Covid-19: Long-Term Investment Implications

Nassim Taleb, and Benoit Mandelbrot before him, referred to "black swans" as extremely rare, significant events with non-calculable probabilities. Covid-19 is not such an event and its consequences are quite predictable. Among other things, Covid-19 may have accelerated the dominant trends in the economy, with significant impact on long-term expected returns of equities and bonds.

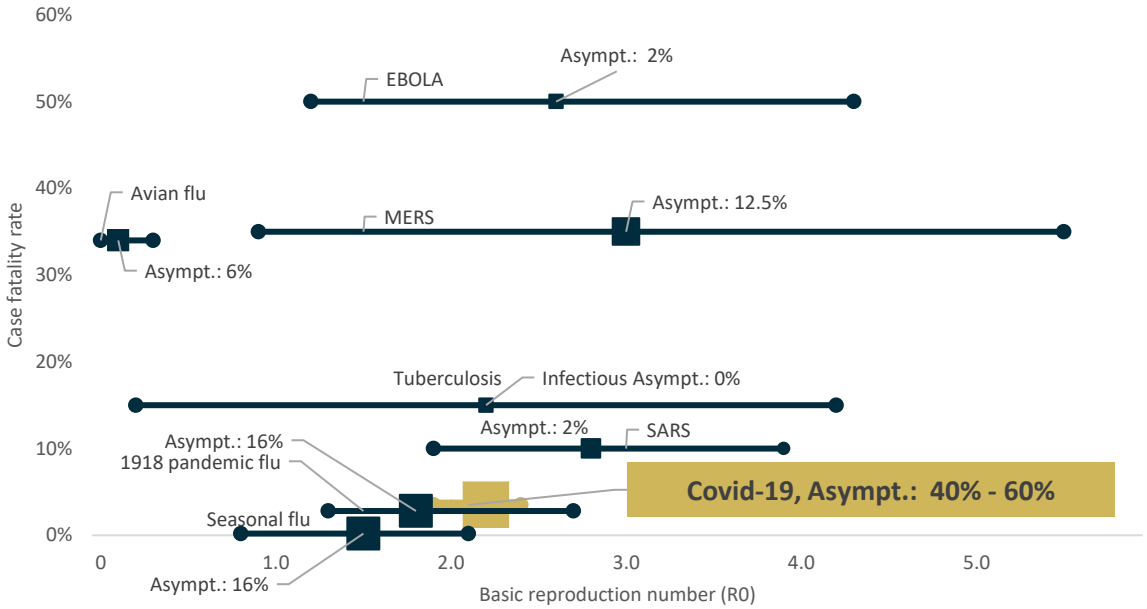


Figure 1: Case fatality rate and reproduction number by virus, Source: WHO, nature.com The size of the square refers to the percentage of asymptomatic cases, with Covid-19 at ~50%, 1918 flu pandemic at 16% and Ebola at 2%. The combination of novelty of Covid-19, its rate of asymptomatic transmission and the fact that it is airborne (as opposed to e.g. Ebola) turns it into a perfect public health storm.

There is a school of thought that our experience of Covid-19 is largely due to the echo chamber created by social media. If this were the case, it is hard to imagine that the global pandemic could have any meaningful long-term impact on the economy. To a very limited extent this line of reasoning is justified; there are many things about the novel corona virus that are very unremarkable: we have experienced viruses both deadlier and more contagious, even viruses that are deadly and contagious at the same time.

Precisely because of this, Covid-19 is not a "black swan" event[1] in the sense that almost all its features are very ordinary (Figure 1). In fact, the novel corona virus is remarkably like another very average virus – the one that caused the 1918 flu pandemic killing by some estimates nearly 100 million people and causing multiple decades of economic impact.

*) Get in touch with us or request a trial of Mira ABM, including Covid-19 scenarios: https://linksanalytics.com/request-trial/

[1] Classifying Covid-19 as a black swan event opens the pandora's box of conflicting arguments for and against worrying about "black swan"- like events, as they are very infrequent, and markets quickly recover from them.

At this point it is hard to say just how devastating in terms of loss of life the virus will be, since to a large extent it depends on the policy action. Half a million deaths at the time of writing this report and the rate of growth of this number already places the virus in the list of most impactful pandemics of the last one hundred years.

A longer historical perspective is inevitably less reliable, but still informative at least in terms of the magnitude of numbers. Estimates of historical pandemics suggests that even the current number of deaths is not insignificant (Table 1).

Table 1: List of selected historical pandemics from (Oscar Jord, 2020) study. The study understates the death toll of 2009 H1N1 pandemic by considering only one year, while in subsequent years the death toll may have reach several million by some estimates.

Event	Start	End	Deaths
Black Death	1347	1352	75,000,000
Italian Plague	1623	1632	280,000
Great Plague of Sevilla	1647	1652	2,000,000
Great Plague of London	1665	1666	100,000
Great Plague of Marseille	1720	1722	100,000
First Asia Europe Cholera Pandemic	1816	1826	100,000
Second Asia Europe Cholera Pandemic	1829	1851	100,000
Russia Cholera Pandemic	1852	1860	1,000,000
Global Flu Pandemic	1889	1890	1,000,000
Sixth Cholera Pandemic	1899	1923	800,000
Encephalitis Lethargica Pandemic	1915	1926	1,500,000
Spanish Flu	1918	1920	100,000,000
Asian Flu	1957	1958	2,000,000
Hong Kong Flu	1968	1969	1,000,000
H1N1 Pandemic	2009	2009	203,000

Source: Alfani and Murphy (2017), Taleb and Cirillo (2020), https://en.wikipedia.org/wiki/List_of_epidemics and references therein.

Bill Gates, in his now well-publicised Ted talk in 2015 put it bluntly: one of the reasons that Ebola did not spread globally is that "we got lucky" that the initial spread was limited to rural areas. At the time, his estimate of the impact of a novel flu epidemic was 33 million casualties within a year and a total economic impact of ~ $3 trillion. His reasoning for worrying about a global pandemic was simple in retrospect: we have invested huge amounts in nuclear deterrents but have not invested in systems to deter pandemics. ***We did not factor in our lives and economies the very real likelihood of average viruses causing pandemics. The technology and automation-driven adjustments to the business models needed to survive pandemics were there all along but were not adopted due to organisational inertia. This is likely to change though, and that change will be the driver of the long-lasting impact of Covid-19***.

