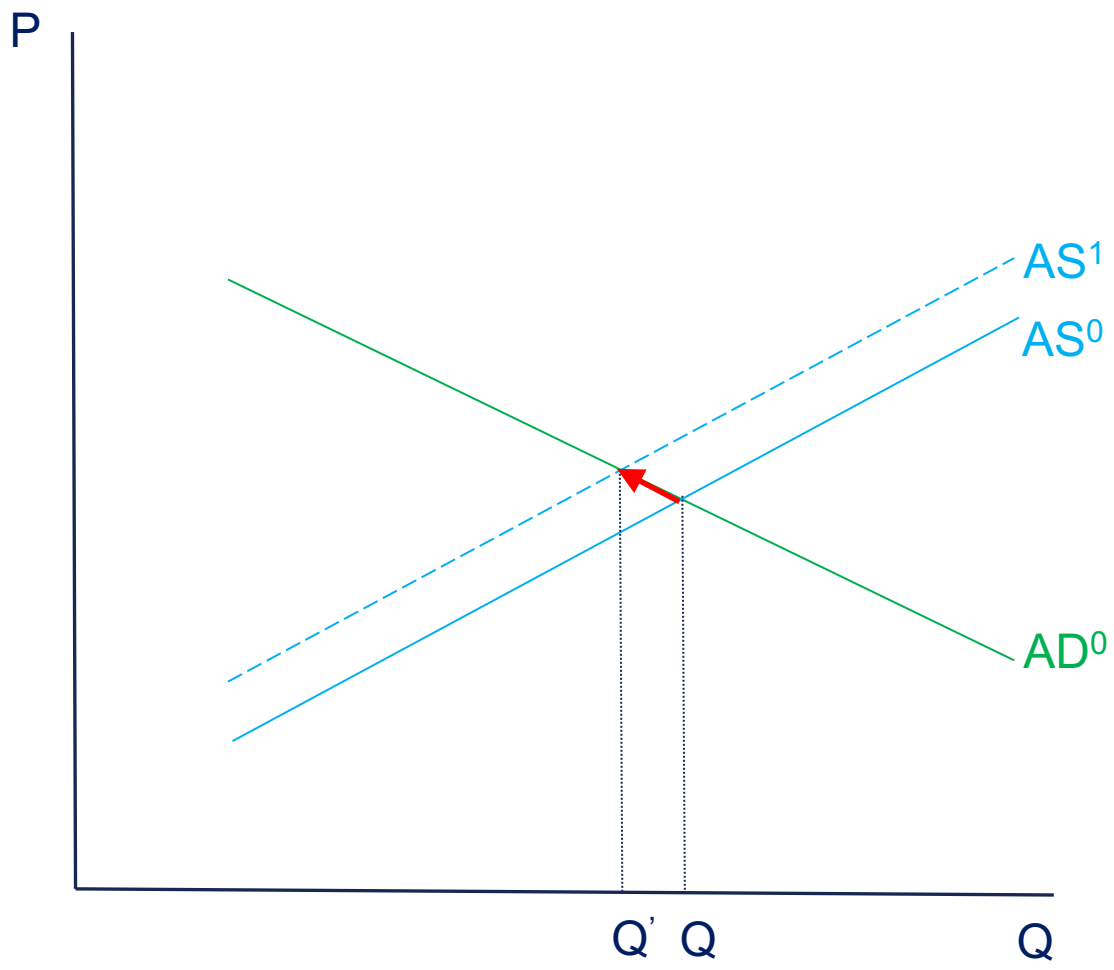
At first, covid-19 may look like a supply shock:

- 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:

