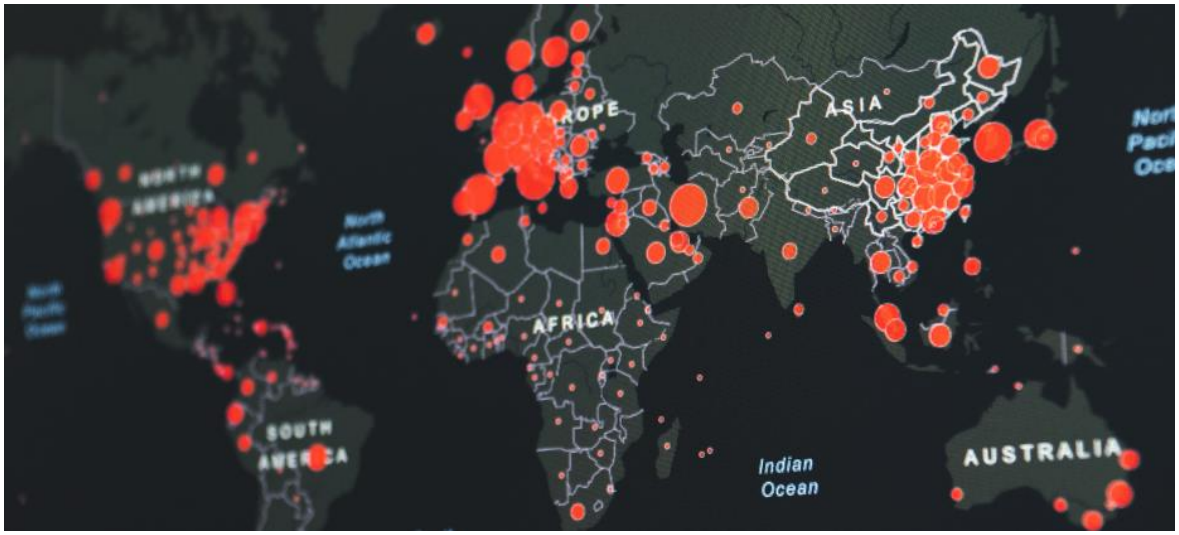
Covid-19: What Is the End Game?

We consider two likely exit scenarios of Covid-19 pandemic and the world economy, but without a need to select one. A blueprint with early data signals will guide institutional investors and help them decide when (and IF) to switch from the "bad" scenario to preparing the portfolio for the "really bad" scenario.



The spread of Covid-19 disease globally tests the limits of the usefulness of conventional statistical models for building expectations with regards to the financial markets. Indeed, if the nearest equivalent to this virus is the 1918 Spanish flu epidemic, there is very limited or no relevant data to guide us. Given the lack of historical precedent, we build scenarios using Mira's Agent-Based Modelling, which is more suitable for cases, when available history is not relevant.

In this issue of Risk Wire we develop two broad directions (scenarios) in which the sequence of events can take us, building up from the industry-level information and covering both supply- and demand-side impacts. Beyond the two scenarios, we also examine the likelihood of outcomes that are currently in the spotlight of our institutional clients and the general investment community, such as for instance stagflation. We then conclude with some remarks about certain investment cases we believe are either "hyped" (gold) or overlooked (the likely impact of the specific geographical spread of the virus). The latter could turn out to be a decisive factor in switching between scenarios and building a contingency plan specific to the fund.

The two scenarios are introduced for Mira ABM users and available on the platform*:

- LINKS Covid-19 Scenario A (the "mild" outcome), and
- LINKS Covid-19 Scenario B (the severe outcome)

The scenarios differ in the extent of "lock-down" that it takes to fight the corona virus, or rather the number of the required "lock-down" cycles that may be required. Industry-level supply- and demand-side effects of the range of scenario outcomes will help to adjust institutional portfolios in order to limit the risks and position for any recovery.

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

A separate attention is paid to the development of interest rates. Particularly, the conflicting pressures of greater supply of government papers due to the stimulus and the lower business activity that implies lower yields. However, we begin with the discussion of the likelihood of and the factors to consider about the stagflation scenario, which is not considered among our plausible scenarios.

The threat of stagflation

In 1973 the members of Organisation of Arab Petroleum Exporting Countries proclaimed an oil embargo against the nations supporting Israel during the Yom Kippur War. The price of oil quadrupled within a year and caused the best-known episode of stagflation in the US.

The parallels with the current situation cannot be overlooked:

- Sudden and severe shortage of a critical commodity could be likened to a sudden and severe shortage of most consumer and capital goods coming from China
- Increased budgetary constraints of consumers due to higher petrol prices meant a pull-back in demand, whereas demand today pulls back due to an external shock (the virus)

The combined effect prompted the economists at the time to conclude that oil price increase was directly responsible for the stagflation episode. A consensus was quickly reached: "simulation model shows that fuel inputs are sufficiently important in production that a large part of the worldwide recession may be attributed to the change in the relative price of oil, since 1973." (Jeffrey Sachs, 1979)

The similarity with the oil embargo incident may raise a question whether the current episode of a supply shock combined with falling demand due to the Covid-19 may result in stagflation. Indeed, historically, most stagflation episodes[1] have been after a sudden oil price increase. Moreover, at the extreme, oil imports were close to 3% of the US GDP, while combined imports from China are currently around 2.0-2.5% of GDP both in the US and Europe.

Figure 1: Oil prices, US imports from China as % of GDP and Stagflation episodes, Source: Bloomberg, MacroTrends, (Bertold, Grundler, 2013)

[1] There are very few "formal" stagflation episodes, but more borderline cases. In order to consider the full range of cases, we have elected to use the stagflation indicator as in (Norbert Berthold, 2013).