The "social media" school of thought was right only in one sense: the virus causing Covid-19 is not exceptional, at least in terms of its epidemiological parameters. Where that school of thought is mistaken, is that the size and impact of even unexceptional virus can be devastating and not so much due to the virus per se, but due to:

- the leading/lagging **timing** of the spread globally
- the type of **network structure** of the community in which the virus strikes first
- **randomness** or luck
- degree of our preparedness, or **government action**

The timing of measurement is one of the toughest issues policy makers have had to contend with. The virus impact is delayed over time and it is impossible to judge the success of different policy actions based on contemporaneous data. Judging from the table in Business Insider, for instance, 2019-nCoV is one of the least impactful viruses in the last 50 years. Clearly, the publication was somewhat early in its assessment (Table 2).

Table 2: List of virus statistics from Business Insider publication

Wuhan coronavirus compared to other major viruses

VIRUS	YEAR IDENTIFIED	CASES	DEATHS	FATALITY RATE	NUMBER OF COUNTRIES
Marberg	1967	**466**	373	80%	11
Ebola*	1976	**33,577**	13,562	40.40%	9
Hendra	1994	**7**	4	57%	1
H5N1 Bird Flu	1997	**861**	455	52.80%	18
Nipah	1998	**513**	398	77.60%	2
SARS	2002	**8,096**	774	9.60%	29
H1N1**	2009	**>762,630,000**	284,500	0.02%	214#
MERS***	2012	**2,494**	858	34.40%	28
H7N9 Bird Flu	2013	**1,568**	616	39.30%	3
2019-nCoV*	2020	**11,871**	259	2.2%	24

*As of January 31, 2020 **Between 2009 and 2010 ***As of November 2019

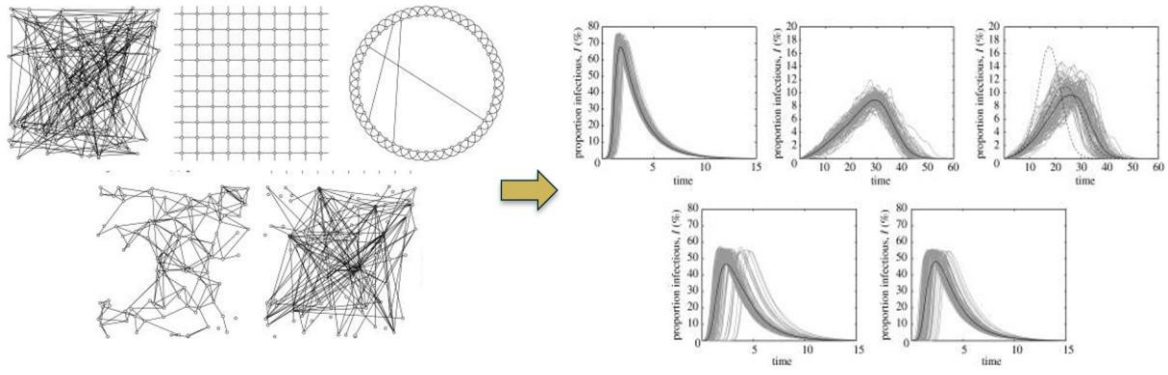
#Countries and overseas territories or communities

Sources: CDC; UN; WHO; New England Journal of Medicine; Malaysian Journal of Pathology; CGTN; Johns Hopkins University; The Lancet; Reuters, CIDRAP

BUSINESS INSIDER

The network structure is another "wild card" that complicates comparisons and conclusions. Depending on the patterns of connections between people in any given community, the same virus may have vastly different impacts. The speed of virus spread could be 4-5 times faster in highly dense urban areas compared to sparse rural areas. Analysis of five different theoretical network structures and corresponding virus transmission rates shows the difference of transmission (Figure 2). What is more challenging, closure of schools, for instance may transform one network structure into another one, thus changing the shape of transmission.

Figure 2: Five theoretical network structures and their impact on infection development, Source: (Matt J Keeling, 2005)



Randomness plays a considerable role, as even with the same network structure, introducing the virus in nodes (to locations or people) that are less connected to the rest of the network limits the overall spread and impact.

Finally, as noted ***government action*** can have a significant effect due to changing the network structure, limiting transmission.

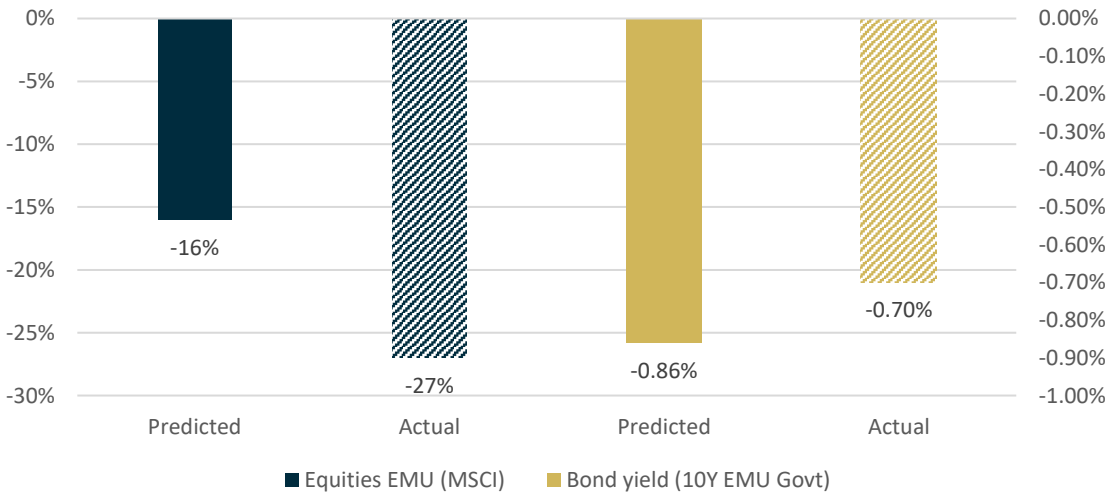
Due to all these complexities, it is difficult to draw conclusions about specific policy actions or geographic locations and devise a single dominant "correct" policy response. This creates a large economic and political uncertainty and paralysis, which in turn results in the worst-case economic scenario: a half-hearted policy response.

