

Economics of Coronavirus

Leonardo Becchetti

Structure of presentation

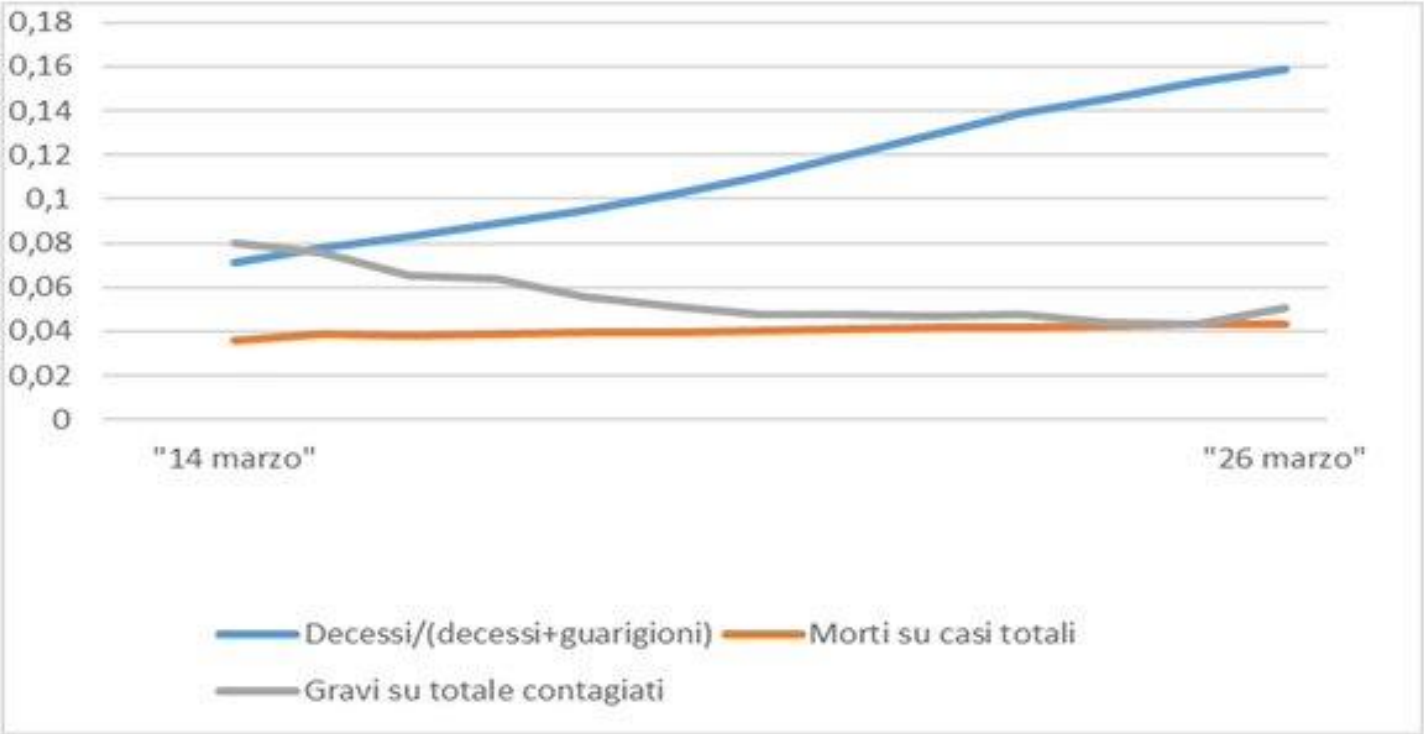
1. The interpretation of the phenomenon and its puzzles
2. The economic shock and policies to reduce it
3. Coronavirus, relational goods, life sense and subjective wellbeing
4. Two lessons from Covid and policy proposals to increase subjective wellbeing

Coronavirus outcomes are full of measurement errors

- Deceases (with or due to Coronavirus?)
- Recoveries (recorded or non recorded)
- Number of contagions (gross or net ?)
- gross: $\text{Contagion}(t) - \text{Contagion}(t-1)$
- net: $\text{Contagion}(t) - \text{Contagion}(t-1) - \text{deceases}(t) - \text{recoveries}(t)$

The divergence puzzle

Dinamica del Coronavirus a livello mondiale



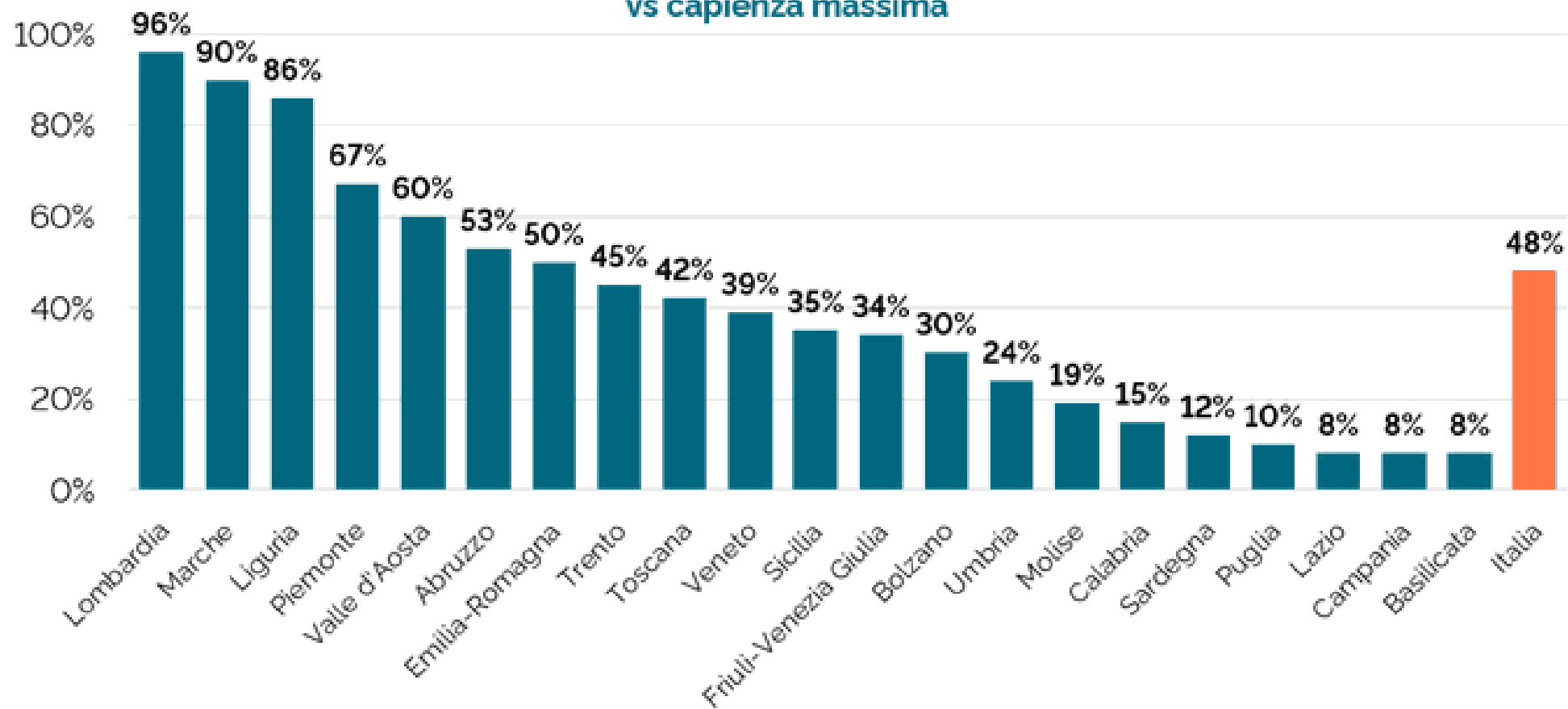
The puzzle

- Viruses do not travel alone. They take human beings as means of transport. This fact makes the heterogeneity of the diffusion of Coronavirus in Italy puzzling.
- Several authors in the literature emphasize that the Coronavirus was circulating well before end February/beginning of March when cases became to growth and the first restrictions were enacted. In the month before the government decision to limit people movement around the country the flow of commuting between Rome and Milan has been intense. High speed trains allow to move from one city to another in slightly less than 3 hours.
- Every day the flow of passengers moving from Rome to Milan (airplane plus train) is XXXX. The question is therefore why the intensity of the epidemic has been so different between the two cities and in general between the different provinces of Italy.
- A first tentative answer is that the virus was not in Milan before the wave government restrictions and therefore the latter were crucial to prevent diffusion in Rome and in the Center South of Italy.
- The second tentative answer is that the virus travelled also before that decision around Italy and some concurring factors (temperature, humidity, particulate matter) made it weaker when arriving in areas different from the center of the epidemic.

COVID-19: Stress sul sistema sanitario per Regione

Pazienti COVID-19 ricoverati in terapia intensiva al 19 marzo

vs capienza massima



Dati: Protezione Civile e Ministero della Salute.