The similarities, however, end there. There are several reasons we believe a stagflation scenario is sufficiently unlikely not to consider it as a plausible extreme scenario in Mira ABM:

i. Oil as a homogenous, irreplaceable (non-discretionary) primary input commodity, had a significant proportion in total cost of products. The four-fold increase in price made it impossible to manufacture at the pre-crisis prices. Imports from China are heterogenous (diverse), have some substitutes depending on the product at least in the medium-term.

ii. In 1973 there was no "natural" pull-back in demand; the main cause of lower demand was lower business activity caused by oil price. Currently, an external effect limits both supply AND demand simultaneously and there is a noticeable shift in consumption towards food and staples. There are no hard data available yet, but it should not surprise anyone if demand for discretionary items (automobiles, consumer goods etc.) shrinks. While this spells bad news for the business cycle and activity, this does translate into limited demand outside the core food and staples (food price inflation is discussed below) and low likelihood of price hikes. Put it simply, most imports from China are discretionary, particularly in an environment of pandemic.

iii. Oil price is still relevant (albeit not as much) for the European and US economies and it is unwise to ignore the historically low oil price dampening the overall price levels.

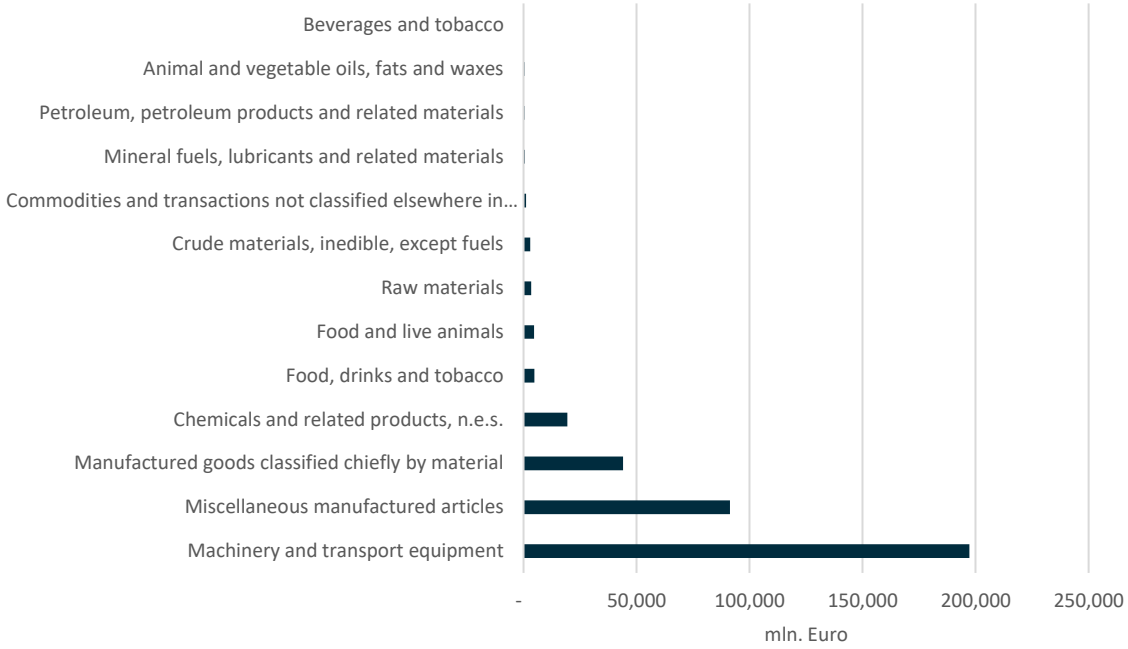
Demand for food and consumer staples, of course, has not shrank, or in fact, may have increased. But both the US and Europe are fundamentally self-sufficient in terms of key agricultural commodities and food supply chain. In the last eight months there have been significantly more exports of cereals than imports (Table 1) in Europe. The only strategically marginally important trading partner with respect to agricultural commodities for the EU is Brazil, which accounts for 9% of total extra-EU food imports.

Table 1: Cereals import/export 1/7/19 - 15/3/2020, Source: EC Customs Surveillance Data

	Export	YoY	Import	YoY
Common wheat	22,202,366	72%	1,588,908	-54%
Common wheat flour (grain equivalent)	398,952	15%	18,902	-31%
Durum wheat	695,524	39%	1,419,050	75%
Durum wheat meal (grain equivalent)	168,224	31%	924	9%
Total Wheat	23,465,067	69%	3,027,784	-29%
Barley	5,151,033	62%	550,215	365%
Malt (grain equivalent)	1,726,646	-9%	11,490	51%
Maize	3,546,157	121%	14,829,808	-14%
Rye	198,782	26%	3,236	-99%
Oats	138,482	77%	1,813	-25%
Sorghum	1,125	-66%	39,143	-92%
Total Coarse grains	10,762,225	55%	15,435,705	-15%
General Total	34,227,292	64%	18,463,489	-18%

Imports from China, on the other hand are mainly manufactured goods and machinery/transport equipment (Figure 2).