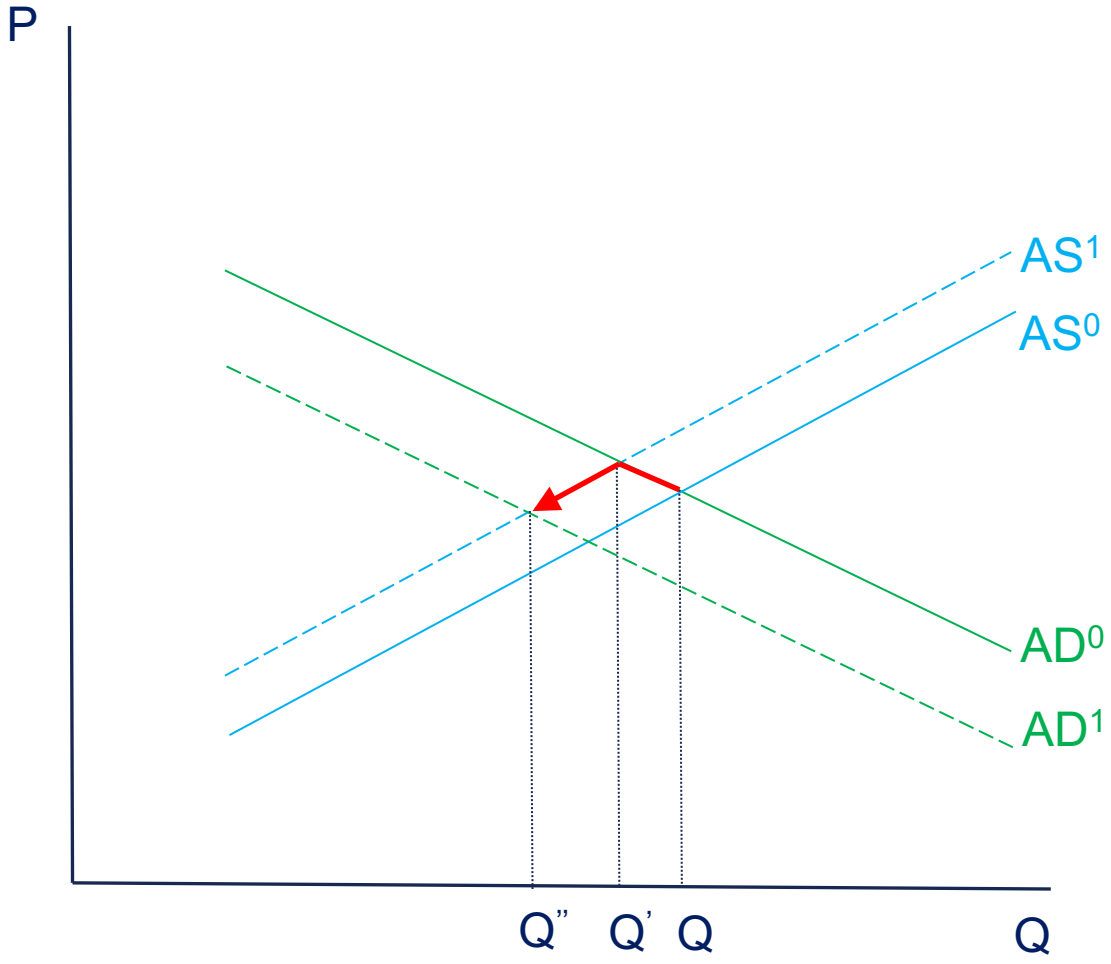
- Great recession of 2007-09: origin of supply shock was in the financial sector
- War/natural disaster: origin of the supply shock is destruction of infrastructure or large-scale permanent loss in labour force.