Short-Term Implications: Dangers of Half-Hearted Response

On February 6 of this year, we made our first effort to quantify the potential impact of the pandemic on institutional portfolios. With information available at the time, our focus was predominantly short-term, as the main uncertainty was about the knock-on effects of the potentially damaging country-wide lock-down in China, disruption of passenger air traffic in Asia and lower oil prices. We introduced these basic assumptions in Mira ABM – our agent-based modelling framework for strategic risk assessment, and ran stress tests on all client portfolios in the first two weeks of February.

Mira ABM calculations indicated that interest rates (10-year EUR) would likely fall by ~90 basis points, while equities in Europe would lose 16% of their value. Within a little longer than a month those numbers did materialise (Figure 3). Rapid government and central bank interventions helped asset prices recover most of the losses of the early March.

Figure 3: Predicted and actual impact on equities and yields, February 6 - March 12, Source: LINKS Mira ABM



In March, due to our growing understanding of the consequences of the virus, LINKS introduced two short-term stress scenarios: Scenario A (mild) and Scenario B (severe)[2], with the latter assuming the economies would fail to re-open safely and resume the pre-epidemic volumes of production within months. The big risk that we perceived at the time was that it was impossible to re-open China's economy safely. Our attention on China was mainly because China was the first to be impacted and therefore, the first to show if it was possible to recover economically.

At the time we set several tests for recovery, particularly it was necessary to see falling inventory levels of various types of steel – this would herald recovery in manufacturing and construction, and a recovery in container traffic, which would indicate trade recovery. Based on the end-of-June numbers we can state that there is no strong recovery yet (Figure 4 and Figure 5).

Figure 4: Rebar, cold rolled and total steel inventory in China, Source: Bloomberg

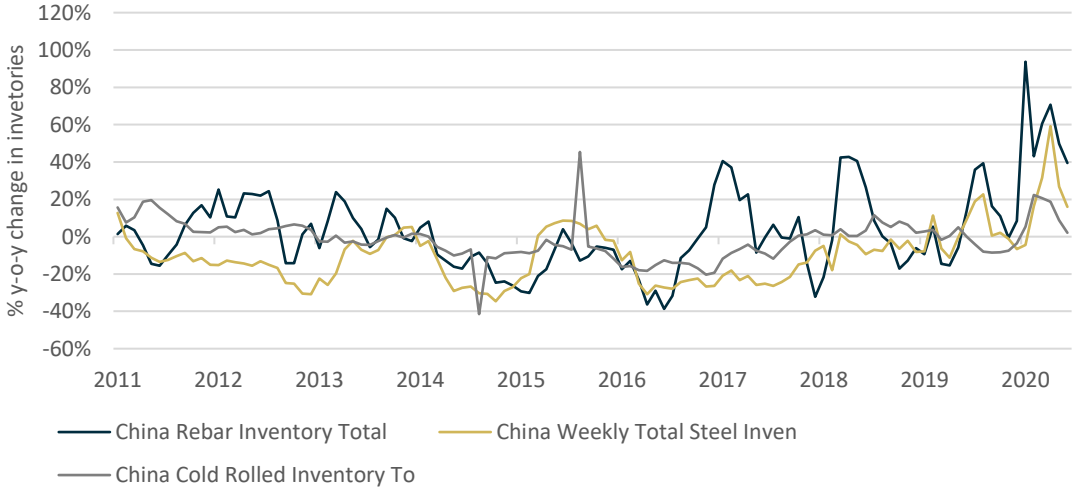
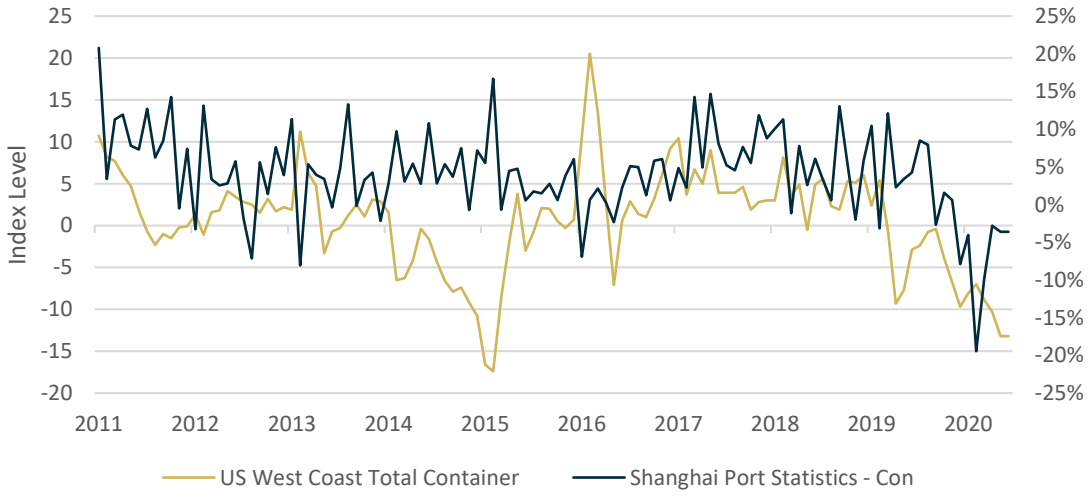


Figure 5: Container traffic, US West Coast and Shanghai, Source: Bloomberg



It is difficult to say whether the near absence of recovery is due to China's inability to reopen meaningfully (even if this were the case, Chinese government would not publicise this), or due to

