Ten Moments of Truths for the Covid-19 Crisis

Authors

Jacques Bughin
Solvay Brussels School of Economics and Management, Université Libre de Bruxelles,
iCite – email : : bughinjacquesrenejean@gmail.com

iCite Working Paper 2020-040

Ten moments of truths for the Covid-19 crisis

Dr Jacques Bughin[1]

INTRODUCTION

The Covid-19 virus went officially recognized by the end of December, when a Wuhan hospital admitted four individuals with respiratory symptoms from its Seafood market. It has made global headlines ever since.

Chinese authorities acknowledged human transmissions of the disease a few weeks later. Contamination cases climbed from 270 by January 2020 to about 50,000 in the Hubei province, three weeks later—a multiplier of 200. Covid-19 has now been spreading across all continents, affecting 215 countries. The virus on the verge to claim 500,000 official deaths by end of June 2020, among 10 million records of infections.

Viruses are part of our life, but some have been mutating into pandemics with exponential attack on human society and with major societal disruptions. The plague of Athens caused by typhus about 430 years BCE led to the fall of the Golden Age of Athens. The Antonin Plague (at about 180 years CE), caused by measles or smallpox, devastated the Roman Empire (Hurbin, 2011). Not far away from us, the Spanish Influenza broke out by 1918, and killed between 40-70 million people worldwide in 10 months, before retracting. Only regions with active measures to protect the population escaped the large recession that the influenza entailed (Correia et al, 2020).

---

[1] The author is the CEO of MachaonAdvisory, an advisory boutique in strategy and economic policy matters, and is also affiliated with the Solvay Business School, Free University of Brussels, an advisor to the Portulans Institute and to the G20-Y, as well a board member of different ventures, including FortinoCapital and Antler. He is retired from being a Director of the McKinsey Global Institute, and a senior partner at McKinsey&Company. This article is his own view-and any error is his own.

Closer to us, HIV in the eighties made significant casualties. If antiretroviral drugs were eventually found to contain the lethal attack, more than 20 million people out of 40 million HIV sufferers have passed away in 20 years according to UNAIDS. HIV is still the main cause of active population death in some sub-Saharan countries such as Zimbabwe or South Afrika, preventing their economic take off (Mboup et alii, 2006).

Covid-19 has joined the club of exceptional outbreaks, and is becoming the 7th case of a virus with excess mortality rate above 0,1% since the 17th century according to the WHO (Table 1). Notably, it is already reaching the death toll of the 1957 H2N2 in the US,- and may have boosted the world death rate by about 25% in the recent six months.

"Notably, Covid-19 is already reaching the death toll of the 1957 H2N2 in the US"

Table 1 : High level influenza driven fatalities, estimates

Year	Virus	USA	Worldwide
1918	H1N1	between 500k to 1 million	between 40 million to 70 million
1957	H2N2	150,000	> 2 million
1968	H3N2	70,000	> 2 million
2009	H1N1	15,000	300,000
2020	Covid 19	125,000	500,000 (by june ended)

For reference:

Traditional flu		30,000 to 80,000	300,000 to 700,000

Source : Author's own computation based on WHO, Lancet, Wikipedia, CDC

Note: Numbers readjusted to current 2019 population, as per IMF data

Economic consequences have also been visible. Stock recovered a large part of their fall by now, thanks to announcements of various stimulus plans by the largest economies. But stock markets original reaction was first to lose US 6 trillion of value by end of February 2020 when markets came to realize that the Chinese outbreak was morphing into a global pandemic. The market dropped by about 10% in a matter of days, versus a matter of weeks for other

pandemics- eg SRAS put S&P 500 down by 7 % on more than 30 sessions. March 16, 2020 even saw the Dow Jones drop by close to 3000 points, the largest fall ever in history (Avalos, and Zakrajsek, 2020).

Regarding the real economy, multiple estimates have been converging to a potential contraction of 5% of worldwide GDP for the year 2020. The « Great lockdown » (as coined by the IMF) became the mainstream response of countries to flatten the diffusion pace of the disease, by means of imposing social distancing. It led to a shrinkage of more than 10% of worldwide output in first semester of the year- with some economists calling it the largest (yet voluntary) contraction of our economies since the 1929 Great Depression (Lipton and Prado, 2020).

At current, the jury is still out whether the battle is won, and whether the virus is on the verge of global retreat. On the positive side, health systems of main developed countries are now able to breathe and have now enough capacity to support the severe cases of the disease. Major economies are slowly exiting the lockdown and at least the stock exchange may seem to believe into a "V"-like rebound.

But the « uncomfortable truth » is that the virus continues to spread. The virus is now hitting many developing countries with more fragile populations and heatlhcare systems. The recent days have witnessed the largest absolute increase in number of infected worldwide, on top of new clusters forming in regions otherwise under control such as in Pekin (China), in multiple regions of Germany, or in many counties of the US.

The odds of a second wave remain high statistically, as the containment achieved by many countries has happened at level of contagion an order of magnitude lower than the level estimated to guarantee herd immunity. Worse, when wave 2 happens, history also teaches us that the wave comes often only a few months after the first, breaking the momentum of socio-economic recovery-,and killing a multiple (4-5 times) of the first wave, --as if the virus was taking a revenge (Helferty et al, 2010).

« *As a guide, history teaches us that the second wave hits only a few months after the first, breaking the momentum of socio-economic recovery-,and killing a multiple (4-5 times) of the first wave* »

The reality is that the war against covid is far from over. First, we must keep our eyes on the ball in order to win the war against the worldwide diffusion of covid-19. And we must go beyond protection strategies to act upon more complex and longer term effects arising from

covid, so as to define a better « new normal ». Hereafter, we propose a list of overlooked issues, (with solution space illustrations) -, that could serve as a priority agenda. We think of them as « moments of truth »-- as success of failure to fix them will define whether we have win or lost the war linked to the coronavirus crisis.

The list is evidently not exhaustive. It is mainly the result of lots of exchanges and discussions with academics, businesses, government officials around the world, regarding the « uncomfortable truth » that the covid-19 crisis does not stop with lockdown exit. We are at the time where leadership is badly needed to continue and shape our covid-19 future.

THE TEN MOMENTS OF TRUTH

<u>Theme 1 : Reconciling health and wealth</u>

1. **Crushing the Covid-19 diffusion curve beyond total lockdown**

Background. Severe lockdown has been the rule in many countries since a series of radical actions were implemented in January of this year by China at the epicenter of the covid-19 spread. (Wang, et al. 2020)[2].

Lockdowns have been rather effective (Alvarez et al, 2020). Countries examples demonstrate drastic reduction (up to 90%) of contacts. Yet they also have brought a significant toll to citizens. As countries are now exiting, and bursts of infection re-emerge, re-imposing a full blancket lockdown strategy is likely to be challenging, with risk of social unrest. One thus needs to enlarge the set of tricks to continue to manage the curve of the disease.