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



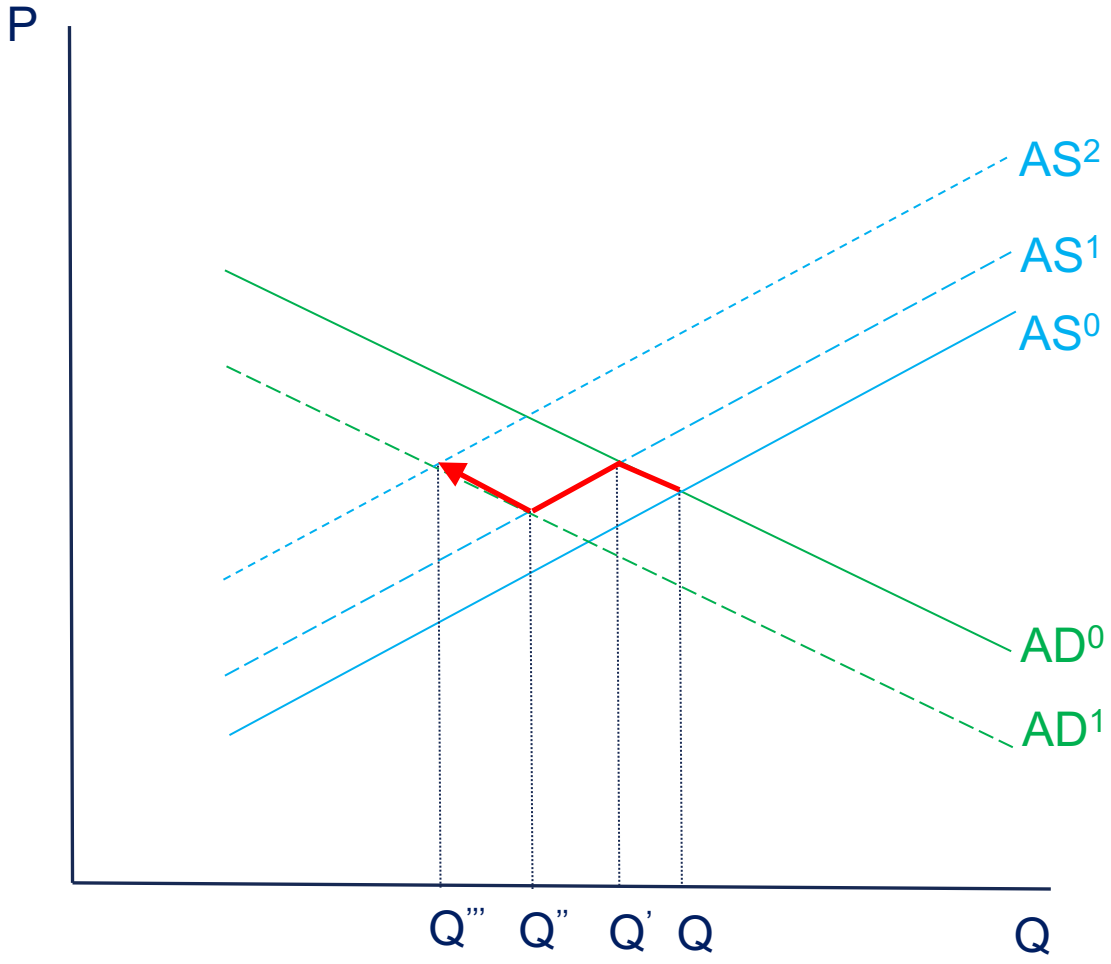
The race between supply and demand

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.

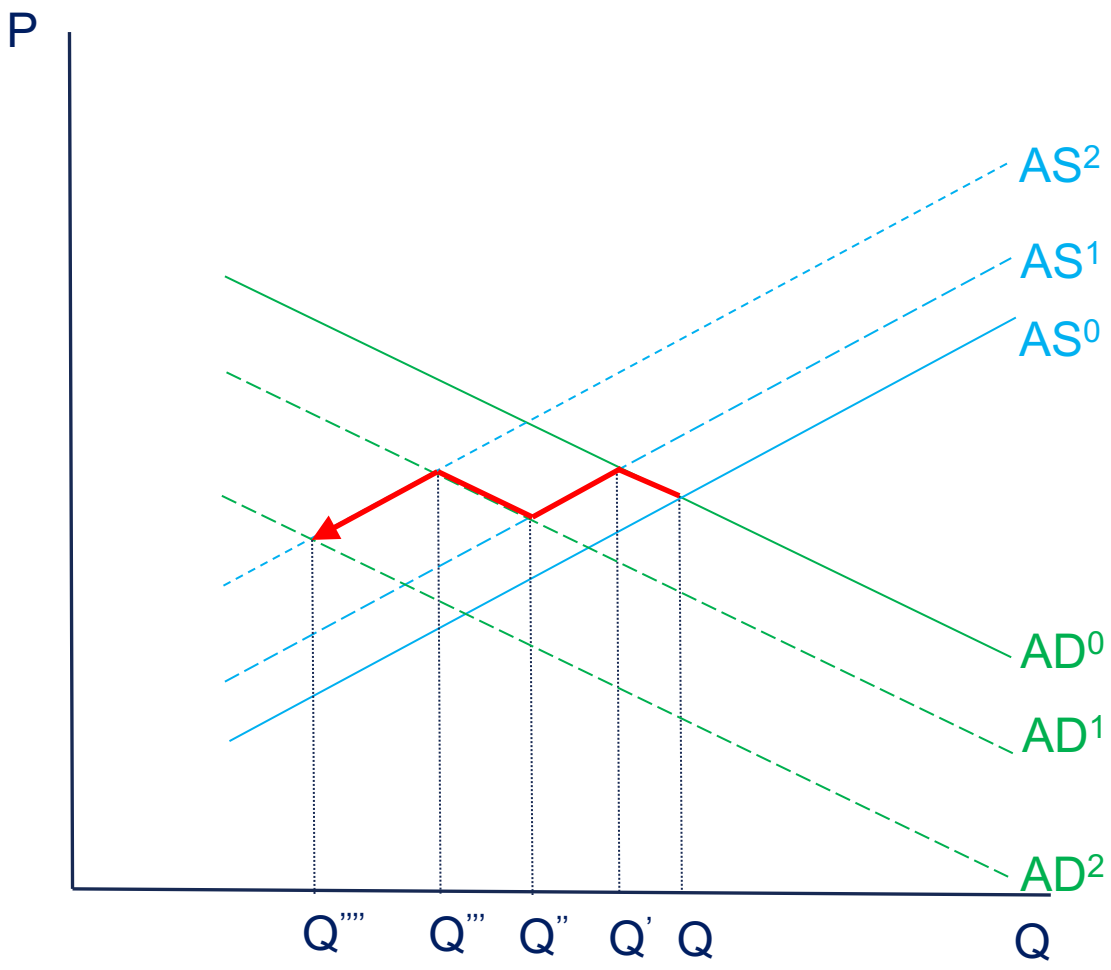
Different from war/disaster: there, demand might increase as governments redirect war efforts towards fight/rebuild and so potentially inflationary.