Figure 2: EU27 import from China by product group, Source: Eurostat



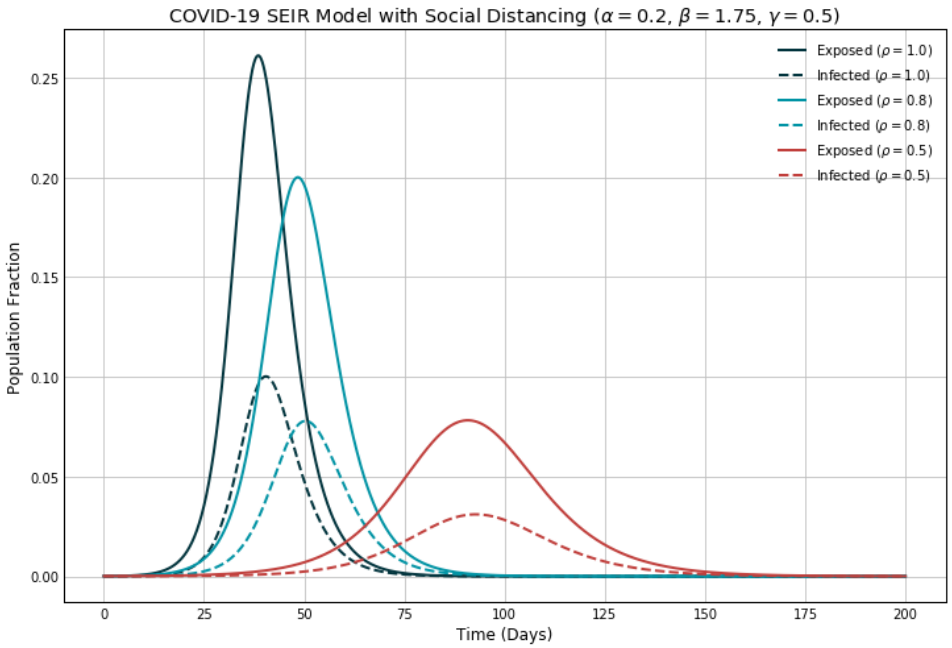
It is clear then that although on the face of it, simultaneous external supply shock from China and falling demand in the US and Europe may spell stagflation, the reality is more nuanced, as demand is likely to fall exactly in product groups that are supplied by China, while demand for food and staples is met predominantly by domestic production, which has the capacity to scale. Even if there is a significant government intervention in supporting income of the population, these subsidies are very unlikely to be directed towards purchases of capital goods or discretionary products. Such stimulus may barely cover the fixed household outlays, such as rent and insurance. A stagflation, as a scenario, in our view, is therefore implausible.

What are the relevant unknowns?

The greatest unknown is of course the **how long.** How long will the general global lock-down last? It is clear now that using the lock-down measures arrests the development of a regional epidemics, but it is also plausible to assume that relaxing the lock-down measures would increase the risk of a second or third wave of a virus. Since China was the first to successfully arrest the development of the epidemic, it is China's example that is most relevant. More specifically, will China manage to successfully **and safely** re-launch its economy without another flare up of the virus? How many such "waves" of lock-downs lasting 3-4 weeks each will be necessary to get to the ultimate end-game of either a vaccine or "herd immunity"?

The dynamic of epidemiology is very similar to the supply chain models used in Mira ABM (in fact, epidemiology was the main inspiration behind Mira ABM modelling). Assuming no social distancing measures, a pandemic of the Covid-19 would reach a 60-70% exposure within ~50 days (Figure 3). In terms of initial disruption this would be mild, however, this would overwhelm the hospitals and result in ~80% of population infected simultaneously, causing death rate of 4% of population. This would be devastating in terms of the post-virus world both morally and economically.

Figure 3: Modelling of Covid-19 pandemic spread, with Rho denoting social distancing (1 - no distancing, 0 - total house confinement), Source: (Hubbs, 2020) [2]



This explains the current measures of social distancing required (red line in the graph), that indicate a 60-70% of exposure rate of 110-120 days. If we consider the first days of pandemic in January and the combined global effort of social distancing as at least 50% effective (the coefficient Rho in the graph), this points us in the direction of end of April as a potential end of the "lock-down" phase. This is our **Scenario A**, in which after four months of lock-down China successfully re-opens its production capacity, while the rest of the world slowly gets back to work in May.

There is of course a significant risk to this scenario. While the global economy is fully integrated and operates as one, social distancing policies are taken inconsistently and with delay. China's approach has been to arrest and isolate the spread of virus, elsewhere in the world the spread has not been contained yet. It is possible that the propagation of the epidemic follows a series of separate curves, each similar to the one in Figure 3, sequentially connected together in one long and flat curve. In that case, there is a significant chance of the virus returning to China (re-imported) after the lock-down there is over. In terms of modelling, this would mean an artificially very high social distancing (Rho) value of say 0.8-0.9. This would further limit the deadliness of the virus but would also extend the required lock-downs significantly – by up to 8-9 months or longer, until a vaccine is available. This would be our **Scenario B** (Table 2).

[2] Simple test codes in Python are available from the source to run alternative epidemic scenarios for those interested.

Table 2: LINKS Covid-19 scenarios and early signals

	Description	Early signals
Scenario A	*China successfully manages to restart its production. European and US manufacturing down 10% in volume but manages to continue operations. Services sector, including aviation, miss 4 months of operation.*	Inventory series in March and April fall, there is no significant new Covid-19 cases after April.
Scenario B	*China fails to safely restart its production. European and US industries suffer due to supply chain problems. Oil and airlines industries continue to struggle up to 8-9 months.*	Inventory series in March and April do not fall, or they do and there is a spike in Covid-19 cases.

We model each scenario based on the proportion of the year that business is shut. A decline in volume of 25% for instance means that either 50% of the industry is off-line for half a year or 100% of industry is off-line for 1 quarter. Moreover, we assume that oil industry continues to face low oil prices (Table 3).