> **« Re-imposing a full blancket lockdown strategy is likely to be challenging, with risk of social unrest ».**

Issue. But how large is the potential diffusion of the pandemic in the first place, and what are the different alternative levers to blanket lockdown to play to further control the virus ?   So far, the (adequate) focus has been on assessing the level of sustained transmission, the so-called $R_0 = b_0.n./y$. In the seminal contribution by Kermack and McKendrick (1927), where all contacts have same probability to infect third parties, b_0 is known at the rate of effective transmission

---

[2] On 1 January, the Hunan Seafood Wholesale Market was closed in the hope of eliminating zoonotic source of the virus. On 11 January, reverse transcription-polymerase chain reaction (RT-PCR) agents were developed to trace the infection. Ten days later, the Emergency Response System was activated and intensive surveillance and isolation of suspect cases started aggressively. School and work were suspended. Close ties to infected received medical observation and quarantine for 14 days. Travel from and to Wuhan City as well as other medium-sized cities in Hubei Province went to be restricted

per contact between the infected and the susceptible. y is the rate at which infected individuals recover, and n is the number of contagious contacts.

The implied law of motion of infected through times t, I_t-I_{t-1}, is guided by I_t-I_{t-1} = b_0.n. I.S.-y I. When this becomes negative, transmission is under control, and the epidemy is on the verge of dying out. In the case of the covid-19, the median of studies suggests that R_0=2,5, with b_0=0,3 and y = 0,12 (Arroyo et al., 2020). The implied covid-19 peak will happen at $1-(1/R_0)$= 60%, and the final portion of affected $R(\infty) = 1/R0* \ln[1-R(\infty)]$ would be then be 85% of the worldwide population .

The above predictions regarding the spread of the disease are likely extreme. One reason is that n is not constant (Eksin, 2019). People have been adapting their behaviors as a function of their perceived risk of the disease. Eg for work, we have witnessed the emergence of teleworking; or for daily activities, a large set of people have adopted practices of self quarantine when getting infected, (or wearing masks and washing hands as protective practices). In general contact rates for non infected individuals have decreased by 30 to 40% during period of large influenza (Caley, et al 2008).

The second reason is that the prediction above assumes that everyone mixes—and everyone is equally susceptible to transmit the disease. If the heterogeneity in the ability to infect is large, the outbreak may actually weaken as the strength of the influence may be lower at some points of the diffusion. Measles infection for example behaves like a Pareto distribution (Lloyd Smith et al, *2005*). 20% of infected contributed 85% of the disease spread for SARS, while the figure is up to 95% for HIV. The distribution is more equal for smallpox (top 20%=60%) and for Ebola (top 20%= 35%). A distribution such as the one observed for Measles will thus have half the number of infected cases of one pandemic which behaves more like Ebola.

There is yet to be an consensus on the actual distribution of the covid 19 contagion "Superspreading events" such as the outbreak in a dormitory for migrant workers in Singapore which affected 800 cases; or hundreds of cases being contaminated by after-ski parties in restaurants at Ischgl in the Austrian province of Tyrol may suggest that the covid-19 ability to spread is rather skewed. If true, an effective strategy already followed by many governements is to limit superspreading events. If not true, the cancellation of superspreading events is not sufficient.

Solution space. The good news is that comparing the history of models prediction and actual pandemic cases looks like models may be painting a picture that is 5 to 10 times bleaker than

what happens in reality[3]. But still, for covid-19, this boils down to *tens of millions infected, and up to 5 millions fatalities*.

One must weight in on incentivize citizens towards a culture of systematic reduction of their contacts, and towards a culture of protection.   Positive incentive programme for social distancing is an opportunity which has been rarely done in practice so far. This may include protection training in exchange of days worked, this could be tax incentive for people to self isolate, among others. It is also important to segment the population in terms of their social behavior and risk in order to refine models of protection that are not as drastic of a full lockdown. In practice, a model that uses self quarantines of the most at risk segments, rather than pure full banket lockdown may be much more powerful to reconcile health and wealth, and a fortiori in developing countries where the population is young and fragile financially.

Theme 2 : How do we build a more comprehensive view of health matters linked to Covid 19.

Background. Despite thousands of research, and data collection, the epidemiology of the Covid-19 virus has yet to be fully understood.

One crucial question for example is *how fast the virus mutates*. If this is slow, this is a good news for getting an effective vaccine, but the reverse may just be as much true, - in which case, vaccines will be challenging. Another crucial question is whether *immunity builds up and for how long*. One possibility could be that covid 19 behaves like the common cold HCov-0C43, with fast decay of immunity, disappearing in 4 to 6 months. This might increase the occurrence of a second wave soon. Evidenlty, one might imagine the other extreme that the virus behaves more like the SarS-Cov-1, with range of immuntiy of 1,5 to 3 years—in which case, time may be on our side.

Beyond those unknowns, it is also crucial to have the right statistics to adequately fight the disease. Relying on current official statistics to derive recommandations for health purpose may be biased, at worst, wrong.

> *« Covid 19 fatalities skyrocketted to 50% of the hosts in home care where the virus managed to enter, as a result of authorities overlooking protective actions for the elderly ».*

---

[3] As an example, assume covid-19 hits the benchmarks of 40% intentional reduction in infectious contacts, and the distribution is skewed like SARS, then herd immunity falls down to about 10-15%, or 5 times lower than anticipated by original model.

As an example, focusing on hospitalizations,- the channel by which the most severe cases of pandemics would concentrate-, has been a wise strategy in absence of pervasive data, except that it led many countries to overlook elderlies in home care. Fatality rates were close to 50% of the hosts in homes where the virus managed to enter. Other important issues are as follows

2. Managing by knowing- how many are infected ?

Issue. Without pervasive testing, it is rather impossible to know how many people have been contaminated. In last 3 months, the scale of testing moved from just above 1% of population to roughly 9% by end of June. This is a large progress, but clearly insufficient - and scaling is costly and takes time.

Yet, we need to know more. Contrary to SRAS for example, infection bycovid-19 has 5 days latency *before* symptoms are visible, favoring large contamination. Further, symptoms like fever may remain mild, limiting fast actions, and worse, a large part, possibly more than 50% of cases, may be asymptomatic[4].

The converging wisdom is that possibly 5-10 times more people are affected and not officially reported (Li et al, 2020). This understatement of cases also implies that the official peak of the disease is felt to be earlier than the real peak as the stock of infected that drives the dynamics of new cases is higher than officially reported. The risk is thus to be taken off-guard, and allows for a second (possibly, more lethal) wave to happen.

« *The wisdom is that possibly 5-10 times more people are affected by covid-19 and not officially reported* »

Solution space. The solution to the above problem is to trace and test people as quicky and as effectively as possible. Scaling can be circumvented by group testing. The idea amounts to pooling samples into groups and to evaluating those pools for the coronavirus rather than individuals, with fewer tests being required. Such strategy is now new, and proved effective to detect HIV, or malaria [5] (Gollier and Gosner, 2020). Tracing is another route, as tests specificity has improved significantly since the start of the pandemic. If the drawback is privacy, this can be circumvented. First, the virus is highly contagious, so there is a large negative externality that the planner of the economy must internalize, and possibly impose to some extent to citizens . Second,

---

[4] As a case in point, the village of Vo Eugeno in Italy, where patient zero has been assumed to live, has decided to test its 3000 inhabitants after full lockdown- with more than 50% of cases asymptomatic, or two times more than in the case of a typical flu. This matches the 52% of asymptomatic cases found out of the 94% tested on board of the Princess Cruise ship.