Four rationales for the puzzle

- Higher commuting flows and economic activity
- Temperature and humidity
- Particulate matter and pollution
- Lockdown decisions

An hypothesis: the link between Coronavirus and pollution

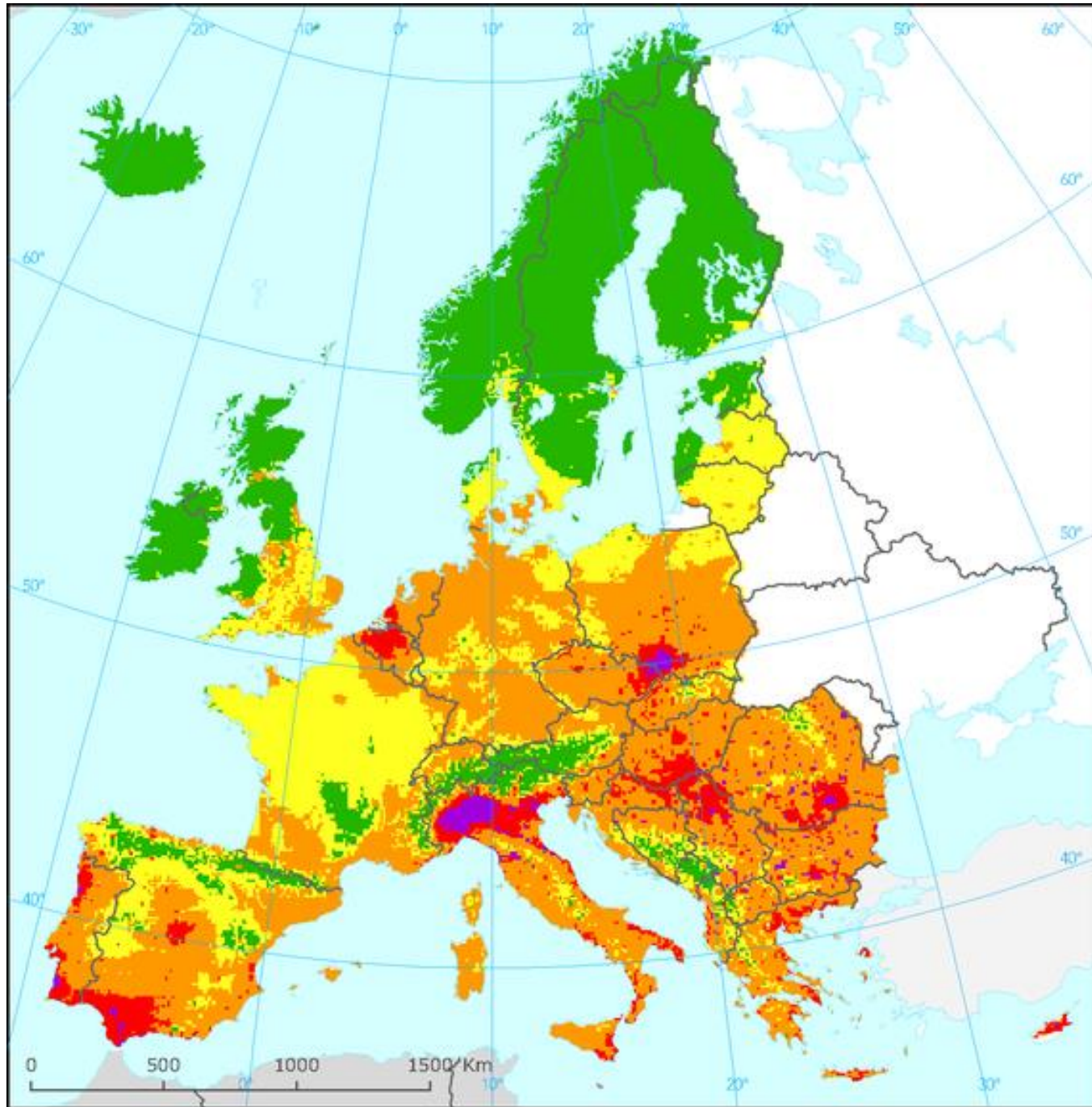
- Around 200 deaths per day due to pollution in Italy....
- Almost 50% percent of affected are in Lombardy and most of them in Pianura padana, an area with very high Pm10 concentration...(similar characteristics to Hubei and Qom)
- The fire analogy: an epidemic is like a fire. If you find favorable condition (pollution) and intervene late it is almost impossible to stop the fire...

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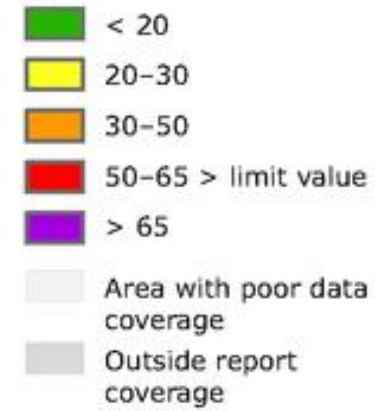
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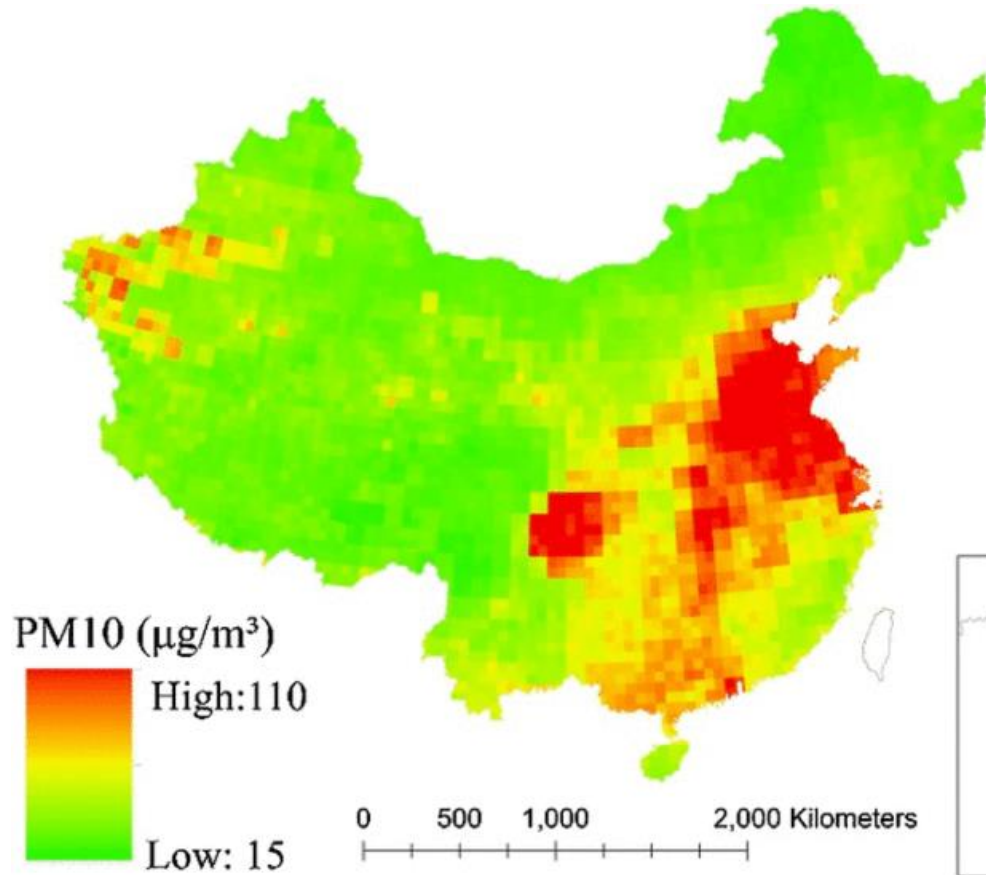


