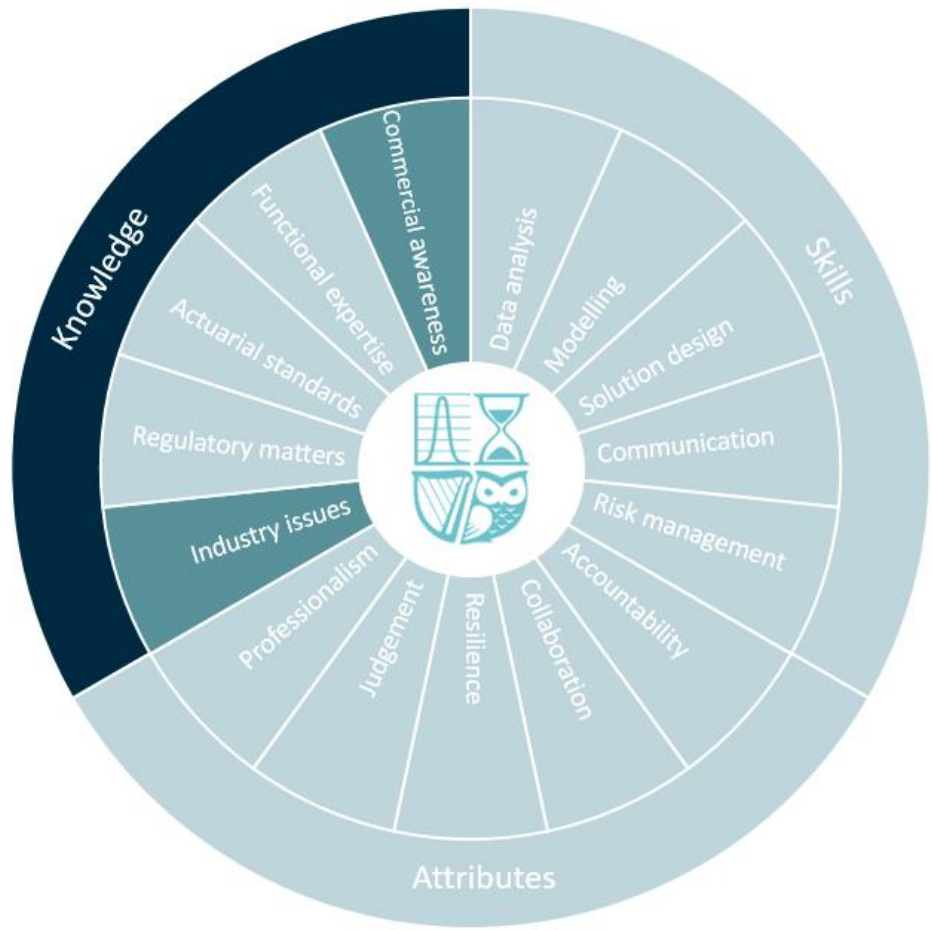


SAI Competency Framework



Disclaimer

The views expressed in this presentation are those of the presenter(s) and not necessarily those of the Society of Actuaries in Ireland or their employers.





The Big Picture

Investing in an uncertain world

April/May 2020

Paul Jackson

Global Head of Asset Allocation Research
Global Thought Leadership

For professional clients/qualified investors/qualified
clients/sophisticated investors only