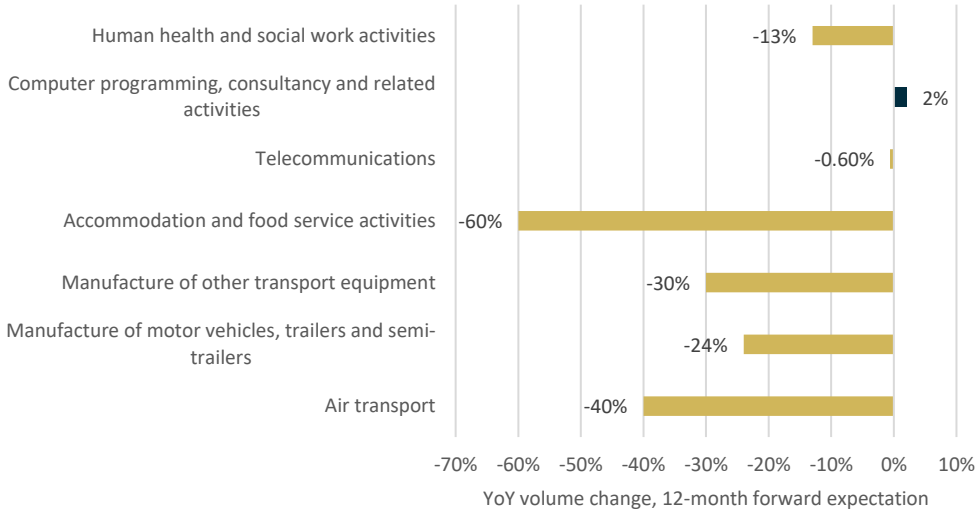
[2] For details of our earlier scenarios please consult our previous Risk Wire: (LINKS Analytics, 2020) at https://linksanalytics.com/wp-content/uploads/2020/05/LINKS-Risk-Wire-20200325.pdf

sharply lower demand in the West. Trade levels are certainly affected by global demand, but steel consumption in China should have recovered much more rapidly and independently from the global demand.

At any rate, we have now the reality of **Mira ABM Scenario B** being a distinct possibility: recovery is clearly not going to be instant or complete. Although government action may mute the impact on asset classes, just how much action is required from the government will still depend on the extent of damage.

Our assessment of the short-term Scenario B was still focused on China and Asia and lacked greater detail about the economies in Europe, and particularly North America – the primary area of concern at the time of writing this report. We now abandon our Scenario A as out of date and expand LINKS Scenario B to include actual and expected business disruption at the time of publication (Figure 6).

Figure 6: Business disruption for the full 12-month period going forward. Source: see Appendix



It is worth specifically addressing the technology and telecommunications sectors. Although the pandemic might have increased demand for telecommunication traffic, telecom companies have limited ability to monetise this demand, as most usage occurs at home on unlimited traffic plans. This means there is an increasing cost component that is not compensated. Additionally, due to lack of international travel, roaming charges have fallen considerably.

In terms of the technology industry, there is increase in demand for online retail and video conferencing, but these are relatively small parts of the industry. Forrester research (see Appendix) expect weaker corporate IT spending as well as difficulties with supply chain disruptions. The combined effect is virtually unchanged volumes for the technology sector.

Given the potential annual impact in Figure 6 the biggest unknown in the short-term remains the pace of recovery. The question here is not whether there will be one, two or many small lockdowns, but rather, at what pace the world will arrive in one of the following states:

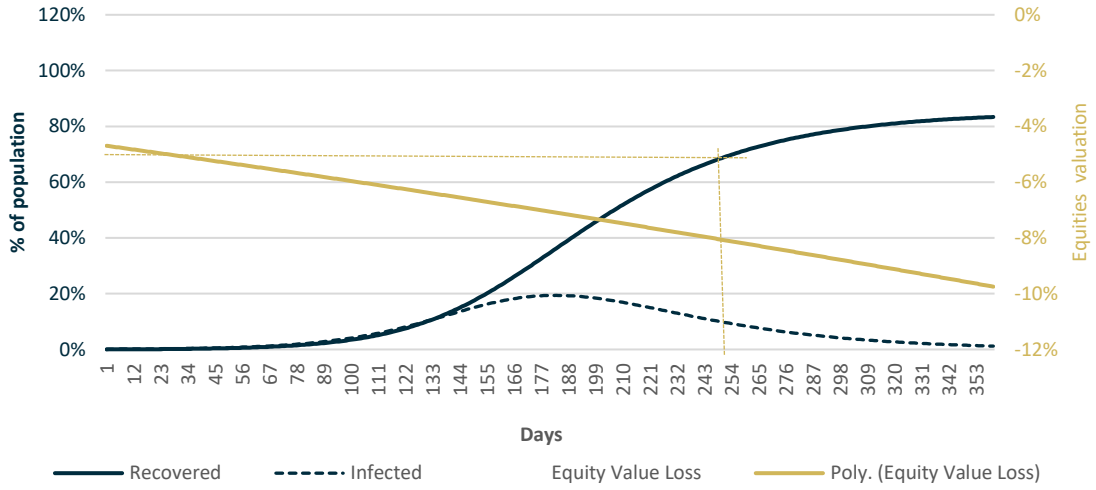
- vaccine is available, mass produced and administered
- there is a significant improvement in patient care
- most countries have reached ~70% of infected and recovered rate
- governments manage to bring the basic reproduction number (R0) to below 1

The first two possibilities are highly uncertain. If they do happen, we would need to review the scenario and consider the implications. This leaves the world with the last two possibilities. Most importantly, these conditions refer to all the major economic blocks at the same time, as it is unlikely that some major trading partners will be able to maintain low infection rate indefinitely, while others experience high infection rates without the infection spreading.

In the **perfect case**, all major governments manage to consistently suppress the virus spread (R0) to below 1. In this case, total infected rate quickly tends to zero and the economic impact is very limited (below 1% impact on equities).

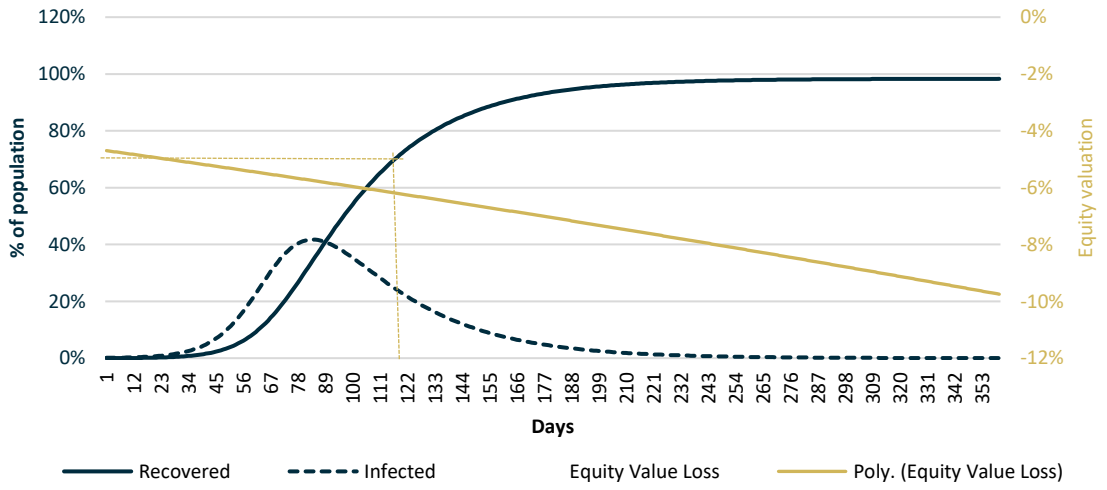
Assuming no government intervention and the low-end of natural R0 (2.3) of the virus, the 70% recovery rate is achieved in about 250 days and the impact on equities is limited to 8% (Figure 7).