PM₁₀ — 36th highest daily value

Reference year: 2004
combined rural and urban
map

µg/m³

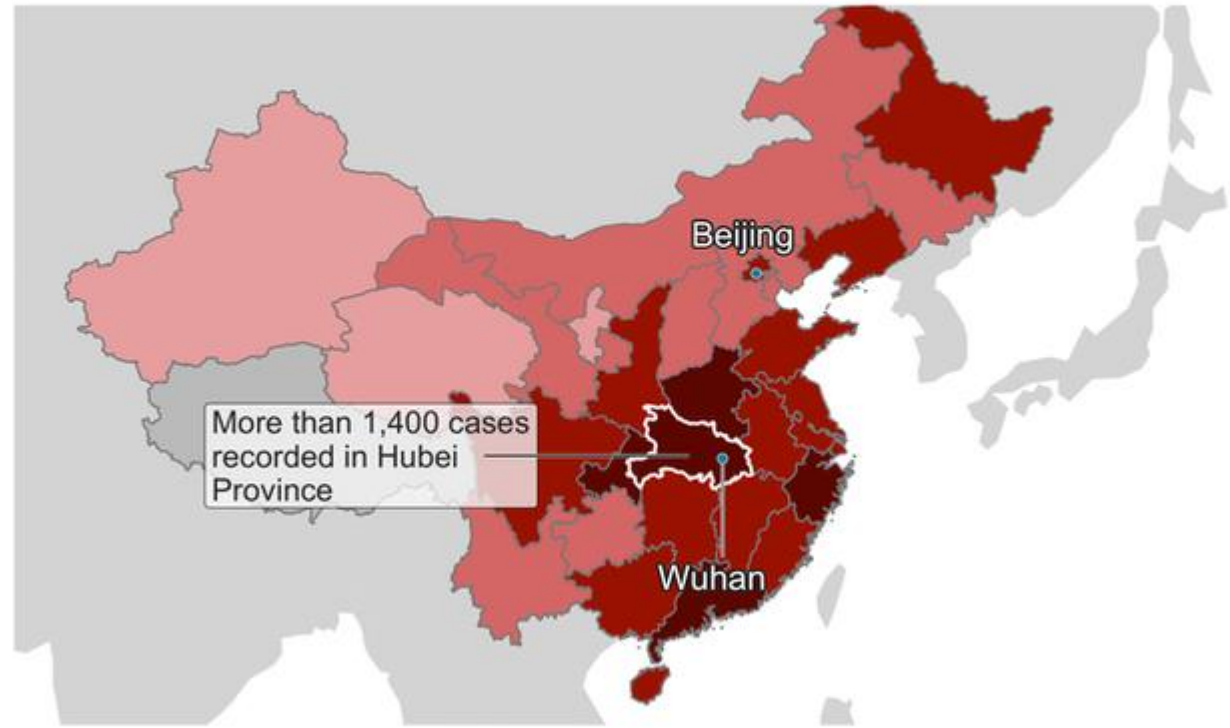




Cases of coronavirus confirmed in China



No cases
 1 to 5
 6 to 20
 21 to 100
 More than 100



Long-Term Exposure to Ambient Air Pollution and Risk of Hospitalization with Community-acquired Pneumonia in Older Adults

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Rationale: Little is known about the long-term effects of air pollution on pneumonia hospitalization in the elderly.

Objectives: To assess the effect of long-term exposure to ambient nitrogen dioxide, sulfur dioxide, and fine particulate matter with diameter equal to or smaller than 2.5 μm (PM_{2.5}) on hospitalization for community-acquired pneumonia in older adults.

Methods: We used a population-based case-control study in Hamilton, Ontario, Canada. We enrolled 345 hospitalized patients aged 65 years or more for community-acquired pneumonia and 494 control participants, aged 65 years and more, randomly selected from the same community as cases from July 2003 to April 2005. Health data were collected by personal interview. Annual average levels of nitrogen dioxide, sulfur dioxide, and PM_{2.5} before the study period were estimated at the residential addresses of participants by inverse distance weighting, bicubic splined and land use regression methods and merged with participants' health data.

Measurements and Main Results: Long-term exposure to higher levels of nitrogen dioxide and PM_{2.5} was significantly associated with hospitalization for community-acquired pneumonia (odds ratio [OR], 2.30; 95% confidence interval [CI], 1.25 to 4.21; $P = 0.007$ and OR, 2.26; 95% CI, 1.20 to 4.24; $P = 0.012$, respectively, over the 5th–95th percentile range increase of exposure). Sulfur dioxide did not appear to have any association (OR, 0.97; 95% CI, 0.59 to 1.61; $P = 0.918$). Results were somewhat sensitive to the choice of methods used to estimate air pollutant levels at residential addresses, although all risks from nitrogen dioxide and PM_{2.5} exposure were positive and generally significant.

Conclusions: In older adults, exposure to ambient nitrogen dioxide and PM_{2.5} was associated with hospitalization for community-acquired pneumonia.

AT A GLANCE COMMENTARY

Scientific Knowledge on the Subject

There are sparse data on long-term effects of air pollution on pneumonia hospitalization in the elderly. Moreover, previous studies have focused on the effect of short-term increases in air pollution.

What This Study Adds to the Field

We found that long-term ambient levels of NO₂ and fine particulate matter with diameter equal to or smaller than 2.5 μm (PM_{2.5}) were independently associated with pneumonia hospitalization in older adults.

The role of air pollution as a risk factor for respiratory diseases such as asthma and chronic pulmonary disease has been recognized (7–14). Less is known, however, about the effect of air pollution on pneumonia hospitalization in older adults, a high-risk population for this illness. Data from animal models support a deleterious effect of air nitrogen dioxide such as its capacity to impair the function of alveolar macrophages and epithelial cells, thereby increasing the risk of lung infections such as influenza, which can predispose to causative bacterial agents of pneumonia such as *Pneumococcus* (15). Previous epidemiologic reports are, however, limited by use of administrative databases for diagnosis of pneumonia (7–11, 14). Lack of

- Neupane, Binod, et al. "Long-term exposure to ambient air pollution and risk of hospitalization with community-acquired pneumonia in older adults." *American journal of respiratory and critical care medicine* 181.1 (2010): 47-53.

Short-Term Air Pollution and Incident Pneumonia

A Case–Crossover Study

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Abstract

Rationale: The relationship between air pollution and pneumonia is poorly understood.

Objectives: To examine relationships between short-term air pollution exposure and number and severity of pneumonia cases along the Wasatch Front in Utah, a region with periodic high levels of outdoor air pollution.

Methods: We applied time-stratified case–crossover analyses with distributed lag to patients presenting to seven emergency departments with pneumonia over a 2-year period. We compared levels of particulate matter less than or equal to 2.5 μm in aerodynamic diameter, nitrogen dioxide, and ozone at patient residences with emergency department cases, hospitalizations, objectively defined severe pneumonia, and mortality. We calculated direct cost impacts of particulate matter less than or equal to 2.5 μm in aerodynamic diameter reduction.

Results: We evaluated 4,336 pneumonia cases in seven hospitals. Among adults aged 65 years and older, we found consistently positive associations between particulate matter less than or equal to 2.5 μm in aerodynamic diameter within 6 days of presentation and instances of pneumonia (Lag Day 1 adjusted odds ratio, 1.35 per 10 $\mu\text{g}/\text{m}^3$ over

12 $\mu\text{g}/\text{m}^3$; 95% confidence interval, 1.16–1.57), severe pneumonia (Lag Day 1 adjusted odds ratio, 1.38; 95% confidence interval, 1.06–1.80), and inpatient mortality (Lag Day 5 adjusted odds ratio, 1.50; 95% confidence interval, 1.03–2.16). Smaller associations were found between nitrogen dioxide exposure and pneumonia occurrence, severity, and inpatient and 30-day mortality. Ozone exposure was modestly associated with increased instance and severity of pneumonia in younger adults. Particulate matter less than or equal to 2.5 μm in aerodynamic diameter and nitrogen dioxide effects were greatest in colder months, and ozone effects were greatest in warmer months. Reduction of particulate matter less than or equal to 2.5 μm in aerodynamic diameter levels to less than 12.0 mg/m^3 could prevent 76–112 cases of pneumonia per year in these hospitals serving approximately half of the Wasatch Front’s population, reducing direct medical facility costs by \$807,000 annually.

Conclusions: Among older adults, short-term ambient particulate matter less than or equal to 2.5 μm in aerodynamic diameter exposure is associated with more emergency department visits and hospitalizations for pneumonia, severe pneumonia, increased mortality, and increased healthcare costs. Nitrogen dioxide and ozone modestly increase pneumonia risk and illness severity.

Keywords: particulate matter; nitrogen dioxide; ozone; respiratory tract infections; healthcare costs