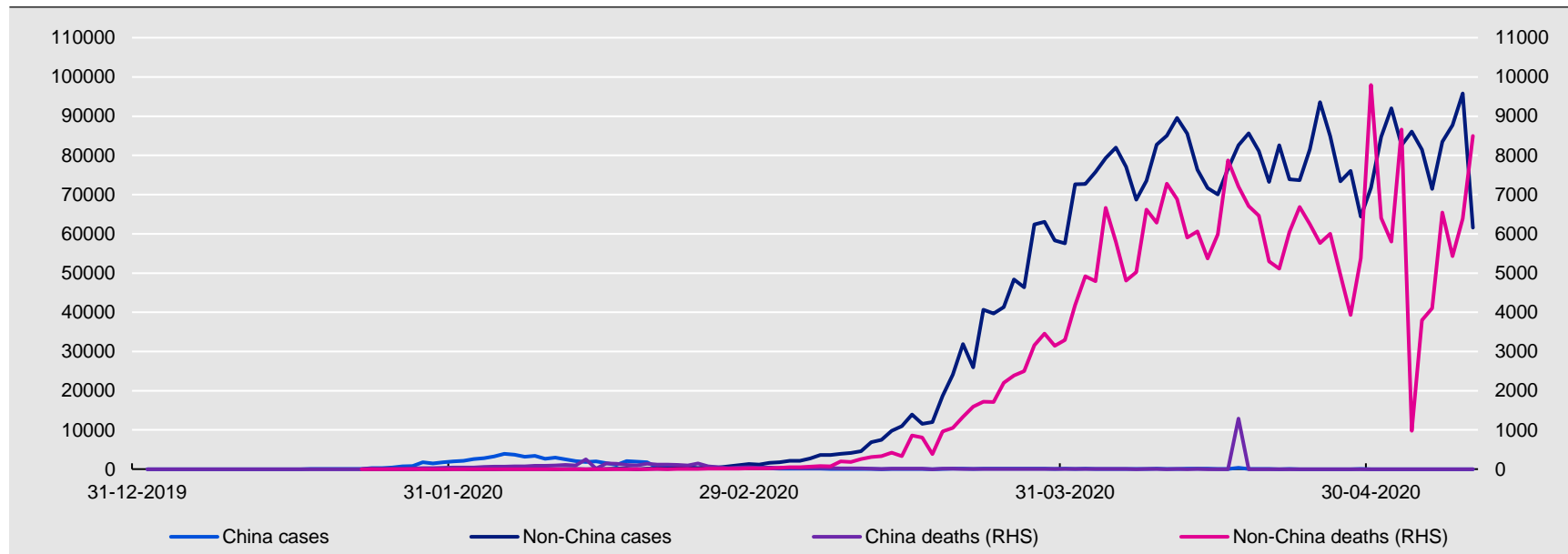
Potential panic circuit breakers



- **Vaccine (12-18 months away)**
- **A clear peak in daily cases and deaths outside of China**
- **Massive policy support**
 - Protect cash flows of businesses and households
 - Enable banks to shoulder the burden for their clients (loan creation)

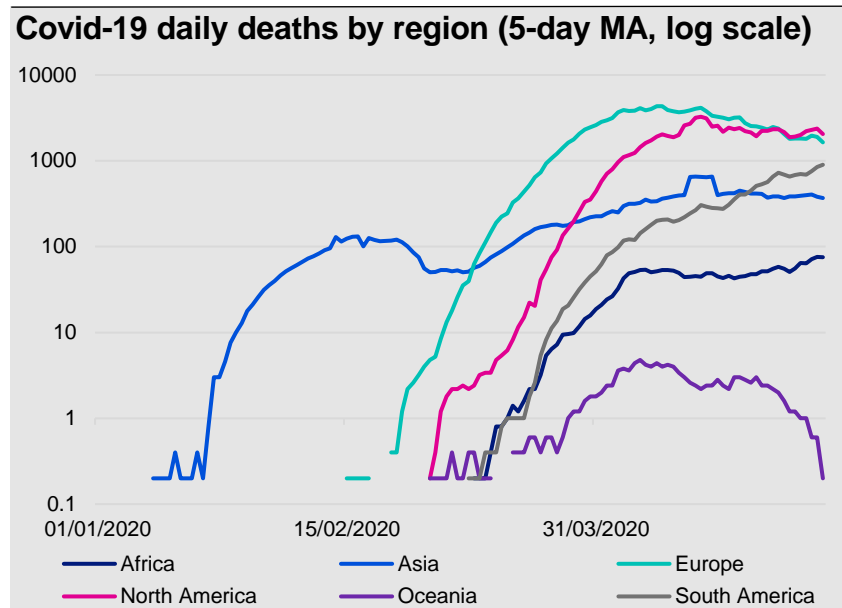
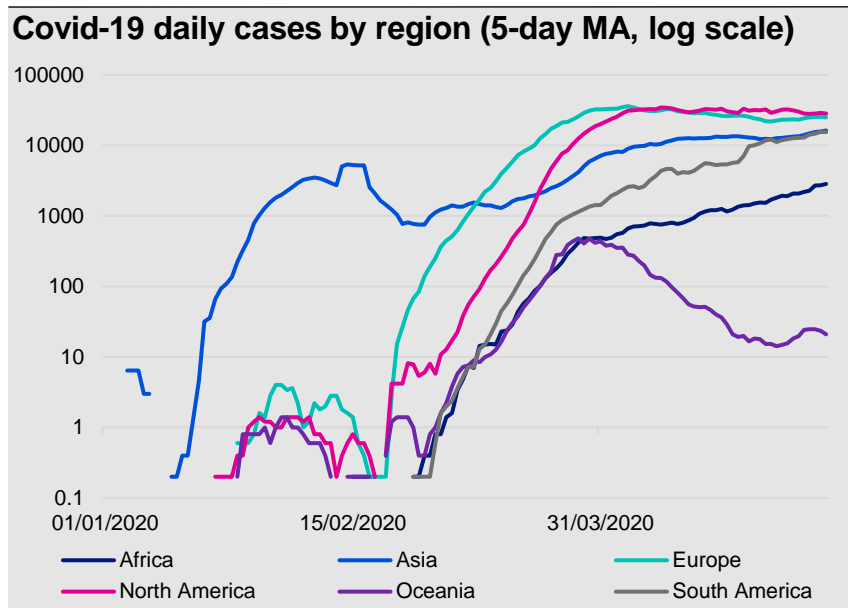
Coronavirus daily cases and deaths (31 Dec 2019 -)