Figure 7: Impact of Covid-19 on equity values, SID model results with R0=2.3, Source: Mira ABM, LINKS calculations



At the higher and of estimates of R0, the 70% recovery rate is achieved quicker – in about 120 days, which results in loss of value of 6% for equities(Figure 8).

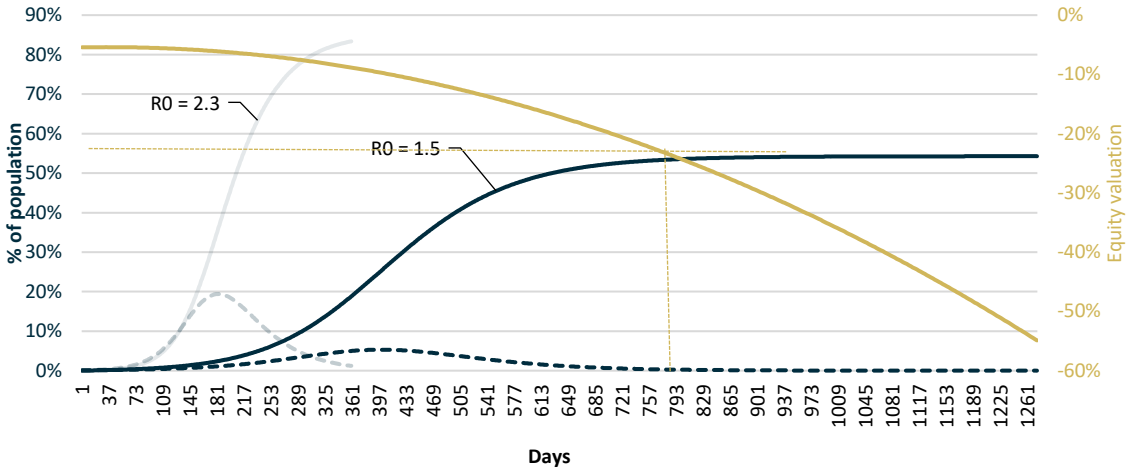
Figure 8: Impact of Covid-19 on equity values, SID model results with R0=4.0, Source: Mira ABM, LINKS calculations



The real negative case is a situation in which governments attempt to bring down the infection rate but fail at it once or several times. In that case, applicable R0 falls to about 1.5 and remains

at that level, which implies that a significantly high level of infection rate is achieved only after about two years (Figure 9). The impact on equities in this case could be at least -25% or more, with no clear limit, as technically 70% of infection rate is never achieved. Such an extended period of consumer hesitation may result in permanent insolvencies, structural changes in supply chains and a slow progression to long-term impact.

Figure 9: Impact of Covid-19 on equity values, SID model results with R0=1.5, Source: Mira ABM, LINKS calculations



This analysis suggests that from the economic point of view, governments' best course of action is a concerted, global and very strict lock-down that brings the R0 to below one and enables very quick recovery without loss of life.

Avoiding any lockdowns theoretically also results in small impact on equities, as total recovery rate is achieved quickly. It is very unclear how realistic is this case, as no lockdown assumes overwhelmed health care systems and very high death rates – both avoidable worst-case events that today's world population will not accept.

The last case is unfortunately the most likely eventuality: as it is not feasible to expect all major governments to be in co-ordinated and strict lockdown, some do fail to bring the rate of infection to below 1. Those countries that do manage to do so still risk importing new waves of infection. The global average R0 then is at 1.5 and the short-term impact slowly progresses into a long-term systemic impact. Unfortunately, this appears to be the current default scenario.

Long-Term Implications

Extending the forecast horizon from short-term to long-term inevitably increases the uncertainty and risk of speculation: plenty of things can change in the next 15 years to affect the results of analysis. More importantly, there are other dominant factors, such as ageing population, automation, de-globalisation, climate change, that have considerable impact on long-term return expectations.

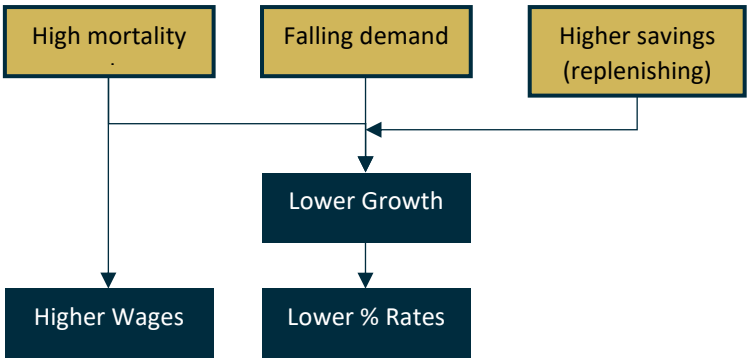
In this section we consider the impact of Covid-19 pandemic on long-term returns in isolation. At the same time, given the larger than usual uncertainty, we cross-reference our results with two other, fundamentally different approaches to estimating long-term impact of pandemics (Table 3).