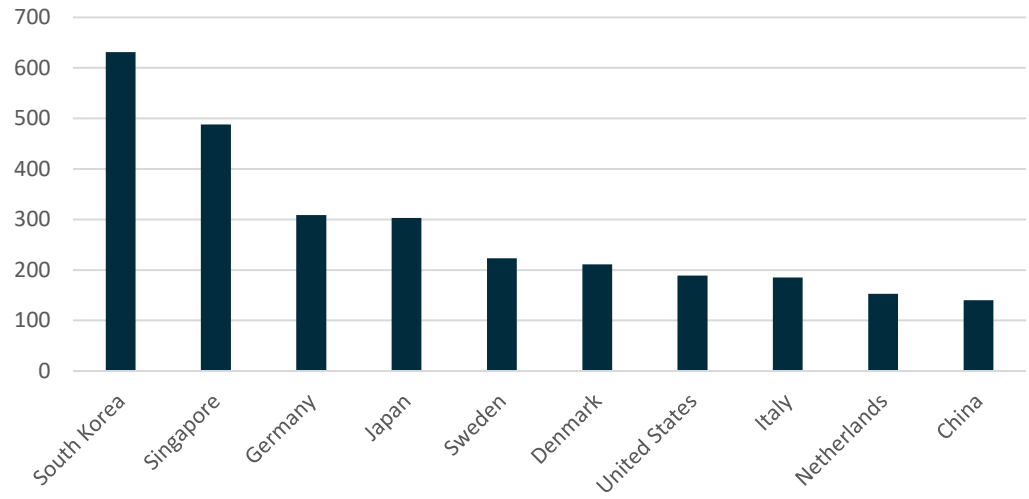
Table 3: Volume declines applied to various industries in Mira ABM by scenario, Source: Mira ABM, LINKS

	Scenario A	Scenario B
Accommodation and food services Global	-0.25	-0.5
Air transport Global	-0.25	-0.5
Manufacturing of other transport equipment Global	-0.25	-0.5
China's industry	0	-0.5
Oil and gas mining US	-0.5	-0.5
Oil and gas mining ROW	0.05	0.05
Europe/US Industry	-0.1	-0.5

In Scenario A we assume a decline in production in Europe and the US of 10%. The situation in the manufacturing industry in China was much worse due to two reasons:

- Most of manufacturing was already in stand still due to the public holiday
- China's level of automation, although rising, is still far behind the US and European factories that may be able to continue operations due to the low density of employees (Figure 4).

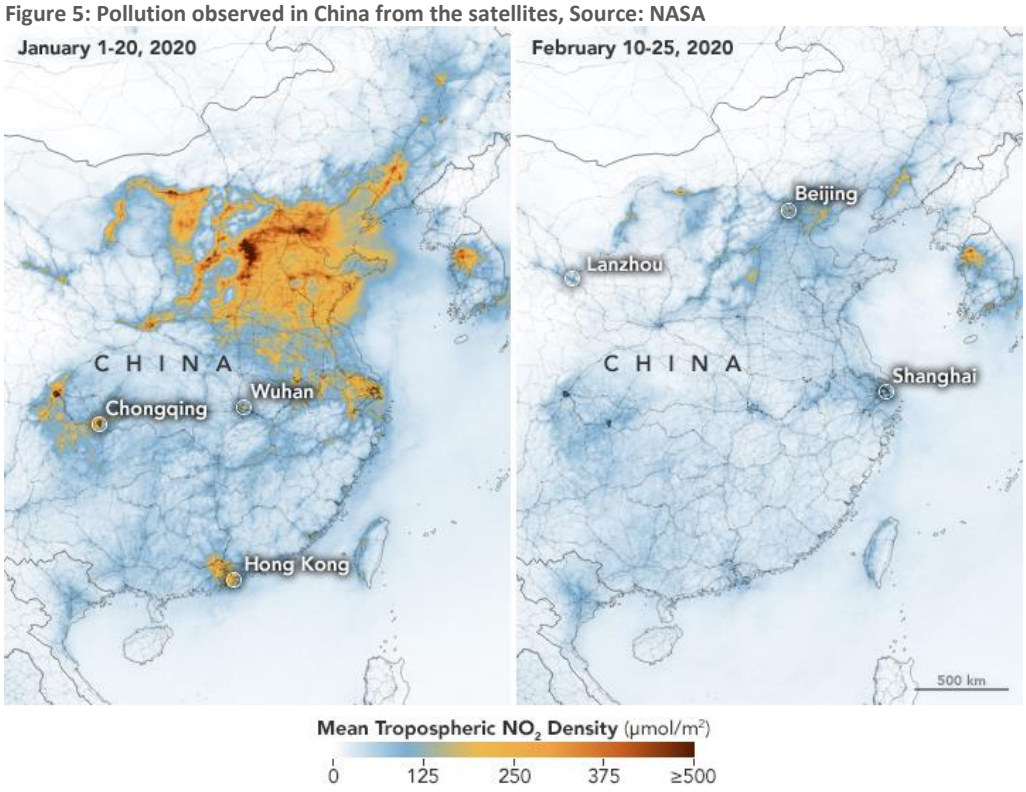
Figure 4: Number of industrial robots per 100,000 employees, Source: International federation of robotics



The portfolio action in each case would need to be different, which is why it is essential to differentiate the scenarios based on early pre-defined signals. Since China was the first country to go through the lock-down, it would be sensible to base the scenario signals on the success (or failure) of China to get back on-line.

The pace at which the Chinese economy came to halt is remarkable. The situation was probably worsened (economically) by the fact that the crisis hit in the middle of the national holiday season. As of the end-of-February there was no sign that the Chinese factories started to operate (Figure 5).

Figure 5: Pollution observed in China from the satellites, Source: NASA



There is limited data with high frequency to monitor the industrial activity in China. Moreover, it would be impossible to tell whether the activity fails to pick up due to the virus or due to the rapidly falling demand in Europe and the US. So far, the few data series that are telling are steel inventory numbers in China (Figure 6). These are monthly series and we have data from end of February.