Have non-China case and death rates peaked?



Note: Coronavirus data is daily from 31 December 2019 to 10 May 2020 with geometric interpolation of data until 21 January 2020. Source: WHO and Invesco.

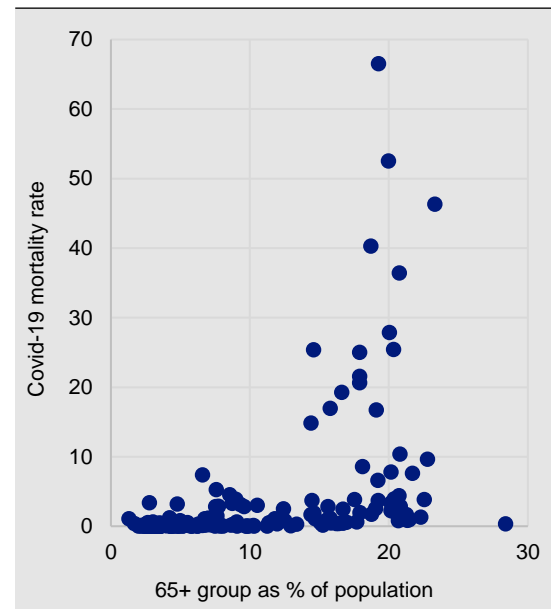
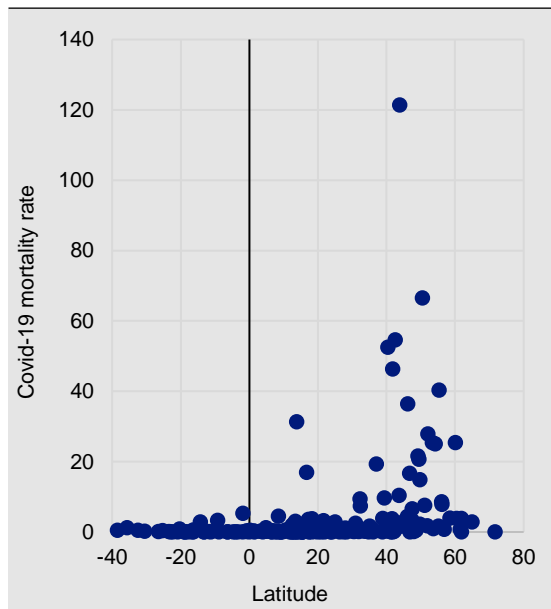
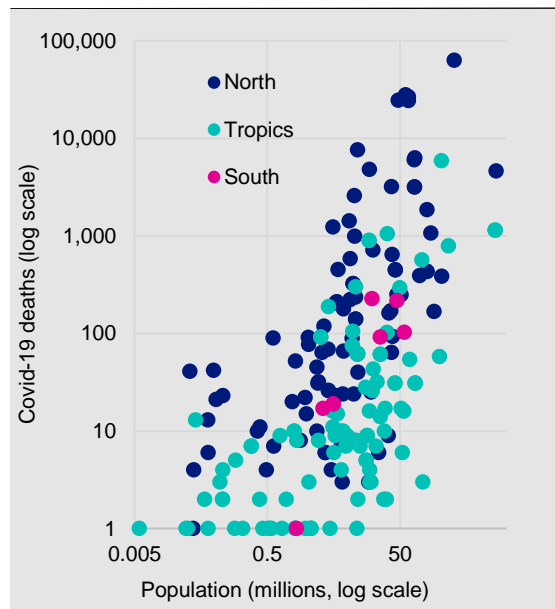
Covid-19 data by region