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.

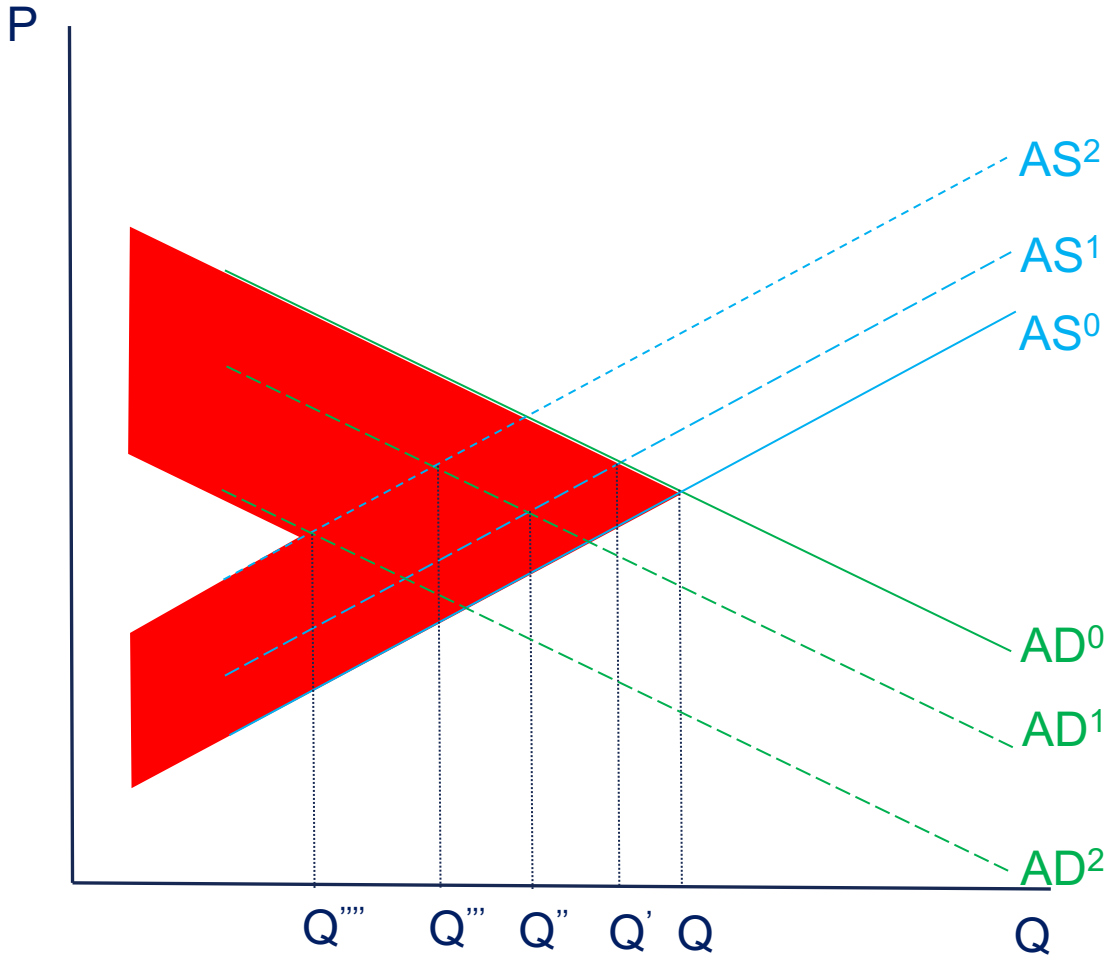


The destruction of economic surplus

Covid-19 virus is not ‘just’ a (large) shock on real economic fundamentals; it is a shock on the frictionless of the market;