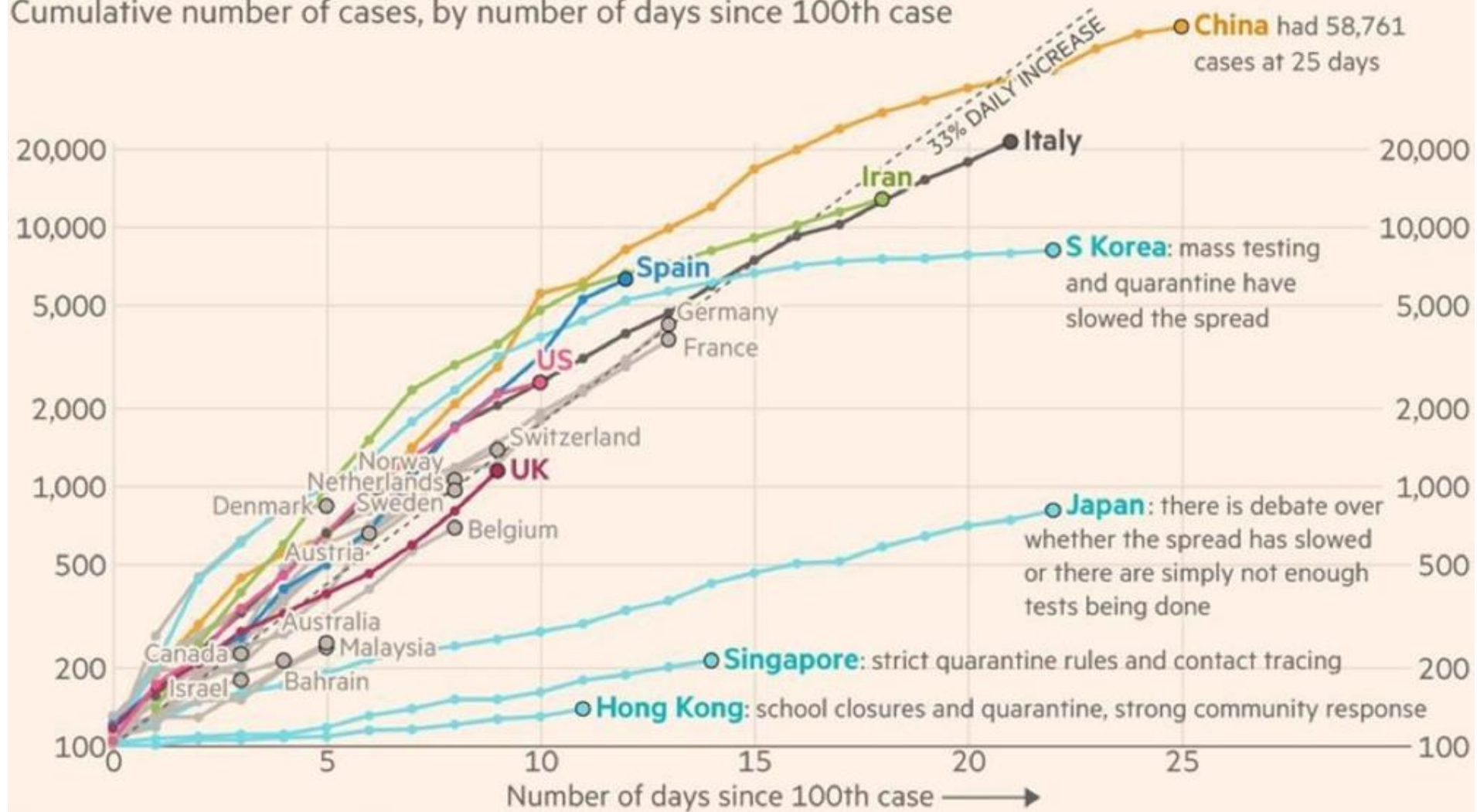
Temperature/humidity and Coronavirus



- Virus outbreaks are significantly reduced by high temperature (Lowen et al. 2007; Barreca et al. 2012; Shaman et al 2009, Zuk et al. 2009) .
- Research on past coronaviruses show that they belong to the family of “enveloped viruses” as they are surrounded by an oily coat (a lipid bilayer). Enveloped viruses are more sensitive to temperature since low temperature hardens the coat into a rubber-like state that protects the virus longer when it outside the body.
- Sayadi et al. (2020) show that areas at higher risk of Coronavirus outbreak are those with an average temperature between 5 and 11 C degrees. Bannister-Tyrrel et al. (2020) provide preliminary evidence that higher temperature are associated to lower incidence of COVID-19.
- Bukhari and Jameel (2020) show that 90 percent of cases until March 22, 2020 have been recorded in the 3-17C temperature range and in the 3-9g/m3 humidity range. The author emphasize how virus diffusion in warmer and more humid areas (regions of the United states such as Texas, new Mexico and Arizona, Asian countries such as Malaysia and Thailand and Middle East countries such as Saudi Arabia) while stronger in others with colder and drier climate (Iran, South Korea, New York and Washington).
- A similar reasoning would apply to differences of contagions between North and South of Italy and between Madrid (who has a colder and drier continental climate) and other regions of Spain in the South or closer to the sea.

Most western countries are on the same coronavirus trajectory. Hong Kong and Singapore have so far limited the spread; S Korea is slowing its progress

Cumulative number of cases, by number of days since 100th case



- A Korean exit strategy : app to trace positive cases and mass testing

FT graphic: John Burn-Murdoch / @jburnmurdoch

Source: FT analysis of Johns Hopkins University, CSSE. Data updated March 14, 19:00 GMT

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The effect of Covid-19 on economic activity and subjective wellbeing

- The characteristics of the shock
- Demand shock
- Supply shock
- Fiscal policies
- Monetary policies
- Coronavirus, smart work and ecological transition
- Coronavirus, relational goods and subjective wellbeing

The race between supply and demand

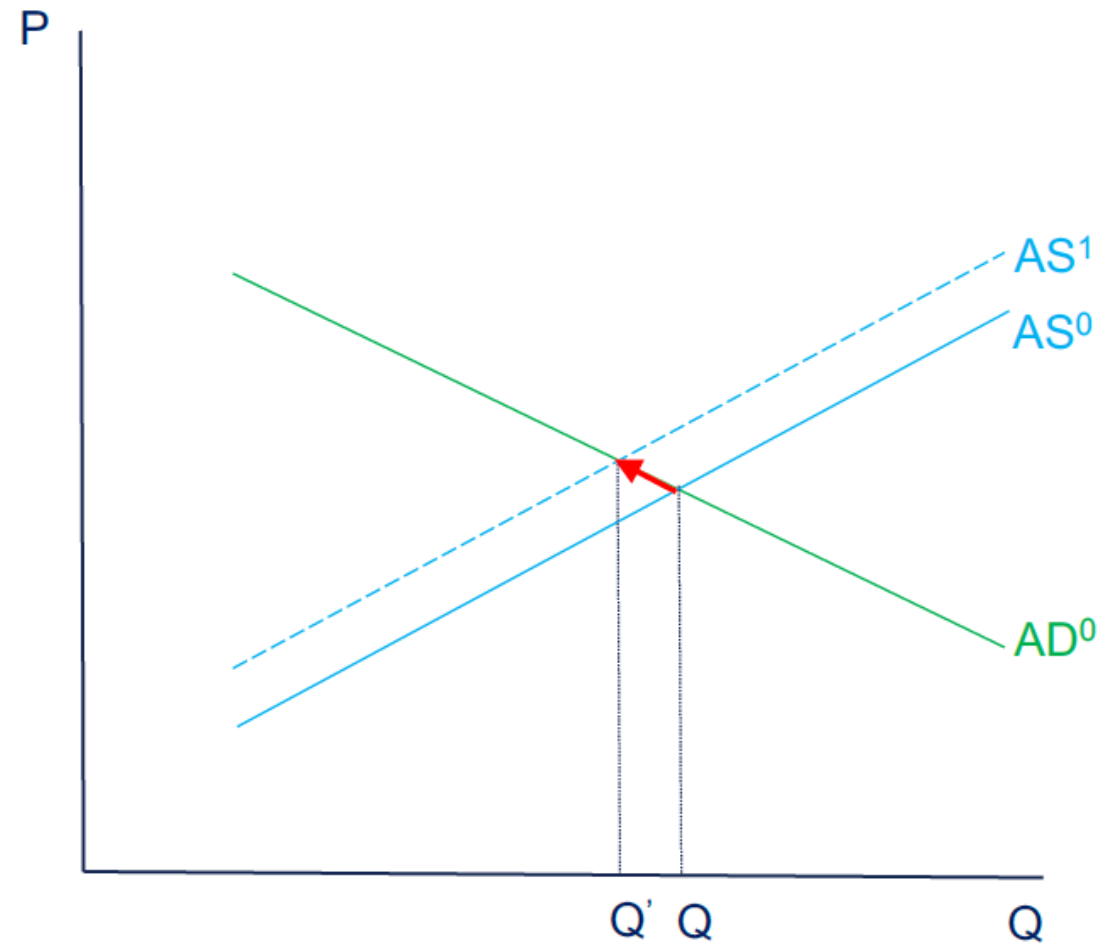
At first, covid-19 may look like a supply shock:

- 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:

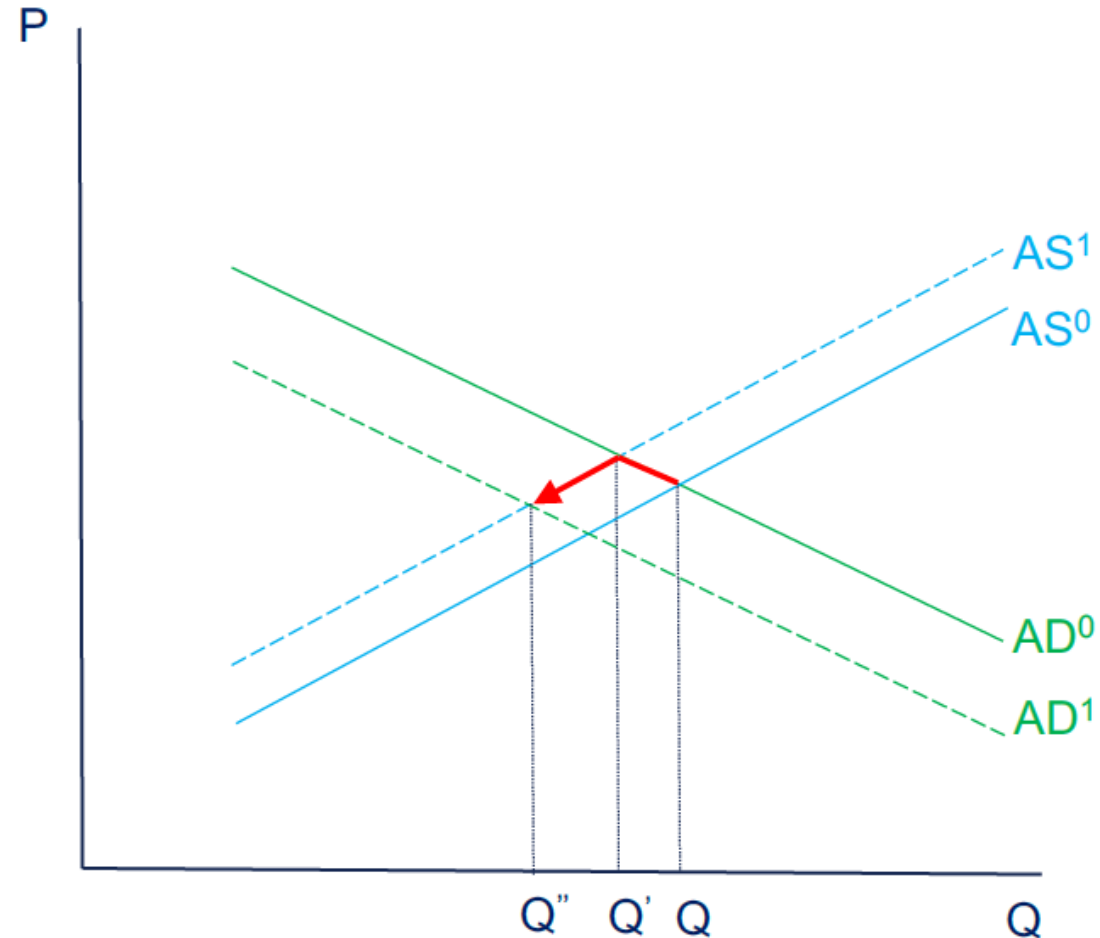
- Great recession of 2007-09: origin of supply shock was in the financial sector
- War/natural disaster: origin of the supply shock is destruction of infrastructure or large-scale permanent loss in labour force.



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



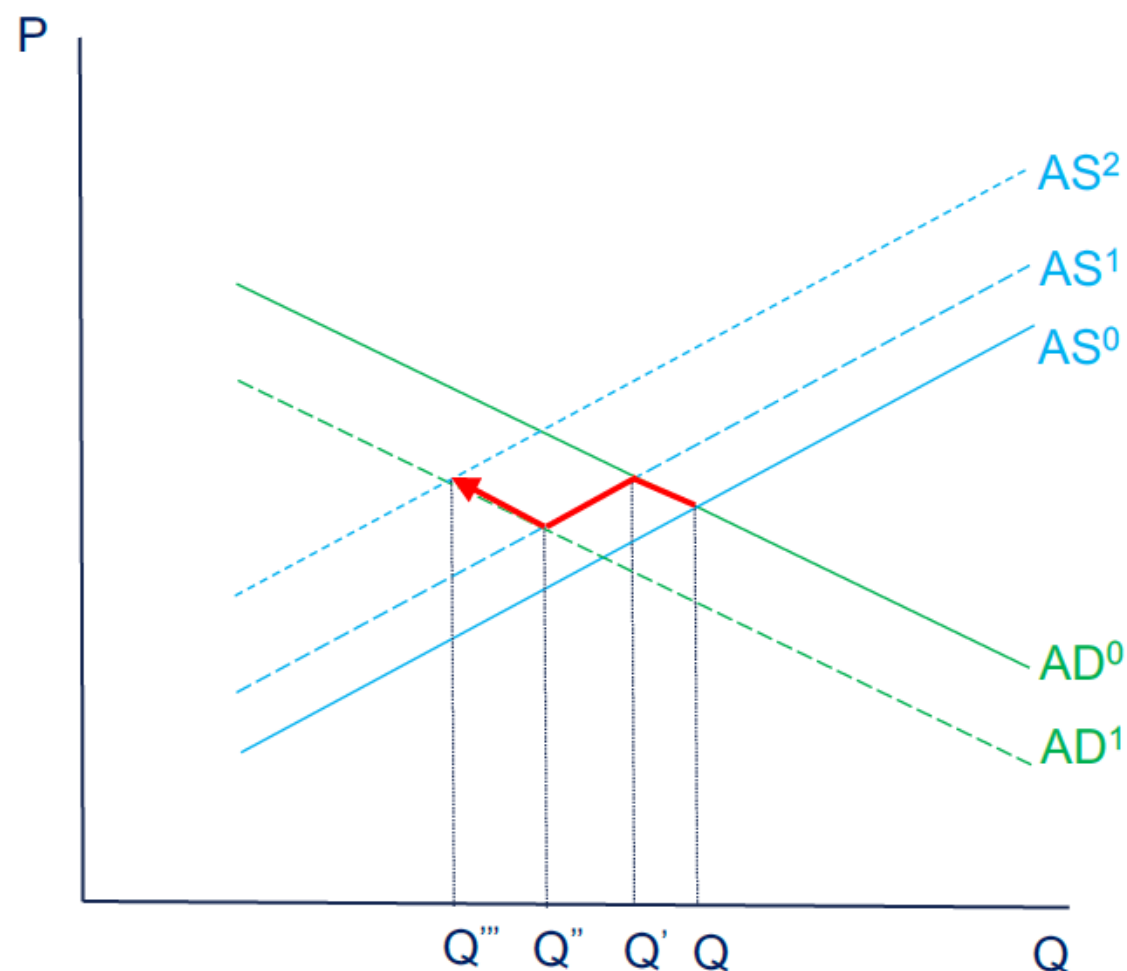
The race between supply and demand

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.

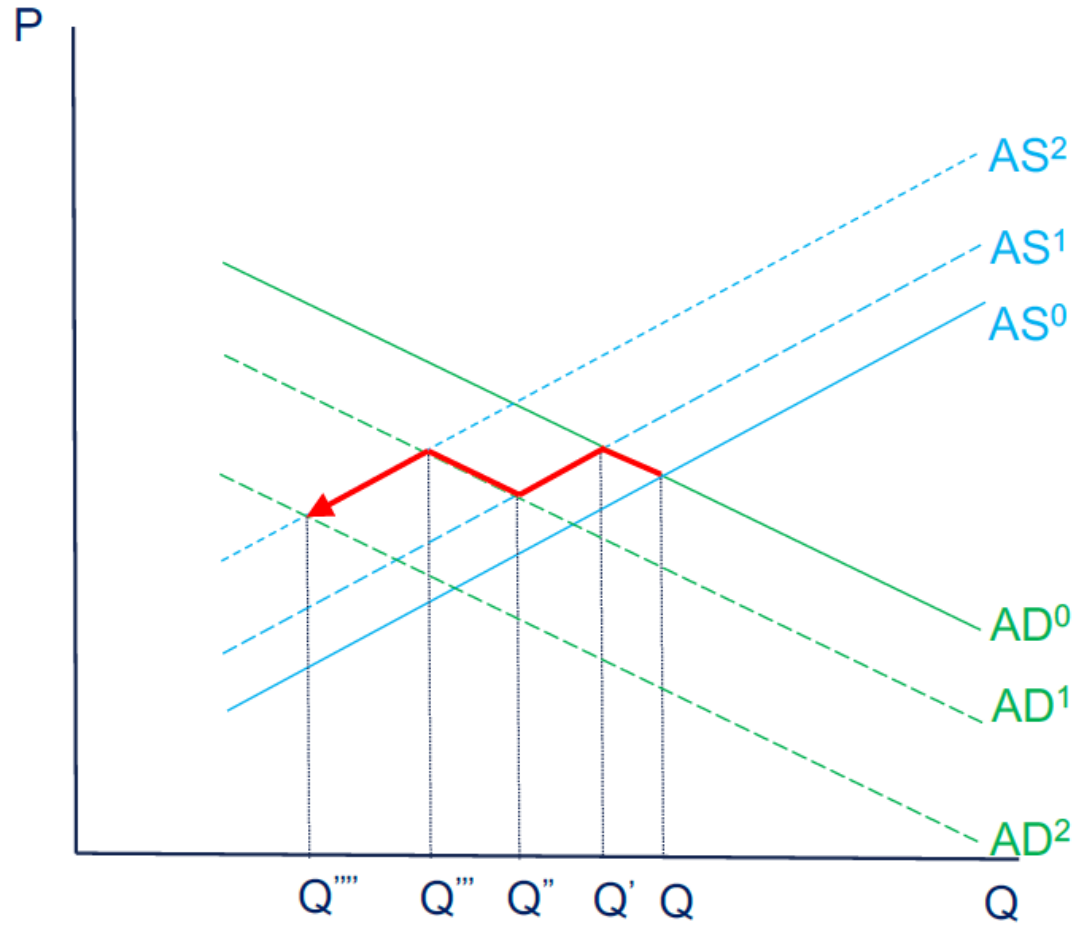
Different from war/disaster: there, demand might increase as governments redirect war efforts towards fight/rebuild and so potentially inflationary.