Based on daily data from 1 January 2020 to 11 May 2020. "5-day MA" is a five-day moving average. Source: European Centre for Disease Prevention and Control and Invesco

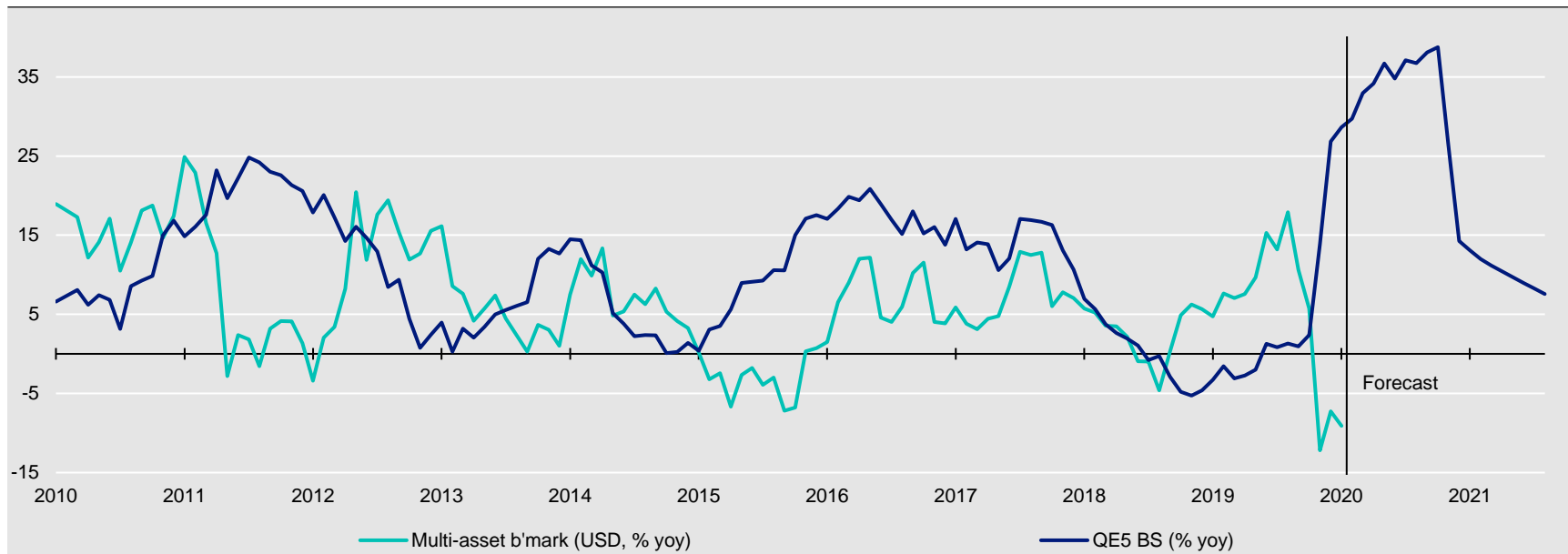
Based on daily data from 1 January 2020 to 11 May 2020. "5-day MA" is a five-day moving average. Source: European Centre for Disease Prevention and Control and Invesco