[5] https://www.webmd.com/lung/news/20200514/group-screening-could-help-covid-19-test-shortages

data can be anonymized, and a civil society governance model can be imposed by which the state has no access and right to the data per se.

> « ***Scaling can be circumvented by group testing, with fewer tests being required. Such strategy is now new, and proved effective to detect HIV, or malaria*** »

3. Managing the journey of infection

Issue. At current, a large focus has been on health-serious cases in the covid-19 crisis. The rough picture is one where 50% of cases are asymptomatic, (with virtually zero risk of fatalities), 40% of mild symptomatic cases, who can heal after a few weeks at home, and 10% of more severe cases requiring hospitalization.[6]

This funnel implies that the fatality distribution is rather skewed. But this raises two questions— why do some people health start to worsen and turn their mild symptoms into a severe issue ? The number od cases is overloooked today, but is significant. *10-15% of mild cases can turn bad*, according to recent research by the WHO (Heymann and Shindo, 2020). The second question is whether recovered people are de facto all « fit and proper ». What if among the 5 million recovered people (and possibly 50 million people if we account for the non reported cases), recovery is not complete ? Those risks are not nil.

In fact, the history provides some clear evidence of short and long-term damages. Regarding short-term damages, more than one third of people who got hospitalized for the 2003 SARS outbreak felt anxiety and depression disorders, still one year after the infection (Lee et al, 2007). Likewise, if pneumony is a marker for covid-19, there is *four times* more probability to suffer a cardiovascular disease, for those getting hospitalized for acute pneumonia than not.

Long term effects may be present too. Studies looking at in utero reaction of to be born kids from parents caught into the 1918 pandemics suggests large morbidity effects still present *25 to 40 years after*, affecting lung, kidney, and many other organs, with further negative impact on productive and social life (Almond, 2005 and 2006, and Mazunder et al., 2010).

> « ***To be born kids from parents caught into the 1918 pandemics still suffer large morbidity effects 25 to 40 years after*** »

---

[6] With hospitalizations, a dominant part (> 50%), must be placed in ICU and on respirators.

Solution space. The above calls for a much deeper look at the funnel of contagion. Best practices include Germany where midly contaminated people were called by authorities to check about evolution of their symptoms during their home quarantine. This allowed to spot worrying trends of health degradation and send people much faster to hospital in order to preempt late handling.

Regarding recovery, it is advisable to build a care protocol for symptom persistence. Those protocols may take an holistic approach incorporating respiratory rehabilitation, physiotherapy and nutritional advice, as well as mental health as the best bet to avoid lasting unwell being.

4. Preventing the crowd out of other health needs

Issue. The covid-19 pandemic and its associated lockdown, has likely pushed people not to seek support for major other health problems.

In France, for instance, the number of new diagnosed cases of cancer fell by 50%. There were twice more cardiac accidents per inhabitant outside hospitals during the lockdown, and twice more deadly outcomes. Consequences can be large- for instance, the above suggests for cancer alone that 30,000 cases were not spotted during a period of 3 months in France. As any month of delay in diagnosis leads to 5-20% decline in survival, this may mean 10,000 deaths in the making, versus 30,000 people passing away from the coronavirus In the country.

Solution space. The solution includes a strategy to reduce the risk to consult for life threatening pathologies during covid time. Israel realized this early, and actually sent covid patients not in hospitals, but in secure high quality hotels, as the capacity was idle during crisis, and high end hotels could be easily repurposed. The aim was not to mix covid population with other patients and with the idea to protect the healthcare providers in scarce supply for the health system.

« *One month of delay in cancer diagnosis observed in France leads to 5-20% decline in survival. Those are 10,000 deaths in the making, versus 30,000 people passing away from the coronavirus»* .

Theme 3 : wealth matters

Background. The importance of wealth matters has been very apparent since the containment debate. Witness a toll of 30 million people unemployed in the US, and a major fall in economic activity, never seen since the Great Depression. In China, for instance, industrial output fell in the first two months of 2020, by more than 13.5%, while investment fell 25% year-on-year (and 30% when it concerns infrastructure) ; consumer retail sales collapsed by 20%. Lockdown exit

allows to reboot the economies, but damages done can be irreversible. Let us remind that ten years after the sub-prime 2008 crisis and the Lehman Brothers bankruptcy, about 60% of countries in the world, still have an output trajectory below precrisis according to robust research by the IMF.

Also the economic context was mixed,- at time of when covid 19 started to invade our economies. Active population has been shrinking in developed countries, R&D returns are on the decline, China has become a major center of economic gravity, and inequality has increased within countries. Interest rates have moved down, and most of the stock markets boost can be traced to a few superstar sectors and firms, and share buybacks[7]. Productive investments and capital deepening have been weak.

5. Building enough of covid-resilient jobs

Issue. An important issue for our economies is job creation as most of citizens rely on them as their main source of income. Job creation was poor in many countries, and the emergence of automation and artificial intelligence technologies has led fear of a « workless future ». A large part of job creation was also low paid. Now, Covid-19 has added a new complexity to the picture, as a brutal shock to the economy and to the labor market.

Three critical elements stand out- the first is that many jobs have appeared non essential, the second is that many jobs can not be done remotely, and the third is that jobs at risk of covid may disporportionately be posiitvely correlated witg jobs at risk of automation.

Depending on the method used, up to *40-50%* of jobs could be labelled non essential jobs, that is jobs that we do not need necessarily to live with, during the transition time of the disease. Essential jobs, such as those fulfilled by healthcare professionals, or those related to logistic delivery or the food supply chain have also appeared to be not that well-paid. By difference, this also implies that non essential jobs may appear to be paid « enough ». Will this argument prevail that might then lead to a pressure on wages going forward ?

The second observation has been the rise of teleworking during the lockdown. Where productivity is solid, teleworking might become more of a base line- limiting unnecessary travel, pollution and office costs. Yet, teleworking is not pervasive- and economically possible for about 40% of workers, (Dingel and Neiman, 2020). Telework is especially less of a profitable

---

[7] In the US at least

strategy for low paid jobs, and jobs with lower level of education, raising the question of further job polarization in post covid economies.

The last observation is that job resilience diminishes : 40% of jobs in Europe and US will be facing replacement threats. A lot of jobs at risk linked to social distancing aspects of covid-19 ,are more likely to be jobs that arise in sectors and tasks that are at large risk of subsitution by automation and artificial intelligence tools. The odds of a job to face both concurrent risks is twice higher than the odd of facing only one risk . As the automation risk may come across the next 10 years, this raises the question whether jobs at risk of covid may trigger a speedier job destruction than planned.

« The odds of a job to face both covid-19 and automation risks is twice higher than the odd of facing only either one of both risks »

Putting all this together, the high-level picture of the future of work that seems to emerge is one of increased bifurcation. On one extreme, there is the happy few, eg less than 20% of workers who are in essential industries, where telework is possible and with enough good education and digital skills to operate in this new normal. On the other extreme, a segment of roughly the same size exists with limited teleworking ability, high risk of automation, and non essential jobs,-- and people with lower education, less secure jobs already today. In between, 60% of workers but with at least one challenge emerging for the occupation, -either risk of automation, a non-essential job, or still a jobs at risk of recession from covid, and lower teleworking ability.