The race between supply and demand

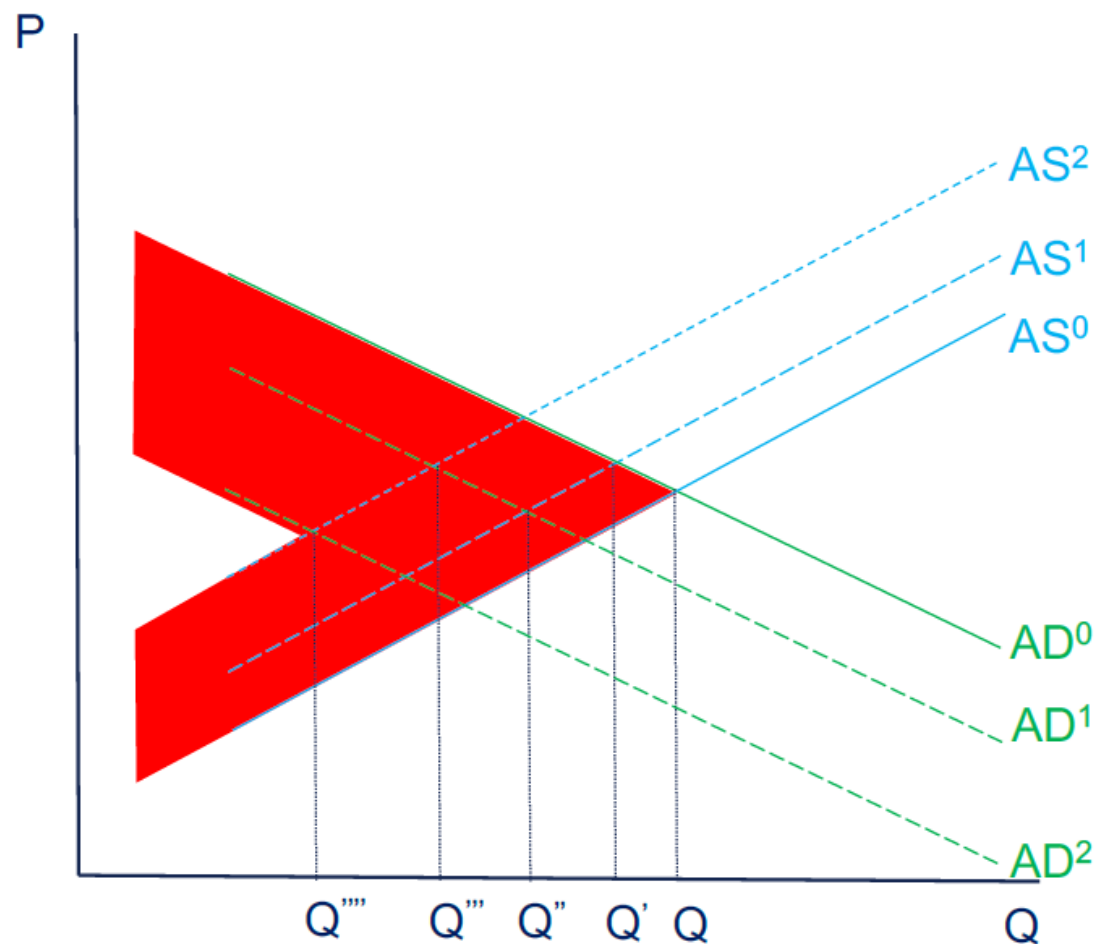
Feedback loop into demand:

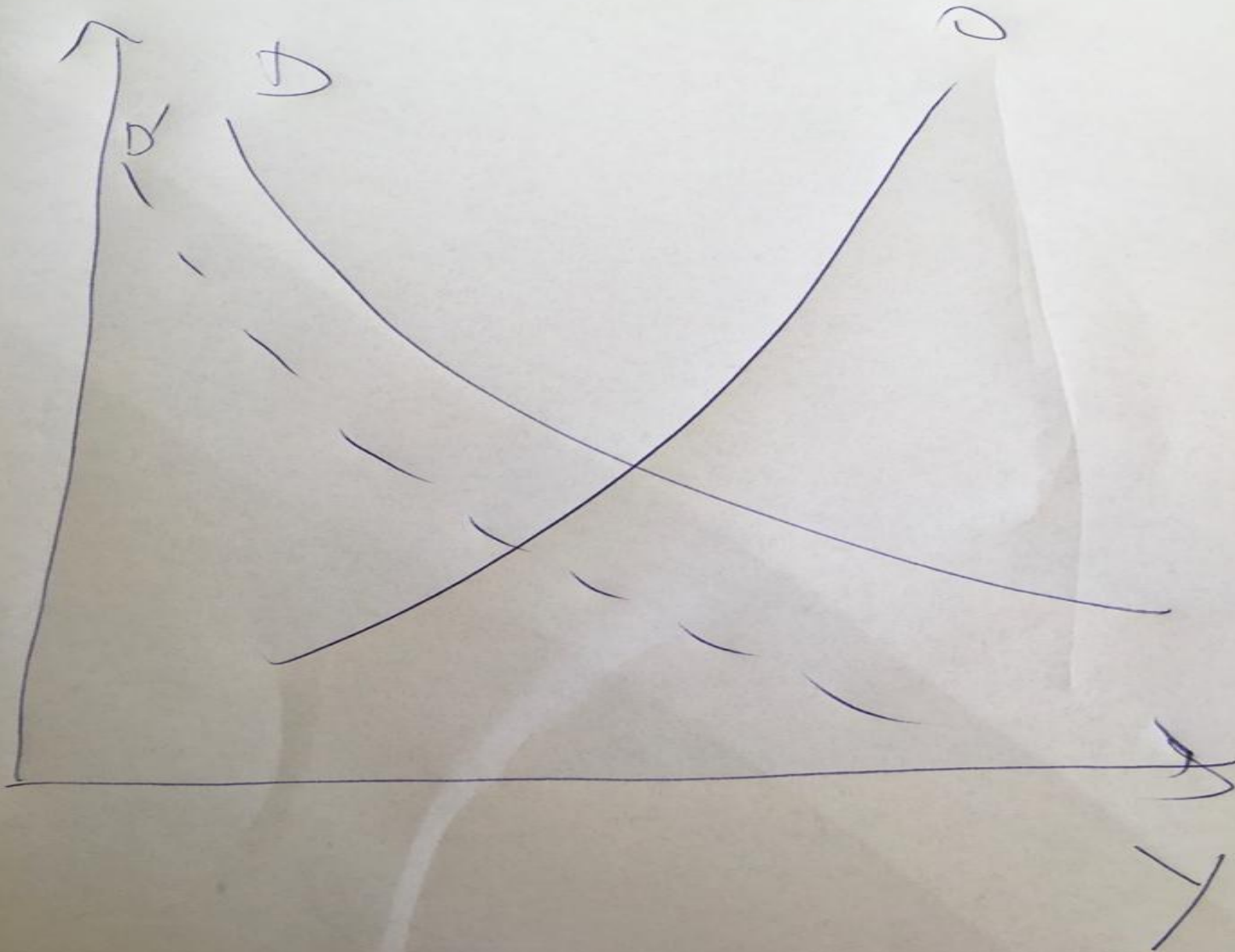
- Workers who lose jobs from closing businesses do not have an income anymore and therefore lower consumption, eventually depressing aggregate demand.