Figure 6: Steel inventory in China, Source: Bloomberg

Clearly, there is no sign yet that the industrial activity has picked up. European and US companies will begin to feel the pinch only in mid-March, as the last container ships delivering the pre-virus production arrive in ports of Europe and US and all existing inventories are used up.

It is important to realise that even if China's factories begin to operate at full capacity in March, it will take at least two months before the supply chains are fully stocked, as transport capacity between China and US/Europe has been cut by 60-80% (so-called "blank sailings", i.e. cancellations of cargo ship sailing). This capacity is impossible to bring back on stream overnight, as just like with airliners, any disruption in schedule results in the wrong ships at the wrong ports, except it takes much longer for the ships to get back to where they are supposed to be. We are locked-in this reality, which is why our Scenario A is still a "bad" scenario.

China's success or failure to return to work can be monitored by following the monthly inventory levels, as March data will be available in early April and the new Covid-19 cases, if they appear, are subsequently reported. In either case, it is not plausible to assume a rapid recovery of air travel or the services industry (hotels, restaurants and bars); in scenario A we assume a total shut down of about 4 months.

How to build a contingency plan?

Earlier we addressed the likelihood of a stagflation scenario. Mira ABM to an extent confirms the low likelihood of a stagflation. Even if we assumed a drastic government fiscal intervention, we see very small overall increase in price levels, partly due to lower oil prices.

Consequently, both Scenario A and B yield lower interest rates and lower equity prices. Unfortunately, neither scenario paints a good picture (Figure 7 and Figure 8).

Figure 7: Change in interest rates and Equity Risk Premiums, Source: Mira ABM

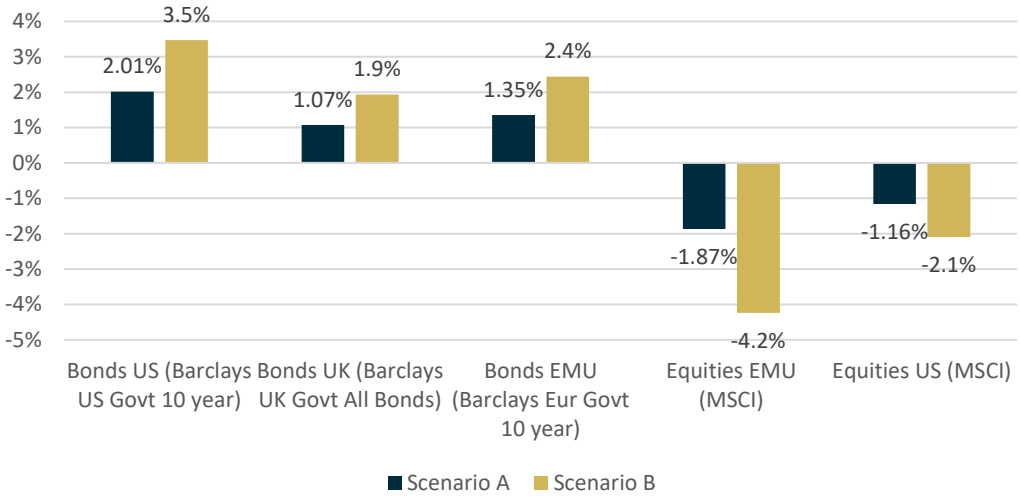
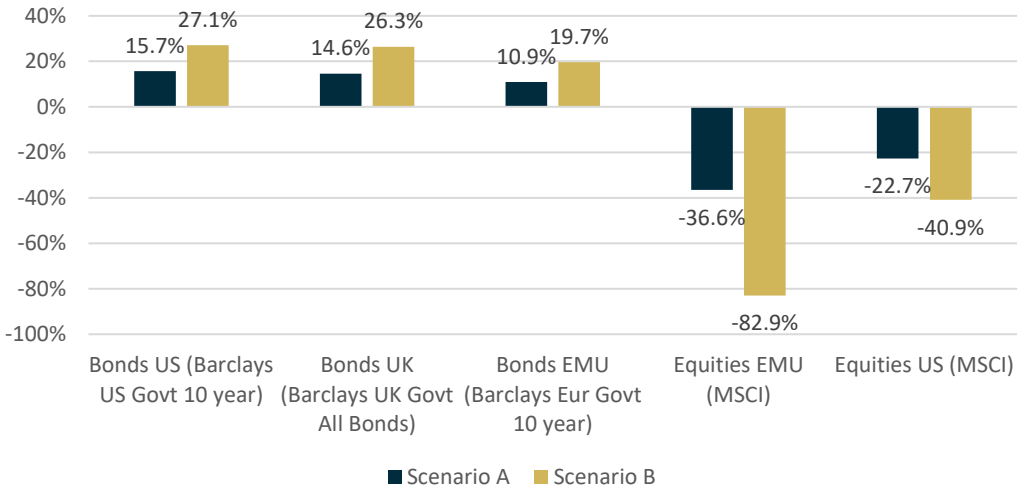


Figure 8: Price impact scenarios A and B, Source: Mira ABM



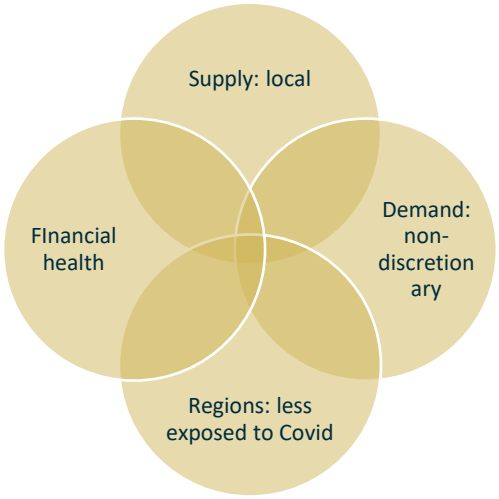
A typical Euro-based pension fund is likely to experience a decline in the Funding Ratio of mid-20s and mid-50s points in scenarios A and B respectively. Scenario B is particularly dire for European equities. It essentially wipes out the fundamental value of all equities, leaving only the "option value", which is not handled by Mira ABM[3].