Solution space. This acceleration is the bifurcation of jobs in the future leads to rising inequality, risk of populism, and in any case, will depress aggregate demand of economies. This calls for a much deeper analysis of the intersection of those new trends of future of work, and the development of models, that support the income of the most affected, as well as new models of accelerated training.

6. Promoting covid-safe firms (and countries)

Background. The flip side of what is a good job is what is a good firm. At the end, more than 8 out of 10 jobs are provided by companies or public agencies, and it is thus also critical to look at the effects of the pandemic on firms.

Those effects are not equally distributed. For instance, the Covid-19 shock is placing significant strains on corporates, with 50% of firms likely with insufficient cash to cover total debt servicing costs over the coming year, according to the BIS (Banerjee et al., 2020). Credit lines could

provide additional liquidity, but access is uneven, against high levered firms. Public sector and healthcare services, as essential sectors have been less hit than say, live entertainment, hospitalities, and restaurants, with up to 80% of their demand being knocked down. In the same way, the pandemic leads to supply chain disruption, which disproportionately affect companies exposed to globalisation. As an example, Dun & Bradstreet reported that million of companies around the world have a first and second tier supplier in the Hubei region, the center of outbreak of the covid-19.

*« **Million of companies around the world have a first and second tier supplier in the Hubei region***».*

Likewise, the institutional context may play a significant role as to the actual consequence of the pandemics. Comparing within each continent by march 2020, we could already see very different curses—by continent, Brazil exposure was bigger than, say, Colombia in Latam ; US was growing faster than Canada, while in Europe, Norway was expanding slowier than Italy

Issue. How do we make countries and firms more resilient to covid is thus of very high priority. Structural factors ultimately will affect how countries will come out from the Covid 19 crisis, across three domains : ability to control social contagion, exposure to fatality rate, and adequate management of the Covid 19 outbreak. Regarding social contagion, Asians do very well, with 82% of Chinese wearing masks during the Covid outbreaks ; Europe has been much less disciplined, and only in part because of lower availability of equipments[8]. Regarding outbreak managements, governements with a culture of coercitive measures and technology tracing are to be found again in Asia ; in contrast, the Anglo saxon and calvinistic cultures, such as found in the UK, US, or the Netherlands, have been much more loose in imposing social distancing restrictions. Regarding fatality rate, Europe has an ageing and old population; while Spain and Spain combine an old population with relatively high co-morbidities, and a lower quality of their hospital system versus the rest of the EU.

*« **Based on structural criteria, we have found that Brazil, as the most exposed country, is twice more at risk of large fatalities, than, best practice, Israel »***

Mixing all those criteria, we have found that Brazil, as the most exposed, is twice more at risk of large fatalites, than Israel, in our study (Bughin, 2020). Asia is only ok-ish, with Singapore

---

[8] On the other hand, the culture of protection is not only about wearing masks ; more Asian people tend to wash hands in their daily life than in Europe, for example. Gall up data and Eurostat surveys in Europe had shown that Italy have much more social contacts in daily life than say, in Finland, but also that only 57% of Italians wash their hands after going to toilets, for 76% in Finland

taking the lead. South Korea faces however old and co-morbid population. But a key message is not that are'nt born equal when it comes to their exposure to Covid 19. Some, even if at disadvantage, may compensate for them. Asia is a case in point of more *effective management of the crisis,* exploiting as well learning from past pandemic.

Zooming into the micro-view of companies, one obvious fact is that, on *average,* the adverse effects of severe pandemics such as the coronavirus, will be felt into corporate performance. Eg., return on assets and employment have been systematically lower for firms affected by pandemics than for firms insulated from the shocks of pandemics, in the year of the pandemic (Ma et al, 2020) . However, as a mirror to countries, the spread of performance following covid-19 seems to be larger *within* firms than within sectors or between countries. This mostly reflects difference in the resilience ability of those firms, extensively using business model innovations to rebound. One example is how some restaurants shifted their business models from diner place to home delivery as a way to rebuild their revenue, another one is how many new entrants have been aggressively entering the competition for innovative drugs as a solution to the covid-19 disease (Byan et al., 2020).

> ***« Significant performance difference is found within firms, that can be traced to the resilience ability through using business model innovations to rebound »***

Solution space. The above suggests that countries, with limited abilities in thier health systems must take the step to aggressively upgrade them—including the way to finance access to them. It shows as well the necessity to build a comprehensive masterplan for handling disease outbreak, so as to avoid deficiencies in supply chain, medical provisions, and for sharing best practices across countries. Regarding firms, this also calls to identifies fragile versus more resilient firms, -- first to anticipate risk of major layoffs, and bankrupticies, but second to anticipate best practice resilience as well as to design policies to facilitate smooth transition from the covid crisis.

7. Building a bold demand-led recovery multiplier

Background. The burden of the current crisis is not small. Only counting for lockdown in the US, average   income and wealth loss is more than 5000 US Dollars and 33,000 dollars respectively (Coibion et al, 2020).

Total burden may come to 5-10% of welfare lost, suggesting that a « V » recovery may be optimistic. A « U » shape may be a better representation, as seen from the early data of China, where economic recovery has been slow pace. Worse, a « L » shape is possibly not to be

neglected, both because of the risk of Wave 2 still this year, and because crises of that size may lead to major distorsions, affecting investments and ultimately growth path in the future.

Issue. Plans have been announced by a large set of countries to stimulate growth, and prevent the worst case of a « L- like » recovery. The key question remaining is thus : are they spending fast, big and smart enough?

Solution space. To date, at time of low interest rate, most countries have rightfully launched a major fiscal stimulus. This amounts to a range of 2,5% of GDP, on top of facilities of re-payment[9]. This amount of direct fiscal spent concerns money at work today, but commitment is higher. Further the figure is already higher than during the crisis 2008 (eg., the G-20 spent roughly 1,4% of GDP in stimulus package).

> *« 2,5% of GDP is currently put at work for fiscal policies, or twice the figure of spent during the crisis 2009. Still, there are some surprises. Germany intends to spend more than 13% of its GDP, while some other will do withmuch less than 2%, like Belgium and Hungary ».*

Some surprises are nevertheless visible[10] . Germany intends to spend more than 13% of its GDP, while some countries much less than 2%, like Belgium and Hungary.

Further, there is a question whether 2% is bold enough : estimating the multiplier effect of the additional spent of 2%, the push to GDP will be for 5 years at about 3,6%, (or a multiplier of 1.5), an impetus that is likely to be below the average risk of output contraction for covid 19 dring 2020. Finally, a lot of spent concerns policies, like CARES, of the rescue, versus recovery type. Solutions must however not only focus on rescue, but favor reallocation of resources toward fast and appropriate recovery. As example, the EU Recovery plan initially proposed by the Franco-German team of a €500 billion of spending could be jointly spent on key forward looking infrastructures in sustainability, new investment in frontier technologies, among others.