Table 3: Approaches to estimating the impact of global pandemics on asset returns/economic activity

Approach	Benefits	Drawbacks
A. Historical: analyse available historical precedents and attempt to make inferences	Benefit of real-world evidence	"This time it may be different"
B. Macroeconomic: use a macroeconomic model to change the inputs and assess the results	Forward-looking analysis	Hard to link asset returns with macroeconomics
C. Microeconomic (Mira ABM): observe real-world changes, build them into an economic activity model and assess impact on assets	Real-world evidence, forward-looking analysis	Sensitive to real-world observations and estimates

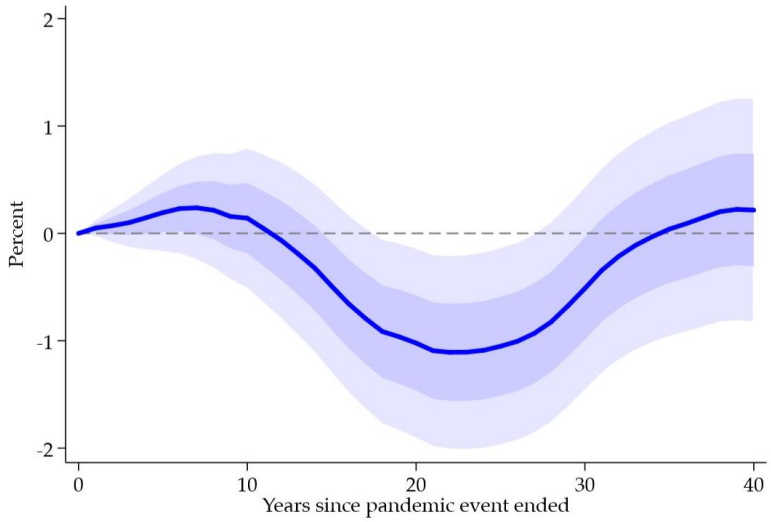
All studies identify three possible ways large global pandemics impact economic activity and asset returns: higher mortality and shortage of labour over time, falling demand due to slower population growth and higher savings rate due to overcompensating/cautious spending (Figure 10).

Figure 10: Impact pathways, global pandemics



One of the most recent papers covering the **historical (A)** approach - (Oscar Jord, 2020), considers pandemics in several major economies: France (1387–2018), Germany (1326–2018), Italy (1314–2018), the Netherlands (1400–2018), Spain (1400–1729, 1800–2018), and the U.K. (1314–2018). Although there is no assessment of the impact on equities, the study uses a robust statistical technic to isolate the long-term impact of pandemics on interest rates. It concludes that the impact of pandemics is very long-lived, with interest rates down ~100 basis points for up to 35 years after major events (Figure 11).

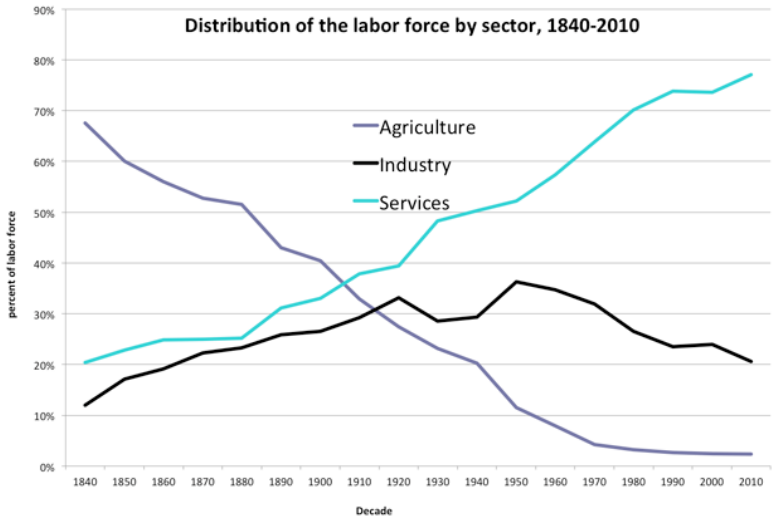
Figure 11: Response of the European real natural rate of interest to pandemics allowing for trend breaks, Source: (Oscar Jord, 2020)



Although historical studies cannot explain the reasons for such a large and long-lasting impact, the educated guess in the study is that shortages of labour in the periods following pandemics have hampered growth and capital investment.

These results are interesting in terms of indication of general direction of change, however, drawing conclusions about the future following the Covid-19 pandemic based on historical studies alone may be difficult. First, the structure of the global economy is drastically different from mid-1800s, with the services sector currently accounting for over 70% of workforce (Figure 12). Such migration of population into the services sector has been enabled by automation, which has created a relative abundance of labour. In the post-Covid-19 world, rapid automation specifically in the services sector will probably create the opposite effect – larger unemployment. At any rate, Covid-19 pandemic specifically disproportionately affects the retired population.

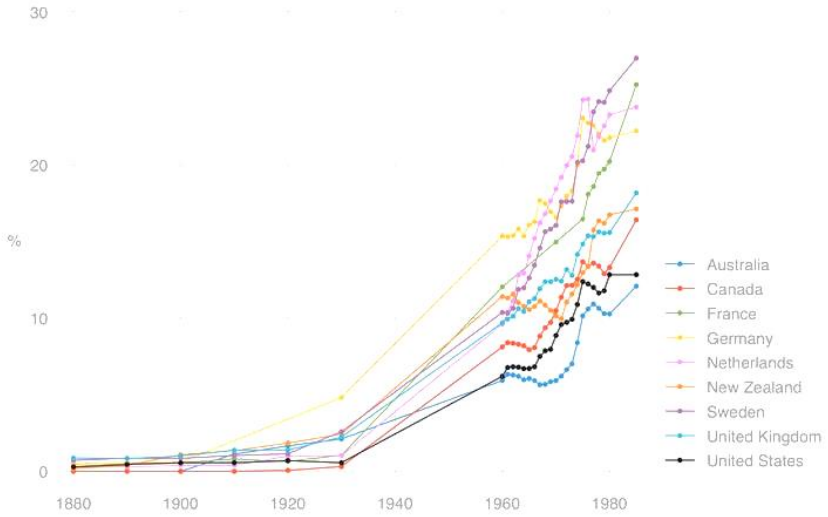
Figure 12: Proportion of population engaged in services, United States, Source: Bicentennial Edition: Historical Statistics of The United States



The second reason why “this time it may be different” is the emergence of the welfare state (Figure 13). The population in 2020 has both the physical ability to “lock down” and the

redistribution mechanism to support such a lock-down. The physical ability comes from the fact that due to automation, we need only a small proportion of population to be physically at work for everyone to have food and consumer products to survive. Thanks to the internet, part of the services economy has continued to operate uninterrupted, while working from home (banks, insurance, consulting etc.) Secondly, there is a strong welfare state that can redistribute income to support the remaining services sectors (hotels, restaurants, travel) for extended periods.