As the external shock of the virus dissipates, there will be a rapid recovery due to the pent-up demand, so the temptation to do nothing may be strong, particularly in Scenario A. However, the outcome of Scenario B would be radically different, as the real risk is that of bankruptcies; there will be an impossibly large need for bailouts and it is unlikely that the governments will have the ability or the desire to bail-out all equity investors rather than businesses themselves: **the productive capacity will remain intact and bailouts would mean reorganisation, e.g. debt-for-equity swap, in which current shareholders get diluted to the extreme. In this instance, there will be a significant and permanent loss of assets.**

[3] Companies that have negative fundamental value and make losses are usually priced based on option pricing, with probabilities assigned to return to profitability. The value estimates based on this method are more uncertain than going concern valuations.

In order to inoculate the portfolio against such a severe scenario (Scenario B), there should be an express effort by institutions to restructure portfolios towards real economic value in "war-like" situations in different **geographies** depending on the virus spread. On the **supply side**, economic activities (industries) and related companies that have heavy reliance on Chinese/global supply chains will struggle to operate even if there is demand for their products. On the **demand-side**, economic activities and related companies (and commodities) that are exposed to discretionary spending will see significant issues. Finally, the **financial health** of the industry going into the crisis matters a great deal. The ideal exposure of institutional portfolios is in the intersection of these four dimensions (Figure 9).

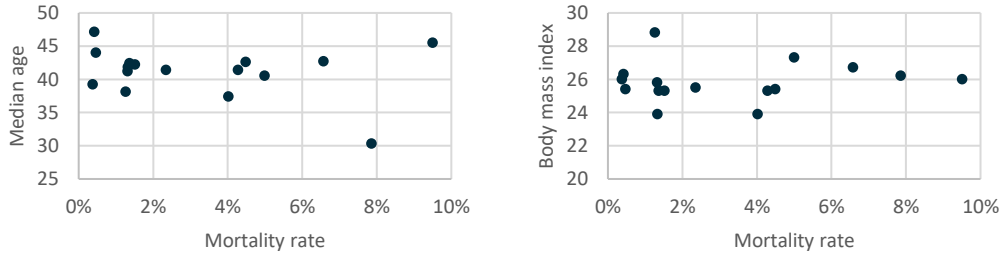
Figure 9: Assets and activities that are likely to retain value past the Covid-19 crisis in the intersection of four dimensions



Geography

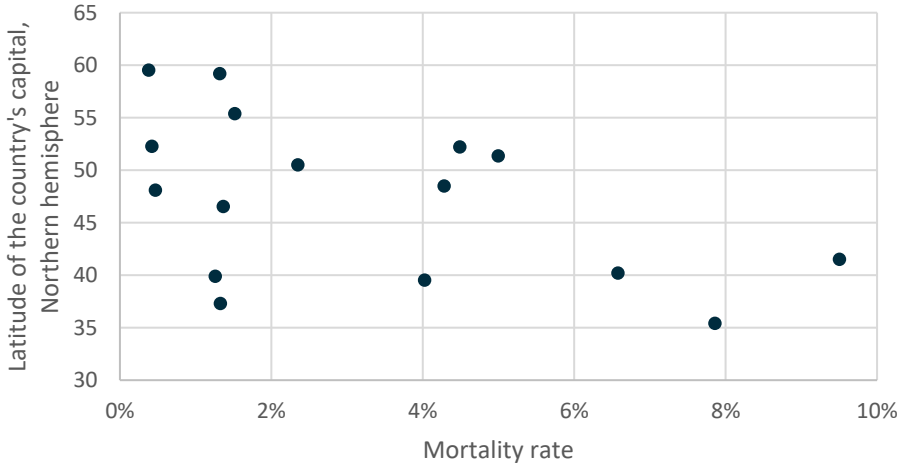
Up until recently there was an assumption that the new coronavirus would spread broadly across the world at the same pace. Initial spread appeared to be similar in different countries. However, there were significant outliers, such as Germany, Russia, Nordic countries, South Korea. We tried to explain the differences in mortality rates by population age or obesity (although both will probably have an effect in the end), but failed (Figure 10).

Figure 10: Covid-19 mortality rate and median age and body-mass index (BMI) by country, Source: Johns Hopkins Coronavirus Resource Centre, UN data on BMI and median age