Theme 3 : Other SDG matters

---

[9] The later is de facto crucial as the OECD, leveraging Orbis data, finds that 1/3 of firms may run out of liquidity after after three months of lockdown. This liquidity crunch is thus massive and must be sorted out clearly (OECD, 2020)
[10] Data collection on extent of commitment is eg done by Bruegel, see https://www.bruegel.org/publications/datasets/covid-national-dataset/

Background. The 2030 Agenda for Sustainable Development, adopted by all United Nations Member States in 2015, have provided a blueprint composed of 17 Sustainable Development Goals (SDGs),to build prosperity and well-being, of which health and wealth are core, but not unique components.

The blueprint is an essential framework by which one may check if we are sufficiently comprehensive in actions related to covid and post-covid time. Herewith, we cover essentially the interactions between covid and three SDGs. We look at SDG 9 on innovation- as covid 19 is possibly an important catalyst for digitization and sustainability : at SDG 16 regarding strong institutions,- as Covid 19 may be the time for good or bad change in socio-politics ; and finally,at SDG 10 on inclusive growth, as one important learning on pandemic is that inclusivity is often weakened, bearing negatively on the potential of prosperity recovery in the future.

8. Scaling (both digital and green) frontier technologies

Digital : Background. Leveraging frontier technology for digitial transformations has been notoriously complex, and slow to deliver the expected returns for many companies (Bughin et al, 2019). As the joke « *who has led your digital transformation ? (answer : not my CEO, not my CDO, but Covid-19)* » alludes to, the Covid-19 crisis has pushed companies to double down on digitization as a mean to replace physical by digital interactions.

> *« Who has led your digital transformation ? (answer : not my CEO, not my CDO, but Covid-19) »*

Figures in this matter can be striking, especially when lockdown has been strict and prolonged like in France for example. For essential goods and services, online doubled its share during lockdown (eg from 3 to 6% of supermarket sales). For non essential goods, the online share of expenditures has skyrocketted, eg in beauty products and personal care, from less than 5% before containment to 75% during the lockdown in France (Bounie, et al, 2020).   Other benefits of digital include e.g. *the mean to timely and accurately trace the disease* (as mostly done in some Asian countries rather successfully for the covid-19 [11] and leveraging their own fruitful experience of tracing previous virus attacks [12] (Akhtar, et al. 2019)) ; or the *build up of predictive tools* of treatment against the covid 19. As an example, digital machine learning tools have identified by February 2020 multiple rheumatoid arthritis treatments as being

---

[11]   See https://www.linkedin.com/pulse/europe-should-play-asian-smart-route-control-covid-19-jacques-bughin/

[12] This is not exclusive to covid-19, as nowcasting was successfully used during the 2015 Zika virus, or even for the flu.

powerfully repurposed for treating the virus. Such type of drugs have been recently confirmed as effective in random health trials by end of April, or two months later**.**

Issue. If digital technologies are no question powerful to handle the covid crisis, the key issue remains whether one can truly scale its use, and reach the minimum mass to make them highly effective. A case in point is the digital testing and tracking tool which is especially useful when 50% of citizens are using the tools. Such a penetration is in practice not easy to achieve, if left at the entire discretion of the user. Even in countries promoting digital tracking, the adoption rate was 40% in Iceland, and just above 20% in Singapore or Israel.   Another example is the use of teleworking technology. While used as de facto platform of workers interactions, teleworking was usually used by less than 30% of employees in countries such as US or Japan, and half of them only had done it for one day a work week.

« Digital tracing tools must reach above 50% of citizens, -in practice not easy to achieve, if left at the entire discretion of the user. Even in countries promoting digital tracking, the adoption rate to date has been 40% in Iceland, and just above 20% in Singapore or Israel ».

Solution space. There is possibly no way back to use digital tools, as many consumers or workers have now passed the hurdle to be familiar with the technologies. However, the power of digital lies as well in more complex use cases like tracing. One way to make this reach critical mass is to ensure usability, and behavioral economics to induce broader reach and usage.

One complaint has been that tracing may not be that effective—to circumvent this, South Korea cleverly has been mashing up multiple sources of data such as mobile geolocation, credit card data, video facial recognition, to better predict the risk of transmission for each person. For even more tracing underground and in offices, Google and Apple have been proposing Bluetooth proximity detection system. Another complaint has been the data privacy- technologies can limit that itself, by proposing decentralized general-ledger based data repositories, and by having the service done outside of the hands of governments, eg through a civil society group.

As participation must be large, simple active opt-in seems to be ineffective. Mandatory use (as done in South Korea) may be a solution, but there are other ways to lure people into being traceable. Behavioral economists will tell you that a system where opt out is the default answer can double to triple the cases of opt-in only. Another solution is to make sure that choices have consequences- eg opt out may mean that people may not have priority access to healthcare. By making explicit and valauble trade off, people may be more inclined to share. We thus need

to prioritize more research into how to boost mass-acceptation of health and welath saving applications.

Green sustainability : Background. Regarding green sustainable tech, there is hope that those technologies will help alleviate ecological risks such as speed of natural resource depletion and the evolution of carbon emissions.

Global warming over the past ten years has boosted the global average temperature by about 0.9 degree Celsius compared with preindustrial temperatures. By rule of thumb, 1 extra degree of warming would lead to 0.2 percentage point decrease in GDP growth—as long as the world does not hit the threshold of overheating. This alas could be hit by as soon as 2030, and much faster than commitments to the Paris Agreement anticipating a reduction 80 to 95 percent of current emissions by 2050 (Jacob et al, 2018, or Robinson et al, 2018). If this implies that we need faster actions, covid-19 have led to some rather powerful experiments. The lockdown for example reduced significantly energy demand and pollution. China's shutdown in February resulted in a 25% decline in CO_2 emissions[13] .

> *« Blanket lockdown will make tGHG emissions fall by 8% by 2020,- twice more than in the second world war. But with lockdown exit, emission might rebuild to previous growth path. The 2009 crisis led to a drop of 1% in emission but rebound to 4.5% in 2010 »,*

The issue. On a global scale, the total of emissions might fall globally, 8% by 2020, or twice as much relative to GDP of the second world war. But with lockdown exit, emission might rebuild, and possibly go back to same growth path as history shows- as a case in point, the 2009 prime crisis led to a drop of 1% in emission but rebound to 4.5% in 2010, catching up on the secural trends. Covid-19 may also have distorted investment in clean technologies (Hepburn et al . 2020). Falling energy demand together wit social distancing has cut by half the growth of wind, solar, and battery capacity for this year, while the collapse in oil prices has made the substitution to alternative energy less evident. Finally, research by Helburn et al. (2020) also emphasizes that only 4% of government policies to relaunch post covid time, have some potential to reduce long-run GHG emissions

> *« Only 4% of government policies to relaunch post covid time are directed towards reducing long-run GHG emissions »*

---

[13]See https://www.carbonbrief.org/analysis-coronavirus-has-temporarily-reduced-chinas-co2-emissions-by-a-quarter

Solution space. At the end, policy success will depend on generating impact fast and deliver the largest multiplier. As mentioned, this includes favoring the use of digital and green-tech technologies, and shift much more of the policy actions to be green. Europe may be a promising example as it remains on track to present a new plan to raise the EU's 2030 ambitions and cut greenhouse gas emissions by 50-55%. But this plan should encompass aggressive decentralization of energy production, new regulatory tools that make the Emissions Trading Scheme much more effective, and environment standards in compliance with post-covid, linked to travel, circular economy, and others.