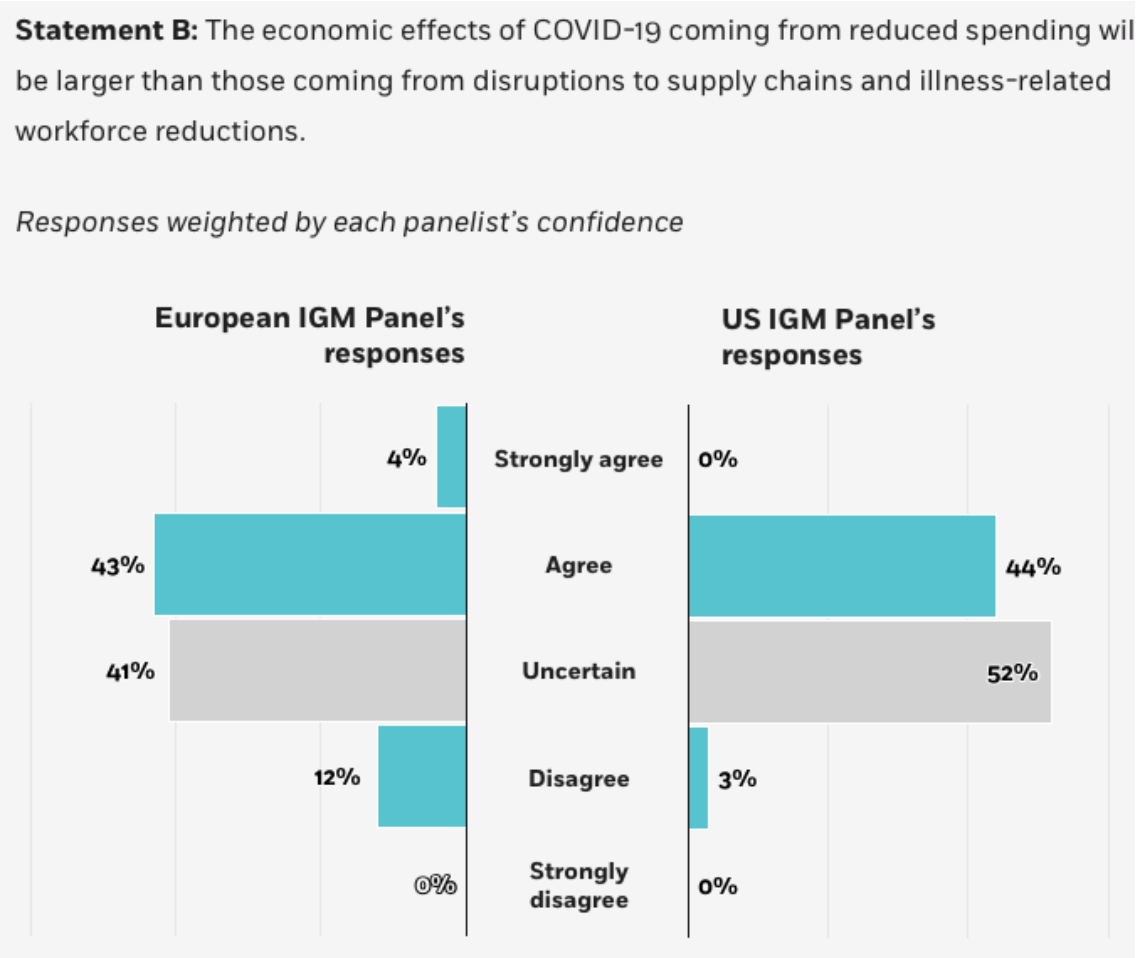
it introduces ‘a wall between demand and supply’ with strong complementary feedbacks in the real economy;