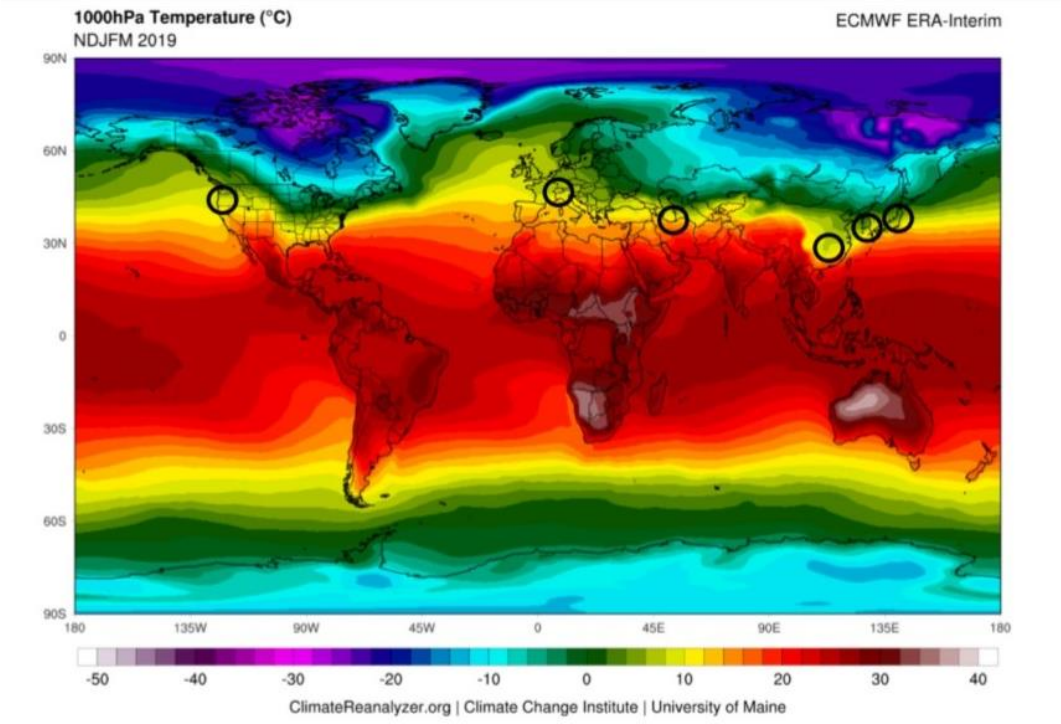
There is however a significant relationship between the geographical location of the country and the mortality rate (Figure 11).

Figure 11: Mortality rate and the geographic latitude of the capitals of respective countries, Source: Johns Hopkins Corona Virus Resource Centre, Google Maps



As it turns out, we were not the only ones to notice the relationship between the mortality rate and the geography. A recent paper published on March 9 from the University of Maryland (Mohammad M. Sajadi, 2020) indicates a consistent pattern of the "preference" for the virus in terms of temperature and humidity: 5-11C and 47-79% humidity. Remarkably, this average temperature "belt" across the globe explained the rapid spread of virus in Italy, Iran and China (Figure 12).

Figure 12: World temperature map November 2018-March 2019. Colour gradient indicates 1000hPa temperatures in degrees Celsius. Black circles represent countries with significant community transmission (> 6 deaths as of 3/5/3019). Source: (Mohammad M. Sajadi, 2020)



The bad news is, as temperatures increase in central and northern Europe and the United States, this theory suggests stronger spread of virus at least until the end of May, when the temperatures

become too warm. The geographical region that will remain "in-the-clear" is South of the 35th latitude – **most Emerging Markets (e.g. Brazil, India), southern Europe, Japan.**

Other important factors that almost certainly will affect the severity of the virus spread and mortality rates despite lack of globally available hard data are the **speed of adequate response**, **consistency of response (the coherence of the existing health care system) and pre-existing conditions (e.g. obesity, diabetes, heart conditions).** On all counts, the United States stands out as a major candidate for a disaster zone, particularly given the "temperate zone" of virus going through the main economically active states.

Financial Health

Companies and financial assets that entered the crisis in a relatively vulnerable financial health will have higher likelihood of being subject to dilutive bail outs and loss of asset value. We use several simple metrics to rank the non-financial industries in the US and Europe in terms of financial health (Table 4).

Table 4: Financial health based on Altman's Z score, Financial Leverage, Cash/Assets, average values by industry (GICS classification), Source: Bloomberg, LINKS calculations

Industry	Altman's Z-score	Financial Leverage	Cash/Assets LF
Water Utilities	0.9	6.0	4.2
Real Estate Management & Development	1.0	2.9	2.8
Diversified Financial Services	1.1	5.3	5.9
Multi-Utilities	1.1	6.3	7.0
Wireless Telecommunication Services	1.3	2.9	2.6
Gas Utilities	1.4	3.6	9.4
Electric Utilities	1.4	4.0	4.3
Equity Real Estate Investment Trusts (REITs)	1.6	1.9	1.7
Airlines	1.8	3.8	11.2
Construction & Engineering	1.8	6.4	14.5
…	…	…	…
Pharmaceuticals	5.9	2.6	8.1
Life Sciences Tools & Services	6.5	2.3	12.3
Software	6.5	2.6	8.9
Electronic Equipment, Instruments & Components	6.7	2.2	6.9
Semiconductors & Semiconductor Equipment	6.7	1.8	24.0
Health Care Equipment & Supplies	7.2	2.2	4.9
Technology Hardware, Storage & Peripherals	8.4	1.8	28.0
Building Products	10.8	2.0	10.8
Entertainment	13.3	3.5	23.9
Biotechnology	15.1	1.8	22.1
Leisure Products	22.3	1.4	17.8
Interactive Media & Services	36.9	3.4	14.5

Supply-side effects

In scenario B, the spread of virus is extended over time and China fails to re-open its production capacity. In such a case, companies exposed to the global supply chains would struggle to operate, as even now the existing inventories of supplies are being depleted. We identify industries most and least exposed to the global supply chains, particularly intermediate imports from China (Table 5).