9. Retooling politics towards safer democracy

Background . Democracies have been the foundations of balanced growth and wellbeing in the last century, but democracy has been under siege lately. From France to Hungary, from Austria to Brazil, populism has been lately on the rise, with major consequences, including a marked decrease in the quality selection and moral hazard of civil servants (Sasso and Morelli (2020), and a sharp rise into disengagement policies which may cause conflict risk (Mattozzi et al., 2020).

As forcefully demonstrated in Algan et al. (2019), development of populism results from two forces—on one side, the increase in the economic challenge felt by the middle class in most of Europe and the US ; on the other side, the increase in personal insecurity as a result of depletion of many social institutions like the family, the religion, or the « café where friends used to meet in the middle of the village ».

Issue. Given the above, the covid-19 outbreak may have a large impetus effect on populism. One view is that covid-19 brings the society back at a time where destiny was guided by nature and by pandemics, and-this will reinforce the sense of altruism, against the rise of forms of populism. But another view is that covid-19 is actually more of a catalyst against the foundations of democratic institutions. The first symptom is that many governments have voted for exceptional power, in the first place to take measures linked to confinement. But it may remain crucial to consider those powers are temporary, as part of this exception—*not as a new rule.* Some governments, -and strikingly close to the populist parties- are already tempted to take advantage of extra power given by the covid 19.

Second, the crisis has marked effect on citizen economic and social perception about their future. The effect is often depressive. Eurofound research in April 2020 shows that a minority of EU citizens remain optimistic about their own future and the pessimism increases with the size of the covid-19 fatalities. Trust levels into others, and governments/ EU went down too.

For once, levels of trust in the EU went *below* national governement in the wake of COVID-19, against the usual findings that trust is often higher towards the EU than towards own national institutions. This is particularly seen in rather pro-EU Member States such as France, Italy and Spain, where the covid-19 health crisis was significant.

Another more subtle issue is the one of election. France is going for a second round of vote for municipalities, at covid 19 time, that may undermine the representation of election, for example. A recent study conducted in the US identified that counties that voted after Super Tuesday and which were then exposed to covid outbreak, were less likely to support Bernie Sanders , leading to 4 percentage points less support compared to Sanders 2016 vote (Bisbee and Honing, 2020). This effect is material and may mean election may be greatly influenced by the hazard of a pandemic wave like covid-19.

> *« US Votes after Super Tuesday were less likely to support Bernie Sanders by 4 percentage points. This effect may mean election may be greatly influenced by the moral hazard of a pandemic wave like covid-19 ».*

Solution space. Covid-19 may be an important catalyst towards major social changes and politics, for the good, or the bad—there is yet to be convincing studies that highlight how effect will play, and how i twill affect policies, voting, etc.

Three elements are worth highlighting here. The first is that the effect of covid must be understood rather holistically—the notion of risk in particular should be decomposed into economic, health, family, social networks, and political constructs such as a region or a country. The second is that the effect should be looked at different stages, - during containment, after exit, and in a few months, so that dynamics are better understood. The third is to use a larger framework than just pure economics, or pure well-being. A clever view used by Stanford economists such as Hall et al (2020), and ourselves (Bughin, 2020) is to use a more general citizen utility welfare framwork, that encompasses not only work income, but healthly life span, uncertainty in those utility drivers, among others. Such a framework is a step towards better understand how covid 19 may play out. With such a framework, the welfare change linked to covid is an order of magnitude larger than simply looking at one single component ; and this change may become drastic for some segments (eg singles with low education, in over-exposed non essential sectors, and with high comorbidity). This level of

granularity is needed if one wish to anticipate any form of evolution (backlash, or in contrary, rise) of social risks and populism[14].

10. Including inclusivity

Background. The notion of inclusivity reflects the idea of provision of equal opportunities for everyone. Disproportionately large gains accruing to a few against oher falling behind is a clear symptom that inclusivity is not achieved. In recent years and decades, so called 'superstar' effects have been emerging. One out of ten of large publicly quoted companies belongs to superstardom and in aggregate, captures 80 percent of the world economy economic profit. This concentration has increased by 50% in last 20 years. Regarding income, real market incomes were flat or fell for between 65 and 70 percent of households in advanced economies, but increased rather significnarly for the top 10% percent[15] .

Issue. Covid-19 has built more inequality in the system, as covid-19 has added fragility to already more fragile groups. The probability of death from COVID-19 consistently increases with increasing poverty, driven by a multiplication of factors such as healthcare accessibility, social distancing ability, or still higher stock of comorbidity per age group[16]. The effect is not only about health. It is also about wealth : Extensive research on top five epidemics of this century (eg SARS, H1N1 to Zika (2016)) –has demonstrated increase in inequality, building up structurally even after 5 years time (Furceri et al. 2020). One main channel is employment impact, as people with basic of education had fallen significantly in recent pandemics. This is a factor that we anticipate as well as playing in full force in the case of the covid crisis, as a result of new interference with automation, and teleworking, on top of traditional recession risk effects.

> *« **The probability of death from COVID-19 consistently increases with increasing poverty, driven by a multiplication of factors such as healthcare accessibility, social distancing ability, or still higher rate of comorbidity per age group** »*

---

[14] There is also scope for redefining roles of international instiutions, even if not covered in this article. The WHO for instance may need ot improve on its agility during crisis, and may build up foresight analysis for pathogens and vaccines. The UNESCO has an essential role in maintaining the spread and delivery of education and humans learning programs. The IMF and work plan may build up new programmes of financing virus proof heath infrastructure, etc.

[15] Disparity is especially detrimental after a certain point, as for exemple, some inequality may be needed for strong incentives for innovation and entrepreneurship. However, in practice, inequality reduces growth when inequality is above a net Gini coefficient of 0.30, which is fro example a fact of life in Europe, see Grigoli, et al, 2016

[16] For factualisation, see among others Imperial College London work available at https://www.imperial.ac.uk/media/imperial-college/medicine/mrc-gida/2020-05-12-COVID19-Report-22.pdf

Solution space. The essential message is that beyond the bulk of committed fiscal policy by governements, the allocation of those resources must be prioritized towards *the more at risk segments of the societ*y. This inlcudes, at the economic level, those with informal work and self-employment, or where social protection systems offer limited cushion. This includes at the demographic level, the older population, as it is more at risk of infection, or at risk of reducing active economic participation as a self-protective behavior (Bughin and Cincera, 2020 demonstrate how this behavior is rational, and depends of a very large asymetric health risk above 60 years).

EPILOGUE-GOING FORWARD

Covid today has been a major adverse shock, affecting all dimensions of well-being.

While actions have been undertaken to control the pandemic, and masterplans have been built for exiting blanket lockdowns prevailing in a large array of countries worldwide, the mistake should be that the war is won. It is not.

We first restart and retool heath and economic systems. We should not think the world is in standstill : the virus continues to spread worldwide, and shows signs of (albeit concentrated) outbreaks in regions exiting the containment measures. Vaccines are not found yet, let alone their effective and inclusive distribution.