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

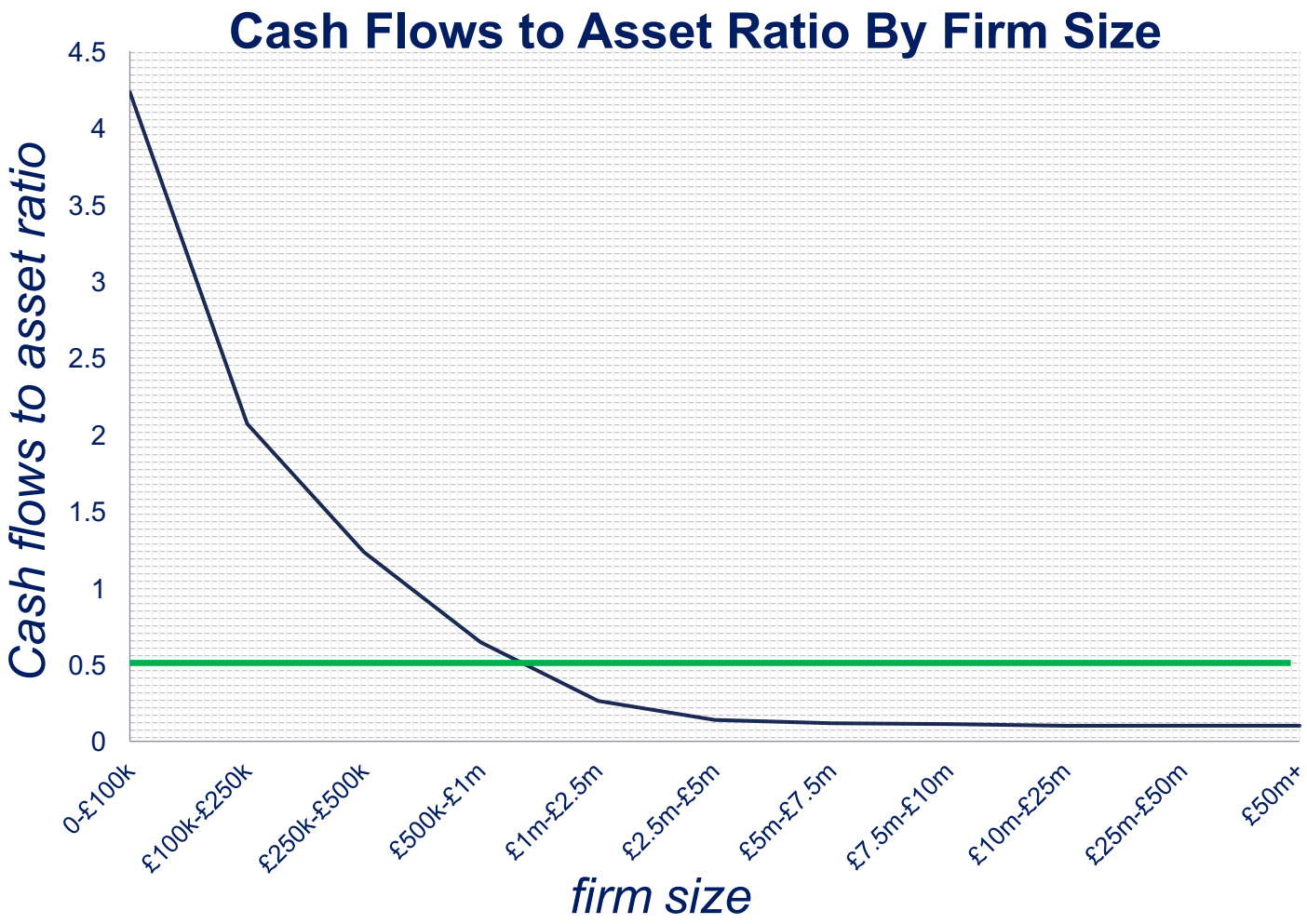


Source: https://voxeu.org/article/economic-impact-pandemic-igm-forum-survey

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**



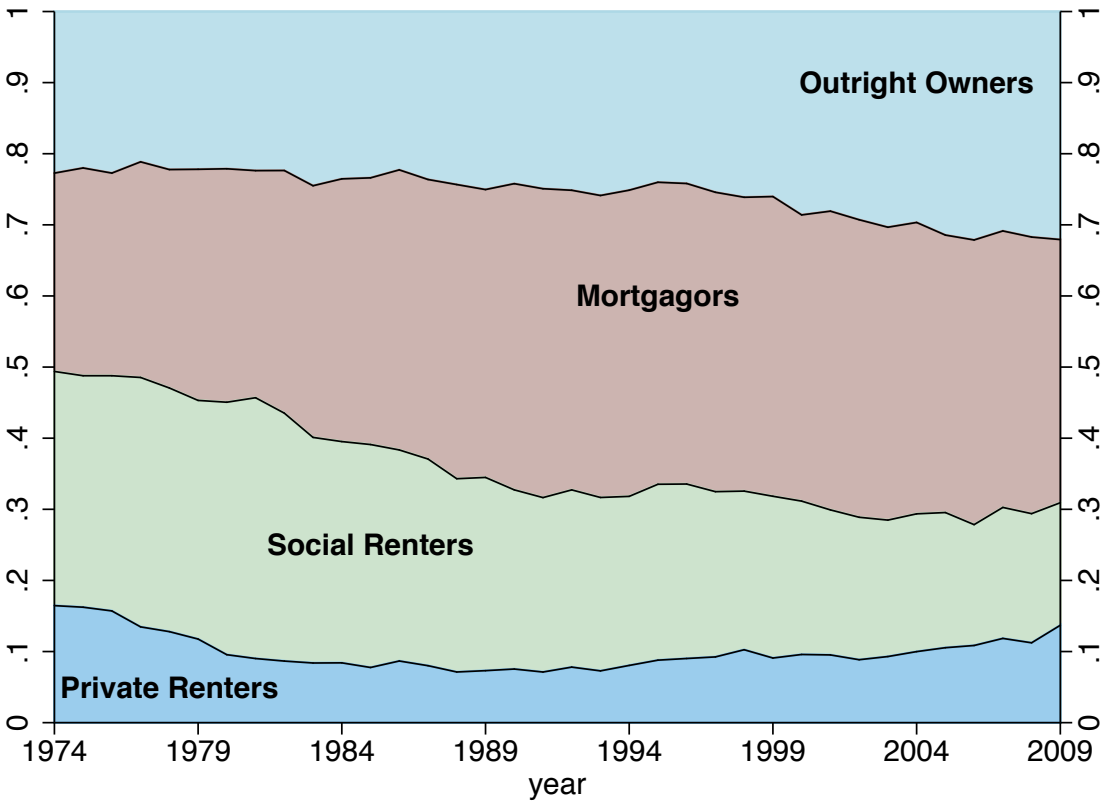
Source: based on calculations from Bahaj, Foulis, Pinter and Surico (2019) on the universe of private non-financial firms in the U.K.

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

	UK BHPS: 2005	
	Median	[p25 , p75]
Net Liquid wealth		
Outright owners	3,050	[0 , 17,034]
Mortgagors	0	[-3,250 , 5,000]
Renters	0	[-455 , 500]
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.

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

Next video: A user guide to Covid-19. Part iv – policy options

This Lecture

1. Science
2. Health policies
3. Economics
4. **Macroeconomic policies**

A four stage strategy?