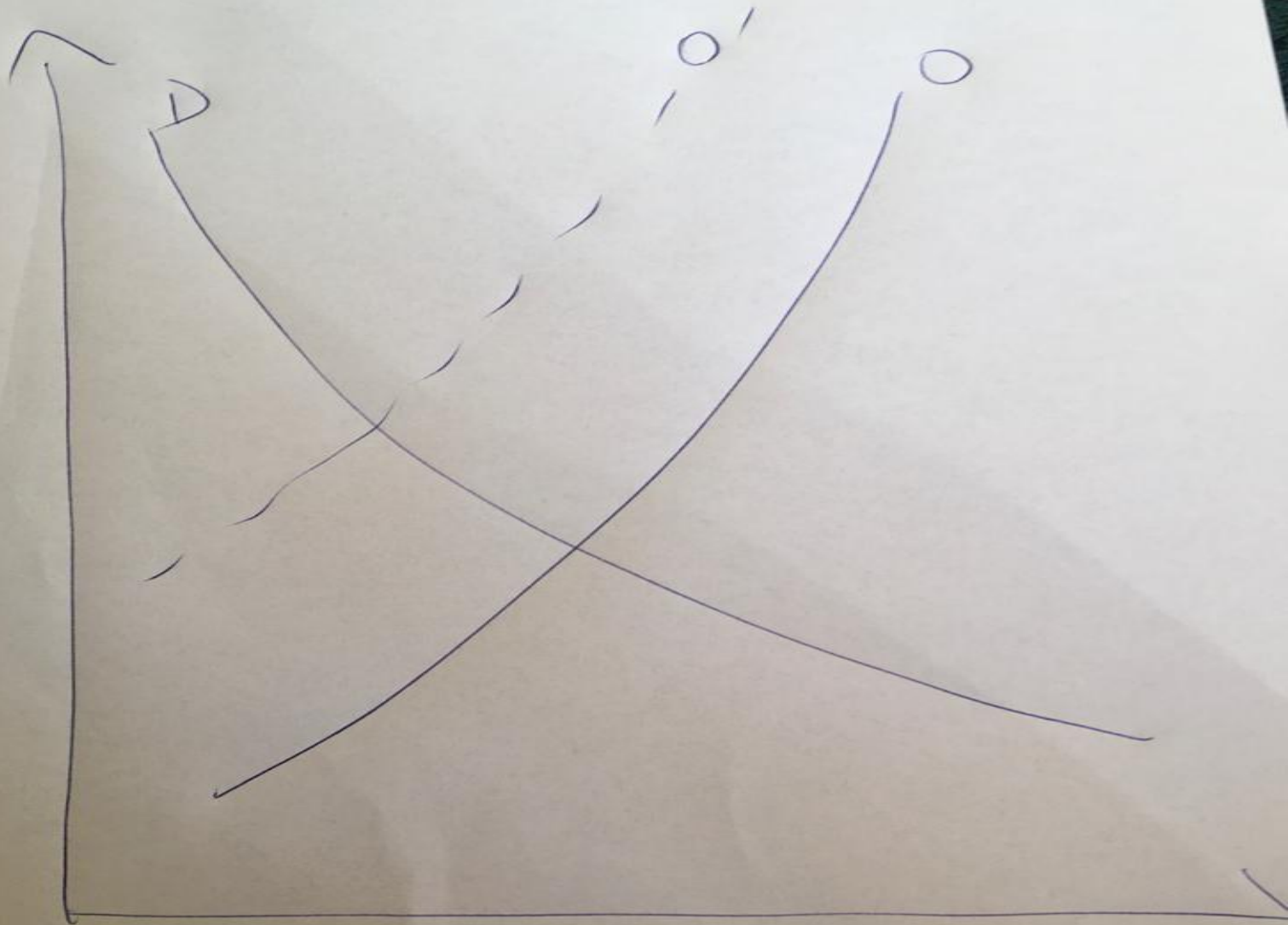
The destruction of economic surplus

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)





- Demand shock:
- Origin in industries where consumption is associated to group presence (tourism, events, restaurants, transportation)
- The fall in demand in these industries propagates to other industries with a negative Keynes multiplier



- Supply shock ?
- Not much since goods can travel also without human beings (containers, planes)...but in part require human beings (van, camions)..the case of Fondi red zone
- A market failure puzzle. Why supply of sanitary masks is scarce in spite of huge demand ? The need of not delocalizing strategic productions

The macroeconomic response

- Symmetric, temporary (how long?) shock not depending on lack of discipline of domestic macroeconomic policies... it requires a 3T (Timely, targeted, temporary) response (Blanchard)
- Recipe: «whatever it takes» expansionary monetary and fiscal policies
- Rationale: this crisis destroys value and money, Central Banks create money ex nihilo and fill the gap
- CBs are like Supermen and they kryptonite is inflation. In case of strong supply shocks expansionary monetary policy does not work

The EU response

- Fiscal stability pact suspended
- Countries are allowed to expand budget deficits as far as it is needed
- ECB monetary policies:
- 1100bln quantitative easing (purchase of EU member government bonds on the secondary market) (without share limits for single countries, Greek bonds included)
- Slow down of capital requirements for banks,
- Credit lines to banks at -.25 lending rate
- 8bln guarantess to SMEs
- Use of UE structural funds not used so far

- The real issue: how to sterilize expansionary fiscal policies in the medium run to avoid growth of debt and interest payments
- Coronavirus bonds ? Three more radical proposals

More radical proposals to «sterilyse» the effect of expansionary fiscal policies in the long run

- Helicopter drop of money

(money directly to the people not through banks. Pros: it replaces domestic fiscal policies that create extra debt. Cons: it is not high powered money)

Wyplosz plan: the extra debt created due to the Coronavirus crisis is purchased in the primary market by the ECB and transformed into a perpetual zero coupon bond (effect: zero extra debt payment in the medium run)

	Caratteristiche	Aumento deficit	Aumento/riduzione debito	Aumento/riduzione spesa interessi
Helicopter drop of money (with/without redistributive features)	CB money in the pockets	No	Neither increase, nor reduction	Neither increase, nor reduction
Quantitative Easing	CB purchase of government bonds on the secondary market	No	No	Reduction (proportional to new debt issues)
Wyplosz Plan	CB Purchase on primary market and transformation in zero interest rate perpetual (unredeemable) bonds	No	Reduction	Reduction
Titoli salute pubblica (italiani)	Domestic government bonds	Yes	Increase (even though it replaces the need of new issues)	Increase
Eurobond	Eu government bonds	No	No	Neither increase

How to interpret the different mechanisms

- In the short run
- Who pays cash and who receives a subsidy
- Who lends and who borrows
- Effects on money balances

- In the long run
- How debt and interest payments vary for the different players

Fiscal response in Italy

- Citizens income
- Wage integration for all categories of workers who are laid off
- Suspension of interest payment on mortgages and loans
- Parental leave subsidy
- 600 euro bonus for self-employed
- Guarantee fund at 90% for loans to SMEs
- Tax credit for corporate rent expenditures
- A key issue for Italy: who pays in the medium run the intervention (extra debt/GDP ratios produces higher interest expenditure in the future)

Liquidity channels to address the lockdown economic shock

- ECB lends to banks (at negative rate $-.25$), banks to companies (liquidity loan)
- Companies transfer cash to workers (layoff transfers, parental leave, quarantine leave, parental sickness leave) financed by the government
- The government transfers cash to workers (self-employed bonus) and companies (bonus for net sales loss?), however increasing deficit and debt and issuing new government bonds to finance it (enjoying the lower interest rates due to Quantitative Easing)
- Guarantee fund (fondo PMI, fondo CdP, fondo EU) reduces the risk of lending for lenders
- Banks transfer cash to citizens and companies with moratorium on loan and mortgage instalments
- ECB soften capital requirement on banks to avoid a Non Performing Loan crisis
- ECB transfers directly cash to households (progressive helicopter drop of money as in the US)
- EU transfers cash to regions unlocking the use of Structural Funds
- ...the problem of irregular workers not covered by most of these measures (except Helicopter drop of money)

Fiscal response in Italy

- A limit: no targeted intervention for companies who report a drop in net sales but do not want to layoff workers
- The paradox: the fiscal stimulus helps only in case of failure and does not support recovery....
-If a company want to recover it needs all its workers

An hypothesis: the link between Coronavirus and pollution

- Around 200 deaths per day due to pollution in Italy....
- Almost 50% percent of affected are in Lombardy and most of them in Pianura padana, an area with very high Pm10 concentration...(similar characteristics to Hubei and Qom)
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Relational goods

	Rivalrous	Non rivalrous	
Excludable	Private goods	Common goods	
Non excludable	Cultural goods, patents	Public goods	

Relational goods are local public goods: anti-rivalrous, locally excludable

Their production function is the encounter...

Relational goods

- Local public goods: anti-rival, not excludable
- The meeting is the production function....
- Three types of meetings and their value
 1. Face-to-face meeting without physical distance (100)
 2. Face-to-face meeting at physical distance (GoToMeeting, Zoom, ecc.) (70)
 3. Non face-to-face meeting at physical distance (10)
- The problem with 2 and 3 (especially with 3) is lack of non verbal communication

The Coronavirus crisis is a giant smart work exercise ...

- Non contemporaneity of time and space in the encounter makes us «richer of time»...
- ...at the cost of «poorer» quality of encounters
- Saving of commuting time (which negatively affects life satisfaction)
- Reduced exposure to pandemic shocks
- Lower pollution and higher environmental sustainability
- Higher work-life balance
- Policy suggestion: much more smart work after Coronavirus and capacity to maintain the online abilities acquired in times of crisis

	Time simultaneity	Space compresence	Time richness (worklife balance)	Quality of encounter	Environm ental sustainabi lity	Permission in times of Coronavirus
Face-to-face meeting without physical distance	Yes	Yes	Low	High	Low	No
Face-to-face meeting at physical distance (GoToMeeting, Zoom, ecc.)	Yes	No	Medium	Medium	High	Yes
Non face-to-face meeting at physical distance	No	No	High	Low	High	Yes

Coronavirus and subjective wellbeing

- Adam Smith's «Fellow feeling»: quality of relationship higher when living together intense emotion in positive or negative circumstances
- Paradox of human relationships: they become more intense during Coronavirus crisis in spite of physical distance
- The generativity challenge in times of Coronavirus
- The paralympic approach is fundamental: a constraint is not a limit but a lever....doing the best given your constraint

- We are searching for solutions addressing at the same time in a positive way creation of economic value, environmental sustainability, health, work-life balance, life satisfaction, reduction of exposure to global shocks...
- COVID-19 suggests....
- «It is the smart work stupid !»