More fundamentally, a large set of questions remains opened that will greatly influence the final answer as to whether the virus will be under control and whether covid 19 could have been a defining moment for catalysing our forces towards a better world. The post-covid era may alas, appear to be only one of many shocks, after which the world goes back to normal ; worse, it could actually amplify negative trends such as rising inequality, accelerating GHG emissions, or dislocating labor markets.

We have laid out 10 critical domains that must be further worked out as actions to « tilt the war against covid towards the bet of a better world ». It is now time to lead and time to act.

REFERENCES

Akhtar, M, Kramer, M ; and Gardner, L, 2019, A dynamic neural network model for predicting risk of zika in real time, **BMC Medecine**, 17.

Algan, Y, S Guriev, E Papaioannou and E Passari (2017), "The European Trust Crisis and the Rise of Populism", **Brookings Papers on Economic Activity**, Fall.

Algan, Y. , E. Beasley, D. Cohen, M. Foucault, (2019), Les origines du populisme, **Editions Seuil, Paris**

Almond, D., & Mazumder, B. (2005). The 1918 influenza pandemic and subsequent health outcomes: an analysis of SIPP data. **American Economic Review**, 95(2)

Almond, D. (2006). Is the 1918 influenza pandemic over? Long-term effects of in utero influenza exposure in the post-1940 US population. **Journal of political Economy**, 114(4), 672-712.

Alvarez, F. E., Argente, D., & Lippi, F. (2020). *A simple planning problem for covid-19 lockdown* (No. w26981). **National Bureau of Economic Research**.

Avalos, J. and Zakrajsek,A 2020, Covid 19 and SARS : what do the stock markets tell us, **BIS Quarterly Review**, March

Banerjee, R, A . Illes, E. Kharroubi and J.M. Serena (2020) Covid-19 and corporate sector liquidity, **BIS bulletin**, 10, April

Barron A. (2018)., "Policy insights from EMF 32 study on US carbon tax scenarios", **Climate Change Economics**, Volume 9, Number 1

Bisbee, J and D. Honig, (2020), Flight to safety: 2020 Democratic primary election results and Covid, **Covid Economics, Vetted and Real time papers**, 19

Bordignon, M and T Colussi (2020), "Dancing with the Populist. New Parties, Electoral Rules and Italian Municipal Elections", unpublished manuscript

Bryan, K., Lemus, J. and Marshall, G., 2020. Innovation During a Crisis: Evidence from Covid-19. *Available at SSRN 3587973*.

Bughin, J. (2020), Making sense of the covid pandemics, ULB, **Solvay Business School**, Discussion paper

Bughin, J. and M. Cincera, (2020), F.O.G. and teleworking : some labor economics of covid-19, ULB, **Solvay Business School**, Discussion paper

Caley, et al 2008. Quantifying social distancing arising from pandemic influenza. **Journal of the Royal Society Interface**

Correia, S. S. Luck, Stephan and E. Verner, (2020) Pandemics Depress the Economy, Public Health Interventions Do Not: Evidence from the 1918 Flu (June 5, 2020). Available at SSRN: https://ssrn.com/abstract=3561560

Bryan, K, J. Lemus, and G Marshall (2020) "Innovation During a Crisis: Evidence from Covid-19." Available at SSRN 3587973 (2020).

Chen, 2020, Towards data science, https://towardsdatascience.com/statistics-and-unreliable-tests-coronavirus-is-difficult-to-contain).

Coibion, O. , Y. Gorodnichenko and M. Weber (2020), The costs of covid 19 crisis- lockdowns, macro-expectations and consumer spending, **Covid Economics**, vetted and real time papers

Eksin, et al. 2019. Systematic biases in disease forecasting–The role of behavior change. ***Epidemics***.

Fetzer, Th, Hesnel, L ? Hermle, J. and Ch. Roth, 2020, perceptinos of coronavirus mortality and contagiousness weaken economic sentiment, **ArXiv.**

Furceri, D, P Loungani, J D Ostry, and P Pizzuto, 2020, "Will Covid-19 affect inequality? Evidence from past pandemics," **Covid Economics** 12: 138-57

Gennaro, G, G Lecce and M Morelli (2020), "Mobilization and the Strategy of Populism: Theory and Evidence from US Elections", massimomorelli.eu.

Gollier, C. and Gossner, O., 2020. Group testing against Covid-19. **Covid Economics**, *2*.

Grigoli, F. E. Paredes, and G. Di Bella, (2016) , Inequality and growth: A heterogeneous approach, **IMF** working paper number 16/244, December 16, 2016.

Guiso, L, H Herrera, M Morelli and T Sonno (2020), "Economic Insecurity and the Demand of Populism in Europe", massimomorelli.eu.

Guriev, S and E Papaioannou (2020), "The Political Economy of Populism", CEPR DP14433

Hall, R.E., Jones, C.I. and Klenow, P.J., 2020. *Trading off consumption and covid-19 deaths* (No. w27340). **National Bureau of Economic Research**.

Helferty, M., Vachon, J., Tarasuk, J., Rodin, R., Spika, J., & Pelletier, L. (2010). Incidence of hospital admissions and severe outcomes during the first and second waves of pandemic (H1N1) 2009. **Cmaj,** 182(18), 1981-1987.

Heynmann, D and N. Shindo (2020), COVID-19: what is next for public health? **The Lancet,** Volume 395, Issue 10224, 22–28 February 2020, Pages 542-545

Hepburn, Cameron, et al. "Will COVID-19 fiscal recovery packages accelerate or retard progress on climate change?." **Oxford Review of Economic Policy** 36 (2020).

Higa, K. (2020) Adoption of Telework by Japanese Organizations:**Tokyo Institute of Technology**

Mazumder, B., Almond, D., Park, K., Crimmins, E.M. and Finch, C.E., 2010. Lingering prenatal effects of the 1918 influenza pandemic on cardiovascular disease. **Journal of developmental origins of health and disease,** *1*(1), p.26.

Hurbin, 2011, OECD report contribution to the project « Future Global Shocks », **OECD**.

Mboup et alii, 2006 HIV/AIDS, chapter 17 in Disease and mortalitiy in Sub-Saharan Africa, **EBRD/World Bank**.

Kermack and McKendrick, 1927, A Contribution to the Mathematical Theory of Epidemics, **Proceedings of the Royal Society**.

Lloyd Smith et al, 2005, Superspreading and the effect of individual variation on disease emergence, **Nature**.

Jacob, D. et al.,(2018) "Climate impacts in Europe under +1.5°C global warming", **Earth's Future,** , Volume 6, Number 2

Jones, Ch. and Peter Klenow, 2016. "Beyond GDP? Welfare across Countries and Time," **American Economic Review**, vol 106(9), pages 2426-2457

Kermack and McKendrick, 1927, A Contribution to the Mathematical Theory of Epidemics, **Proceedings of the Royal Society**.

Kissler, S. M., Tedijanto, C., Goldstein, E., Grad, Y. H., & Lipsitch, M. (2020). Projecting the transmission dynamics of SARS-CoV-2 through the postpandemic period. **Science.**

Lee AM, Wong JG, McAlonan GM, et al. Stress and psychological distress among SARS survivors 1 year after the outbreak. **Canadian Journal of Psychiatry**. 2007;52(4):233-240.