Figure 13: The emergence of welfare state (% of public spending in GDP), Source: Our World In Data 2020, CC BY



An entirely different approach to assessment of the pandemics impact is a forward-looking **macroeconomic study (B)**, such as one carried out in (Lars Jonung, 2006). The study uses a macroeconomic model of simulated economic development (QUEST) to assess the impact of a hypothetical pandemic, **as expressed by a permanent negative shock to population of 0.75%**. A virus similar (marginally worse than) to the 1918 influenza pandemic was simulated, with mortality rate of 2.5%, recovery at 3 weeks. In this model, 150 million people become sick in Europe, 2.5% of those die.

The conclusions of the study are that the pandemic will be over in 1 quarter, with a short-term impact of -1.6% of lost GDP, and a long-term impact of -0.6% loss in GDP. The study dates back to 2006 and it clearly underestimates the impact of lockdowns and self-imposed social distancing that extend the period it takes to recover, while at the same time limiting the number of infected. The study does not expressly estimate the impact of pandemics on asset returns.

Finally, our own **Microeconomic (C)** approach to assessing the impact of pandemics follows these steps:

- we first collect information about the likely structural changes by industry
- then we use Mira ABM to assess the economy-wide impact of those changes

The structural trends in the post-pandemic world existed even before, but Covid-19 become a powerful accelerant:

- **Business Travel:** regular consumer travel may recover to the full extent however, businesses have arguably gone through a culture shift, accepting the effectiveness and lower cost of video conferencing. We assume 30% of business travel never recovers. That is about 13% of airline traffic.

- **Mass tourism:** we assume a 20% decline in mass tourism, driven by higher policy-driven costs, lower scale and strong push to limit mass tourism in major destinations.
- **Working from home:** companies have found that allowing WFH saves on office space and increases productivity by saving on commuting time. While not applicable for all businesses, this will certainly become more common than before the pandemic, with implications for demand for vehicles and public transit
- **Retail:** a part of sales lost by conventional retail stores to Amazon and other platforms are probably not coming back

To be clear, time does heal everything; we do not claim that social behaviour will change permanently exclusively due to the pandemic. Although there will be certain behaviours even in decades that will be traced to Covid-19 pandemic, the more meaningful policies and economic choices are unlikely to be driven by the risk of future pandemics. What makes our input assumptions more realistic is that they made economic sense even before the pandemic, but their adoption was slow due to organisational inertia.

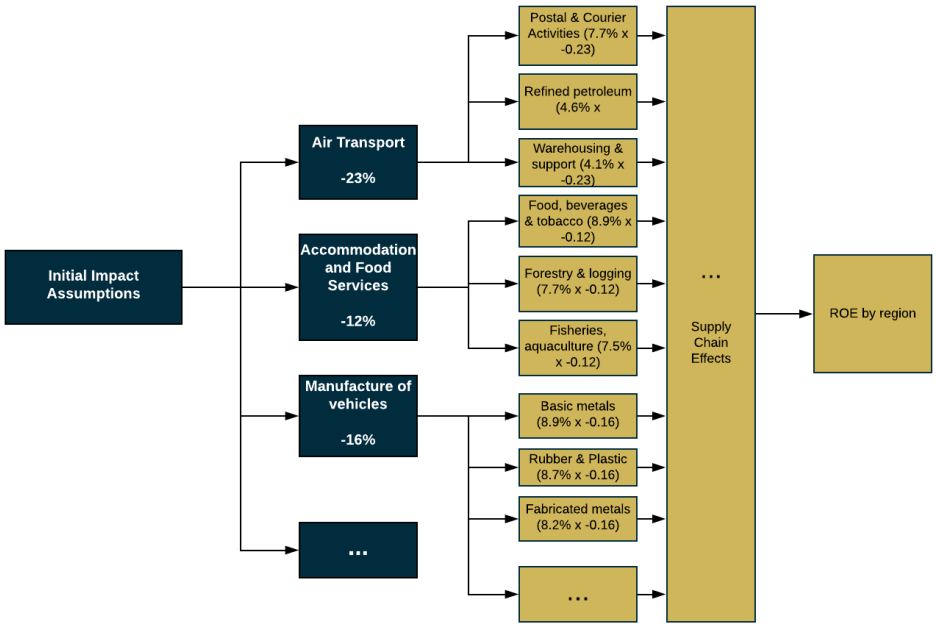
The impact of these assumptions is translated into volume impacts by industry (NACE classification that is used in Mira ABM) for relevant industries (Table 4).

Table 4: Impact of Covid-19-induced long-term changes on volumes by industry, Source: LINKS calculation

Industry	Business travel	Mass tourism	Commuting / WFH	Retail	TOTAL
Air transport	-12.8%	-10.5%	0.0%	0.0%	**-23.3%**
Manufacture of motor vehicles, trailers and semi-trailers	-0.8%	-0.5%	-15.0%	0.0%	**-16.3%**
Retail trade, except of motor vehicles and motorcycles	0.0%	0.0%	0.0%	-5.0%	**-5.0%**
Accommodation and food service activities	-11.5%	0.0%	0.0%	0.0%	**-11.5%**
Real estate activities	0.0%	0.0%	-7.5%	0.0%	**-7.5%**
Computer programming, consultancy and related activities; information service activities	0.5%	0.0%	0.5%	10.0%	**11.1%**