Art.1 del futuro L'Italia è una repubblica democratica fondata su una combinazione armonica del tempo dei propri cittadini tra lavoro, formazione permanente, cura interpersonale e tempo libero





Gli smart worker sono più soddisfatti...

(% di lavoratori su campione rappresentativo Indagine osservatorio smart working*)



* Le percentuali si basano sulla rilevazione di un campione di 1000 lavoratori rappresentativo della popolazione di impiegati, quadri e dirigenti che lavorano in organizzazioni con almeno 10 addetti.
Fonte: elaborazioni Centro Studi Confindustria su dati Osservatorio smart working Politecnico di Milano.

Secondo gli ultimi dati dell'[Indagine Confindustria sul lavoro](#), nel 2019 quasi un'azienda associata su 10 (8,9%) ha offerto forme di "lavoro agile", ovvero modalità di svolgimento del lavoro flessibili in termini di orario e luogo. Si stima che un altro 10% di aziende, pur non avendolo ancora introdotto, consideri il lavoro agile un tema interessante da affrontare.

La diffusione del cosiddetto smart working è mediamente più ampia nei servizi che nell'industria al netto delle costruzioni (11% rispetto a 8,0%) e nelle imprese più grandi, tra queste quasi 1 su 5 prevede tale modalità di lavoro. Nel campione di imprese che hanno partecipato all'Indagine sia nel 2018 sia nel 2019, la diffusione dello smart working risulta in forte aumento in tutte le classi dimensionali e nell'industria, pressoché stabile nei servizi.

Our first proposal

- Compulsory higher smart work in schools, universities, public administration to maintain the abilities learned during the COVID-19 phase....
- accompanied by investment to reduce digital divide

Our second proposal

- Tax free zone for green investment in areas most hit by the shock and with highest level of fine particulate matter
- Four (five) goals with one measure: economic recovery, ecological transition, resilience to shocks, health (and work life balance)

Il grafico sottostante evidenzia una relazione lineare ($R^2=0,98$), raggruppando le Province in 5 classi sulla base del numero di casi infetti (in scala logaritmica: log contagiati), in relazione ai superamenti del limite delle concentrazioni di PM_{10} per ognuna delle 5 classi di Province (media per classe: media n° superamenti lim PM_{10} /n° centraline Prov.) (**Figura 1**)

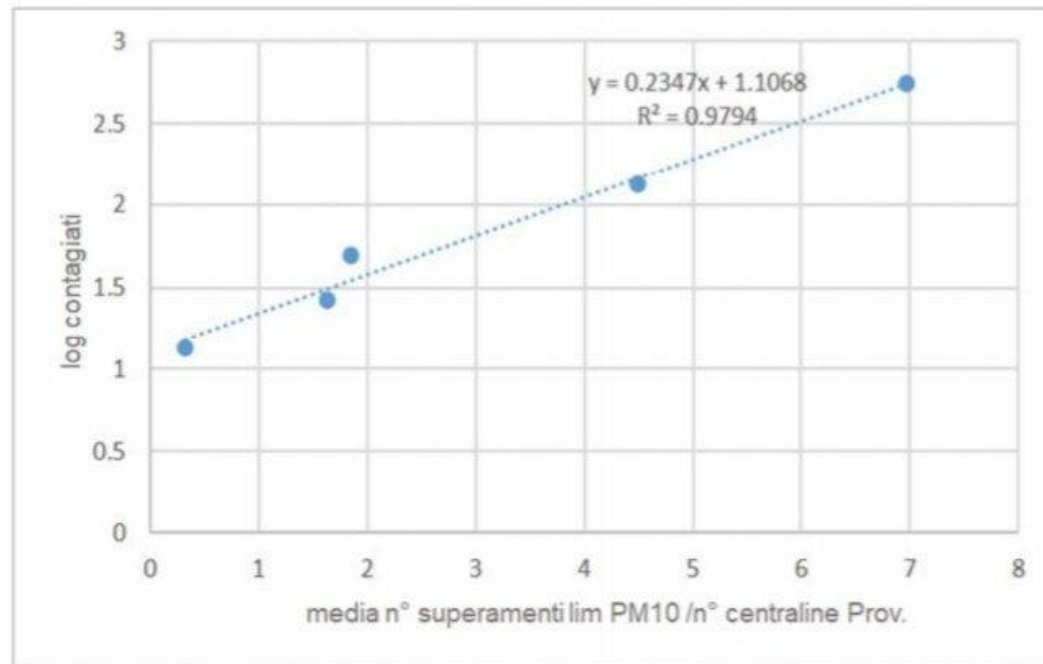


Figura 1

Tale analisi sembra indicare una relazione diretta tra il numero di casi di COVID-19 e lo stato di inquinamento da PM₁₀ dei territori, coerentemente con quanto ormai ben descritto dalla più recente letteratura scientifica per altre infezioni virali.

La relazione tra i casi di COVID-19 e PM₁₀ suggerisce un'interessante riflessione sul fatto che la concentrazione dei maggiori focolai si è registrata proprio in Pianura Padana mentre minori casi di infezione si sono registrati in altre zone d'Italia (**Figura 2**).

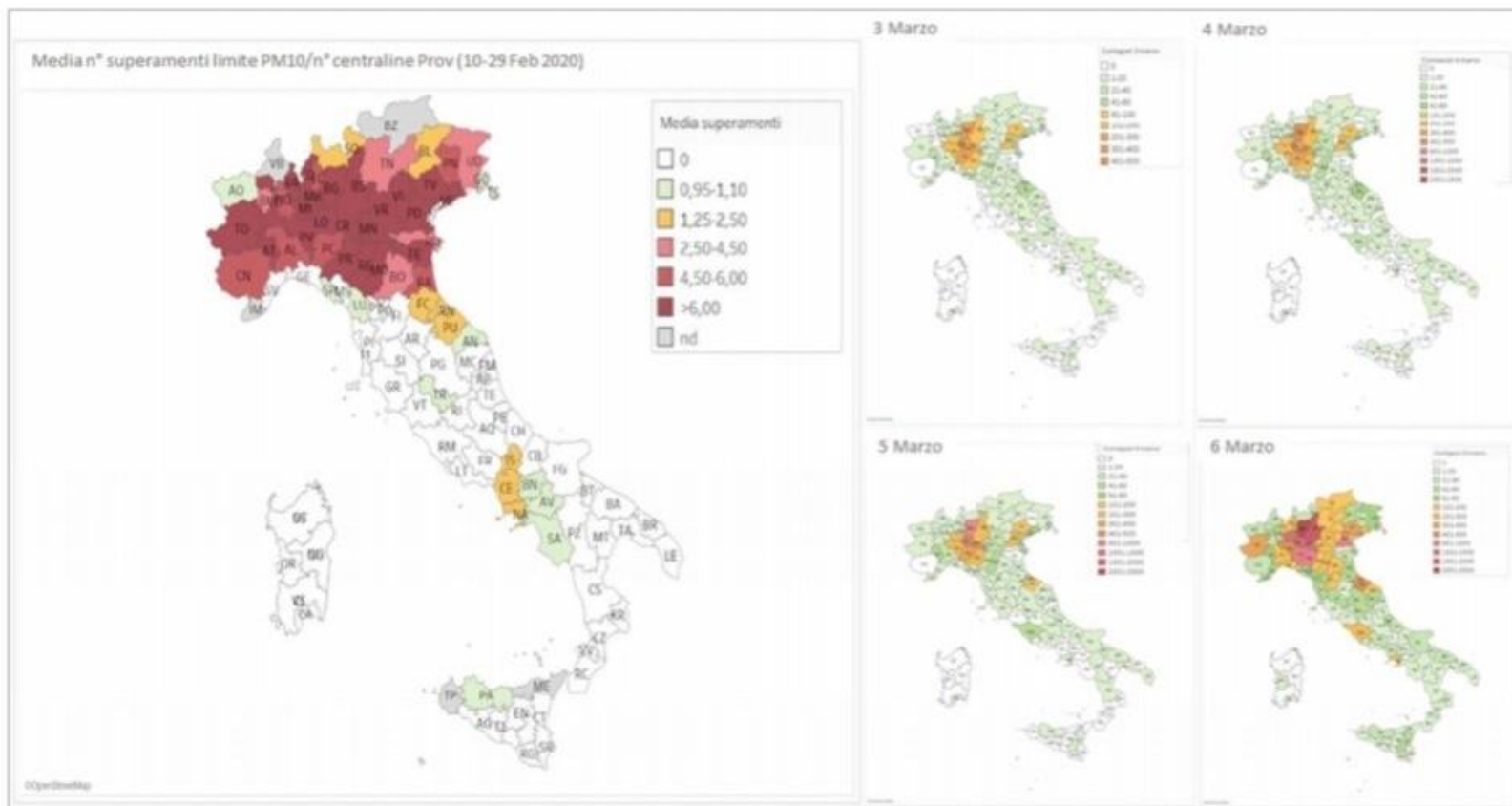


Figura 2