Table 5: Most and least exposed industries to China in terms of costs (NACE classification), Source: LINKS Mira ABM

Economic activity	Country	Imports from China as % of costs
Insurance, reinsurance and pension funding, except compulsory social security	ITA	0.02%
Insurance, reinsurance and pension funding, except compulsory social security	USA	0.05%
Manufacture of coke and refined petroleum products	AUS	0.07%
Real estate activities	GBR	0.08%
Manufacture of coke and refined petroleum products	GBR	0.10%
Air transport	USA	0.10%
Manufacture of coke and refined petroleum products	USA	0.11%
Insurance, reinsurance and pension funding, except compulsory social security	FRA	0.13%
Real estate activities	USA	0.14%
Financial service activities, except insurance and pension funding	ITA	0.14%
...	...	...
Manufacture of textiles, wearing apparel and leather products	NLD	8.03%
Manufacture of machinery and equipment n.e.c.	AUS	8.53%
Manufacture of computer, electronic and optical products	GBR	8.54%
Manufacture of textiles, wearing apparel and leather products	AUS	8.67%
Manufacture of electrical equipment	NLD	8.69%
Telecommunications	NLD	9.30%
Manufacture of electrical equipment	AUS	9.56%
Manufacture of machinery and equipment n.e.c.	NLD	9.57%
Manufacture of computer, electronic and optical products	NLD	11.86%
Manufacture of computer, electronic and optical products	AUS	17.11%

Demand-side effects

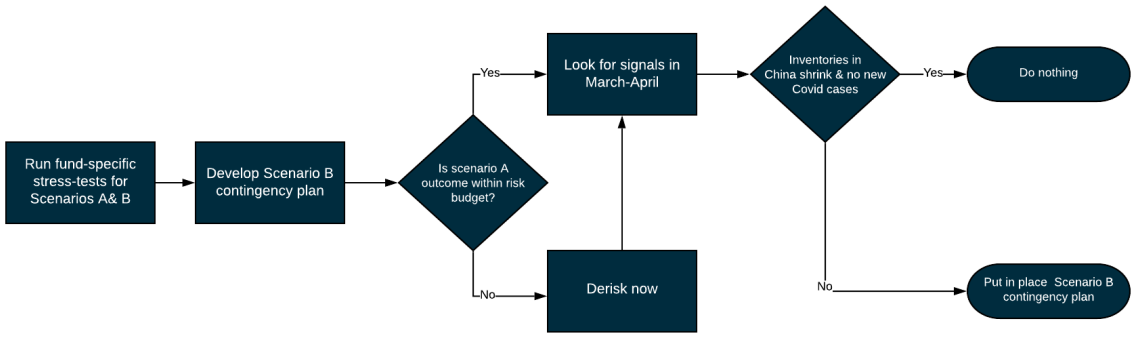
Finally, in terms of demand-side effects, any discretionary spending is likely to be delayed or cancelled, which leaves the traditional industries: consumer staples, health care, telecommunications, utilities and energy.

It is important for the funds to act now: time is of essence. Every fund should have in mind a **Scenario B contingency action plan specific to the fund's mandate**, including a target portfolio that is likely to survive a "war-like" scenario due to its combination of economic exposures in the intersection of the four drivers discussed above. Although very few investments fall completely in the intersection, there are some investments that do and others that are close enough:

- Commodities: agricultural commodities, energy
- Equities: conventional energy (non-shale), financials, insurance, consumer staples, health care, media – all within a mix of EM and Asian/Southern DM
- Bonds: increase (or not cutting) core interest rate hedges, Eurozone periphery
- FX: USD, Energy-related EM currencies

There is no need to know beforehand which scenario will come to pass: to an extent, that is the whole point of scenarios. Instead, the funds should be prepared for both eventualities and put in place specific **contingency plans for scenario B**, including the model portfolio, triggers and sequence of transition. The "Covid-19" blueprint (Figure 13) should help funds create a response program.

Figure 13: Blueprint for Covid-19 portfolio management



Conclusions

The purpose of our focus on economic activities in the portfolio is not to seek the most risk-less investments, but rather build a **Scenario B contingency portfolio unique to the fund** that is likely to benefit from "the light at the end of the tunnel", while at the same time having the highest chance of remaining solvent throughout an extended "war-like" crisis. This portfolio and corresponding plan, using different equity, bond and commodity benchmarks, should be specific to each fund, liquid, easily implementable and can be constructed and tested using Mira ABM.

Most importantly, it is not necessary to guess whether Scenario A or Scenario B will come to pass. It is perfectly safe to operate under the assumption that Scenario A is the base case, provided that the fund's risk budget can afford the outcome of Scenario A. If, however we are wrong and the spread of the virus cannot be stopped by up to 4 cycles of 3-4-week lock-downs, we will have early signs in April. At that point it would be time for urgent action and the funds will not have time to consider and discuss various options. The contingency plan should already include all relevant triggers and changes in the portfolio that are pre-approved and comply with the investment mandate.

Finally, several categories of "hyped" investments have not been discussed in the report as an alternative. Although gold (or bitcoin or any other alternative to fiat currency), as an example, is perceived and touted to be the ultimate hedging instrument, its capacity to be a safe haven is limited by the need to buy and store physical gold in scale, which is already prohibitive for most large institutions, but also by the inconsistent pricing behaviour through the crises. Even in the extreme situations, enforceable claims against assets with economic meaning have better "hedging" capacity than gold. In our opinion, any attempt to preserve wealth beyond the confines

of our current "system" is meaningless by definition, since the concept of wealth itself is a construct of that system.

Another alternative often considered is hedging risk using various derivatives. Such an approach may be effective if considered continuously and put in place well in advance of any increase in risk environment, bearing the cost of continuous hedging permanently. Adding hedges when the risks are apparent would simply crystalize worst-case scenario losses or be simply impossible. Unfortunately, there is little alternative to contingency planning and rapid action.

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