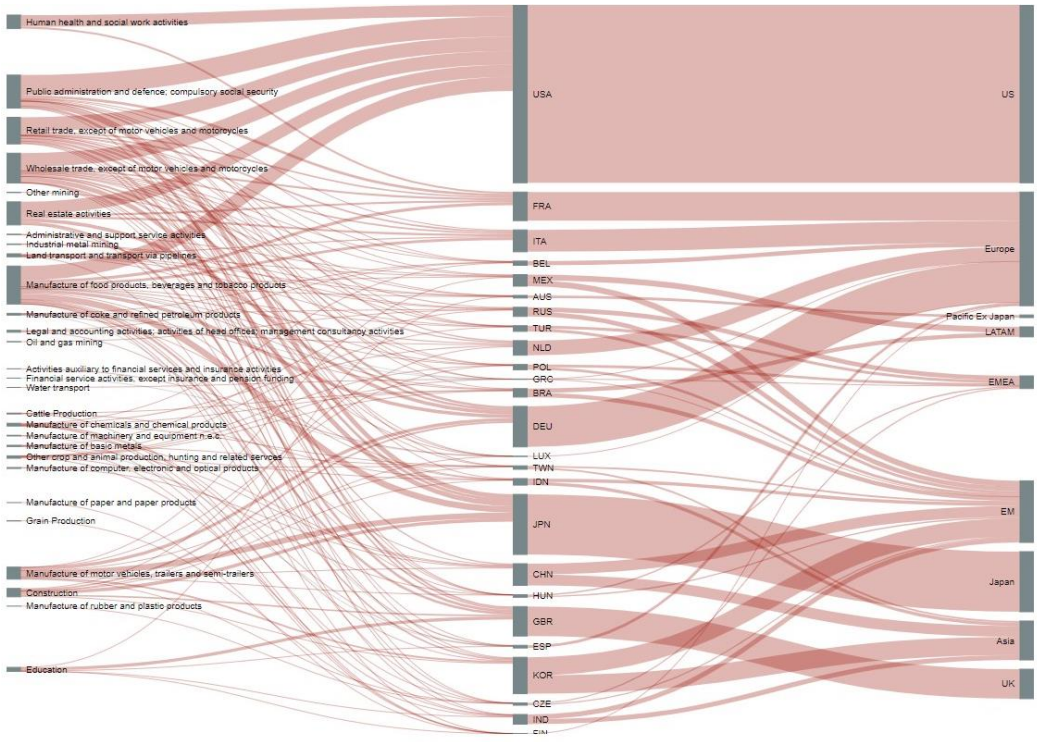
We then use the initial assumptions in Table 4 in Mira ABM to estimate the economy-wide impact. Permanently lower air traffic impacts warehousing, couriers, demand for fuel; the accommodation industry demand impacts the food and beverages proportionately; automotive industry volume impacts its suppliers. The supplying industries, in turn, impact their suppliers and so on (see the schematic depiction of supply-chain effects in Figure 14).

Figure 14: Supply chain impact of initial assumptions, Covid-19. Percentages refer to a one-off decline in volume of business. Source: Mira ABM



Most impacted industries are food, wholesale, retail in the US, Germany, France, Italy. Public administration is another sector that suffers due to falling social security payments, driven by lower level of employment and business activity (Figure 15).

Figure 15: US dollar loss of profits by region, country and industry. Profit loss is not adjusted for the size of the economy. Source: Mira ABM



Since Mira ABM has integrated asset pricing library, we are able to assess the impact of our assumptions on all asset categories. Interest rate expectations for 10-year government bond

yields are in-line with the historical study at -100 basis point long-term impact. Equities are expected to have 1-2.5% lower returns depending on the region. Despite the difference in approaches, the results are broadly in-line with historical and macroeconomic studies (Table 5).

Table 5: Summary of expected impact on equities and interest rates, Covid-19, all approaches, Source: Mira ABM, (Oscar Jord, 2020), (Lars Jonung, 2006)

Results	Mira ABM ST (instant impact)	Mira ABM LT (annual)	Historic study	Macro study (*GDP)
Equities US (MSCI)	-6% to -25%	-1.2%	na	na
Equities EU (MSCI)	-6% to -25%	-2.5%	na	na
Interest rates (Eur Govt 10 Year Yield)	-0.90%	-1.0%	-1.0%	-0.60%*

Mira ABM analysis, as any other approach, has its own caveats. Three of those may change the outcomes considerably:

- **Concentration of ownership:** equities may perform better due to concentration of ownership (share buy-backs)
- **New business models:** new business models may emerge that compensate for the shortfall in volumes
- **Demand:** actual aggregate demand will depend increasingly on transfers – universal basic income is likely to become even more essential

Finally, Covid-19 is only one of many different long-lasting trends that affect all asset classes. Pension fund boards, trustees and family offices will have to consider other, equally important long-term drivers in combination with the changes driven by Covid-19.

Conclusions

Varying degree of success in different countries to bring the level of infection down will have a significant impact on the short-term economic consequences of Covid-19. The ideal outcome requires extremely strict co-ordinated global effort to bring the infection rate down that is followed by effective testing and tracing programs. In such an event the impact on all asset classes would be minimal. A far less attractive alternative is the “herd immunity” approach, which assumes a quick (under 250 days) achievement of ~70% infection and recovery rates. Although the impact on equities in this case would be limited to -6 to -8%, loss of life and overwhelmed health care systems would be the inevitable result.

The third short-term option appears to be the one we currently experience – uncoordinated and half-hearted attempts to limit local infection rates, which results in a global transmission rate of ~ 1.5. The length of time required to reach some form of safe immunity in the absence of cure or vaccine is at least two years. The impact on equities could be -25% or more, if the “flare ups” of infection take longer.

Longer-term consequences of the pandemic may be equally significant. The historical perspective based on a several hundred years of data suggests a very long-lasting (up to 35 years) impact on

real yields of -100 basis points. Macroeconomic modelling arrives at a long-term impact on GDP of -60 basis points. Our own modelling in Mira ABM is in-line with the -100 basis point impact on the yield and further implies 1.0% and 2.5% lower returns annually in the US and Europe respectively.

These consequences are considered in isolation from all other long-lasting trends that can have equally significant impact on expected returns. Investors should consider those trends in combination with Covid-19 to arrive at valid return expectations.

APPENDIX

Sources for expectations listed in Figure 6. These assumptions are based on a rolling 12-month assessment, rather than full calendar year.

Airlines	https://www.economist.com/business/2020/03/15/coronavirus-is-grounding-the-worlds-airlines
Automotive	https://www.counterpointresearch.com/weekly-updates-covid-19-impact-global-automotive-industry/
Aircraft	https://www.intelligent-aerospace.com/commercial/article/14173923/airbus-production-covid-19-coronavirus
Hospitality	https://www.mckinsey.com/industries/travel-logistics-and-transport-infrastructure/our-insights/hospitality-and-covid-19-how-long-until-no-vacancy-for-us-hotels
Telecommunications	https://www.capacitymedia.com/articles/3825246/the-financial-toll-of-covid-19-on-telecoms
Technology	https://www.business2community.com/tech-gadgets/covid-19s-impact-on-tech-spending-this-year-02297147
Health care	https://www.aha.org/guidesreports/2020-05-05-hospitals-and-health-systems-face-unprecedented-financial-pressures-due
Food Retail	US BLS, PPI Data

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