Link: https://www.youtube.com/watch?v=nSXIetP5iak

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

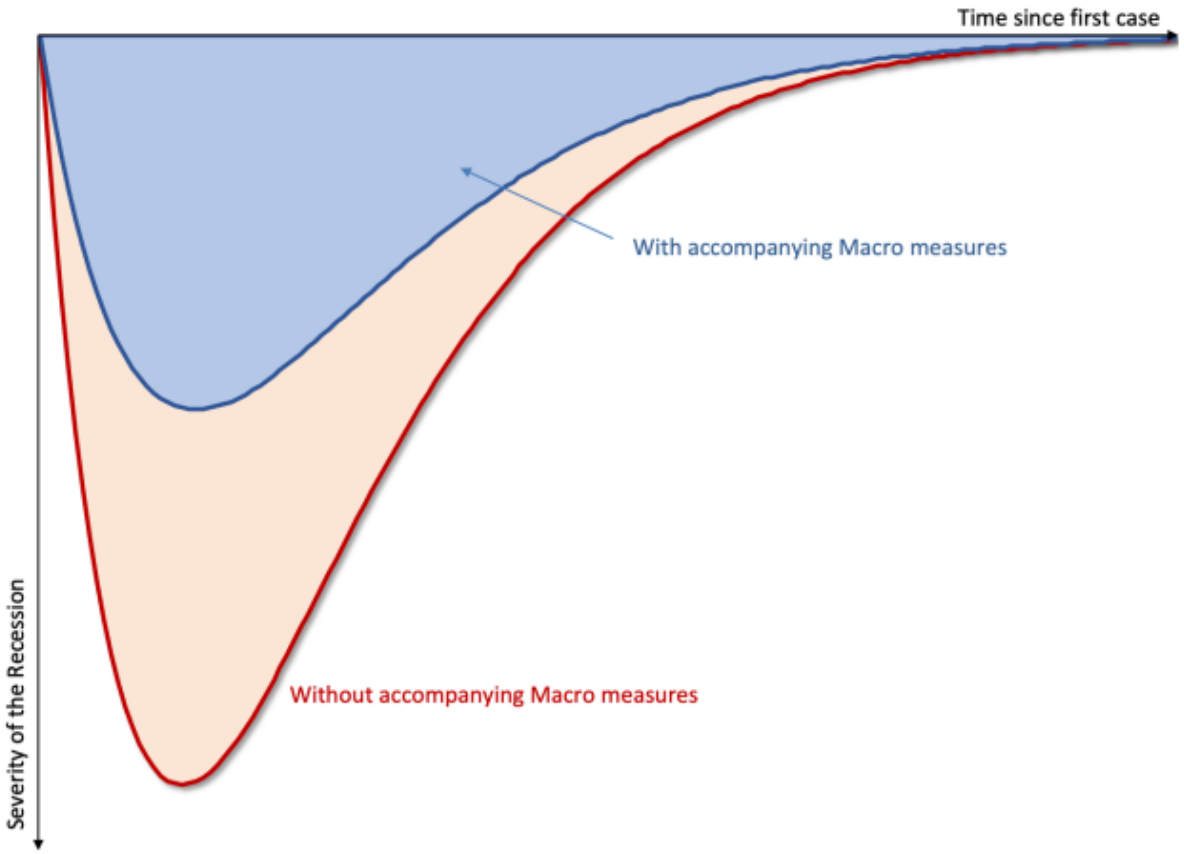


Figure 2: Flattening the Recession Curve

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 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.

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.

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.

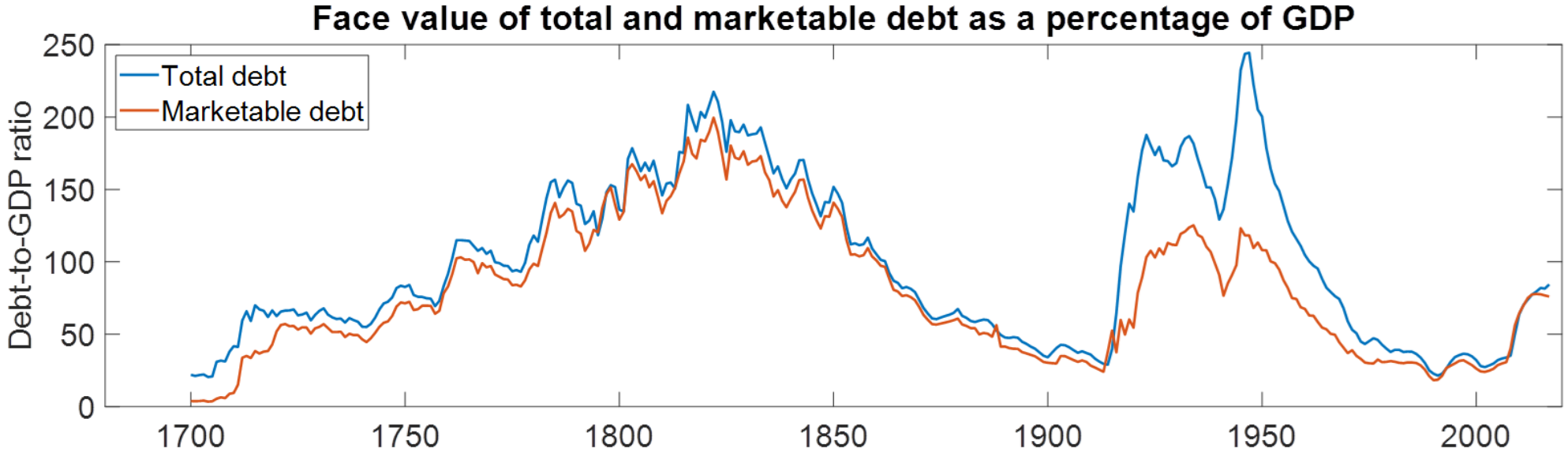
iv. use a **coordination of fiscal and monetary interventions** to maximize and multiply impact and provide financial backing to each other policy.

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)…



Source: Ellison-Scott (2020, AEJM)

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"

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!