Li et al., 2020, Substantial undocumented infection facilitates the rapid dissemination of novel coronavirus, **Science**

Lipton, Alex, and Marcos Lopez de Prado. "Exit Strategies for COVID-19: An Application of the K-SEIR Model." Available at SSRN 3579712 (2020).

Lloyd Smith et al, 2005, Superspreading and the effect of individual variation on disease emergence, **Nature**.

Ma, CH. J. Rogers, S. Zhou (2020) Global economic and financial effects of 21rst century pandemic and epidemics, **covid economics,** vetted and real time papers, April .

Mboup et alii, 2006 HIV/AIDS, chapter 17 in Disease and mortalitiy in Sub-Saharan Africa, **EBRD/World Bank**.

McKibbin and Fernando, 2020, the global macroeconomic impacts of Covid-19 : seven scenarios, **Brookings**

Mummert, A., Weiss, H., Long, L.P., Amigó, J.M. and Wan, X.F., 2013. A perspective on multiple waves of influenza pandemics. **PloS one**, 8(4).

OECD (2020a), "Corporate sector vulnerabilities during the Covid-19 outbreak: assessment and policy responses", **Tackling Coronavirus Series**

Robinson, Mary, and Tara Shine. "Achieving a climate justice pathway to 1.5 C." *Nature Climate Change* 8, no. 7 (2018): 564.

Sasso, G and M Morelli (2020), "Bureaucrats under Populism", **CEPR** DP 14499.

Taubenberger, Jeffery K., and David M. Morens. "1918 Influenza: the mother of all pandemics." **Revista Biomedica** 17, no. 1 (2006): 69

Thorneloe, RI, T. Epton, W. Fynn, M Daly, N.Stanulewicz, A. Kassianos, Gi W. Shorter et al. (2020). SCOPING REVIEW OF MOBILE PHONE APP UPTAKE AND ENGAGEMENT TO INFORM DIGITAL CONTACT TRACING TOOLS FOR COVID-19. 10.31234/osf.io/qe9b6

Tyson, et al. 2020. The Timing and Nature of Behavioural Responses Affect the Course of an Epidemic. ***Bulletin of Mathematical Biology***

Wang, *et al.* 2020, Phase-adjusted estimation of the number of Coronavirus Disease 2019 cases in Wuhan, China. **Cell Discovery**

i(ite **WORKING PAPERS 2013**

001 - Exploring europe's r&d deficit relative to the us: differences in the rates of return to r&d of young leading r&d firms - Michele Cincera and Reinhilde Veugelers

002 - Governance typology of universities' technology transfer processes - A. Schoen, B. van Pottelsberghe de la Potterie, J. Henkel.

003 - Academic Patenting in Belgium: Methodology and Evidence – M. Mejer.

004 - The impact of knowledge diversity on inventive performance at European universities – M. Mejer

005 - Cross-Functional Knowledge Integration, Patenting and Firm's Performance – M. Ceccagnoli, N. van Zeebroeck and R. Venturini.

006 - Corporate Science, Innovation and Firm Value, M. Simeth and M. Cincera

i(ite **WORKING PAPERS 2014**

007 - Determinants of Research Production at top US Universities – Q. David.

008 - R&D financing constraints of young and old innovation leaders in the EU and the US – M. Cincera, J. Ravet and R. Veugelers

009 - Globalization of Innovation Production; A Patent-Based Industry Analysis – J. Danguy

010 - Who collaborates with whom: the role of technological distance in international innovation – J. Danguy

i(ite **WORKING PAPERS 2015**

011 - Languages, Fees and the International Scope of Patenting – D. Harhoff , K. Hoisl, B. van Pottelsberghe de la Potterie , C. Vandeput

012 - How much does speed matter in the fixed to mobile broadband substitution in Europe? – M. Cincera, L. Dewulf, A. Estache

013 - VC financing and market growth – Interdependencies between technology-push and market-pull investments in the US solar industry – F. Schock, J. Mutl, F. Täube, P. von Flotow

014 - Optimal Openness Level and Economic Performance of Firms: Evidence from Belgian CIS Data – M. Cincera, P. De Clercq, T. Gillet

015 - Circular Causality of R&D and Export in EU countries – D. Çetin, M. Cincera.

016 - Innovation and Access to Finance – A Review of the Literature – M. Cincera, A. Santos.

i(ite   WORKING PAPERS 2016

017 - Effectiveness of Government intervention in the SME sector: Evidence from the Brussels-Capital Region – G. E. Fombasso, M. Cincera.

018 - A review of corporate R&D intensity decomposition – P. Moncada-Pastemò-Castello.

019 - The laws of action and reaction: on determinants of patent disputes in European chemical and drug industries – R. Kapoor, N. van Zeebroeck.

020 - How do the normativity of headquarters and the knowledge autonomy of subsidiaries co-evolve? – M. Hansmans, G. Liu.

i(ite   WORKING PAPERS 2017

021 - The case for offensive strategies in response to digital disruption – J. Bughin, N. van Zeebroeck.

022 - Access to finance as a pressing problem: Evidence from innovative European firms – A. Santos, M. Cincera.

023 - Platform play among incumbent firms: the wrong focus? – N. van Zeebroeck, J. Bughin.

024 - Social Movements – M. Hensmans, K. van Bommel.

025 - Decoding Patent Examination Services – L. Gimeno-Fabran, B. van Pottelsberghe de la Potterie.

026 - Countries Attractiveness: an Analysis of EU Firms's Decisions to (De) Localize R&D Activities – M. Cincera, A. Santos.

i(ite   WORKING PAPERS 2018

027 - The impact of EUREKA projects on the economic performance of R&D SMEs – M. Cincera, G. Fombasso.

028 - Forecasting short-term transaction fees on a smart contracts platform – C. Hoffreumon, N. van Zeebroeck.

029 - Sharing the risk of innovative investment: Assessing the effect of new European financing instrument - M. Cincera, A. Santos.

030 - Academic scientists: The golden opportunity for high-tech companies – L. Dewulf, M. Cincera.

i‹ite WORKING PAPERS 2019

031 - Experimentation, Learning and Stress. The Role of Digital Technologies in Strategy Change – J. Bughin, T. Kretschmer, N. van Zeebroeck.

032 - Types of Innovation and Firm Performance – M. Cincera, E. Ince.

033 - Competition and Innovation: Evidence from Worldwide Corporate R&D Spenders - M. Cincera, E. Ince, A. Santos.

i‹ite WORKING PAPERS 2020

034 - Selectivity versus Reach: Flattening the Curve of Covid 19 for Joint Health and Economic Prosperity – J. Bughin.

035 - How firms will affect the Future of Work – J. Bughin.

036 - Making Sense of the Covid-19 (SARS-CoV-2) Pandemic – J. Bughin.

037 - F.O.G. and Teleworking: Some Labor Economics of Covid-19 – J. Bughin – M. Cincera

038 - Learning from 20 Years of Research on Innovation Economics – B. van Pottelsberghe de la Potterie.

039 - The Value of Platform Strategy. It's the Ecosystem, Stupid! - J. Gossé - C. Hoffreumon – N. van Zeebroeck – J. Bughin.

040 - Ten Moments of Truths for the Covid-19 Crisis – J. Bughin.