Covid-19 mortality rates, geography and demographics



Note: Covid-19 mortality rate is the number of Covid-19 deaths per 100,000 of population (the latter as of 2018). Latitude is the geographic latitude of each country as provided by Google Developers. "North" is the group of countries with latitude greater than 23.5 degrees. "Tropics" is the group of countries with latitude between -23.5 and +23.5 degrees. "South" is the group of countries with latitude less than -23.5 degrees. "65+ age group as percent of population" uses United Nations projections for 2020. As of 11 May 2020.
Source: European Centre for Disease Prevention and Control, Google Developers, United Nations and Invesco

QE5 balance sheet growth and asset returns



Note: QE5 BS is the aggregate balance sheet of Fed, ECB, BOE, BOJ and SNB in USD, rebased to 100 in May 2006. Forecast considers asset purchase plans of the central banks but ignores other sources of growth. The Fed has announced unlimited purchases, which we assume occur as follows: \$120bn per month during May and June 2020, \$60bn per month during 2020 H2 and \$30bn per month during 2021. The ECB has announced plans to purchase €1.1 trillion of assets in 2020 and we assume a halving of purchases thereafter. The BOJ has announced a doubling of the rate of ETF purchases: we assume \$45bn asset purchases per month in 2020 and \$30bn per month in 2021. The BOE has announced £200bn of purchases (we assume they occur smoothly during 2020, with a halving of the rate in 2021). The SNB has announced no plan but we assume \$10bn per month in 2020, with a halving of those rates in 2021. The multi-asset benchmark is a fixed weighted index based on the Neutral asset allocation of Invesco's Asset Allocation Research team. Monthly data from January 2010 to December 2021. As of 12 May 2020. Past performance is no guarantee of future results. Source: BOE, Refinitiv Datastream and Invesco

What would quarterly shocks imply for full year GDP growth?



Figure 1: Assumed variation versus baseline global GDP level forecast

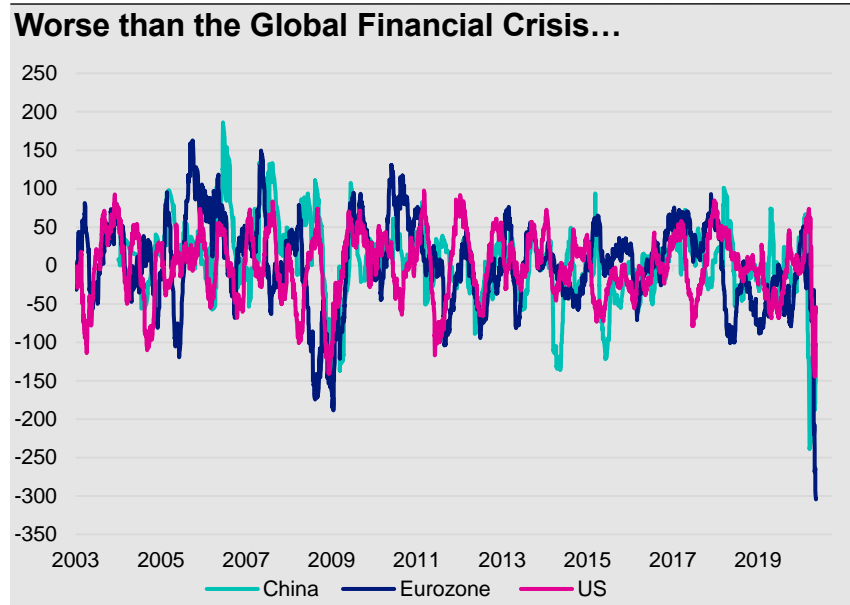
	2020 Q1	2020 Q2	2020 Q3	2020 Q4	2021 Q1	2021 Q2	Thereafter
Very Best	-5%	-15%	7%	10%	3%	0%	0%
Best	-5%	-20%	7%	10%	5%	3%	-1%
Worst	-5%	-20%	0%	10%	10%	5%	-2%
Very Worst	-5%	-25%	-5%	10%	10%	10%	-2%

Figure 2: Summary of implied global GDP growth rates by scenario (%)

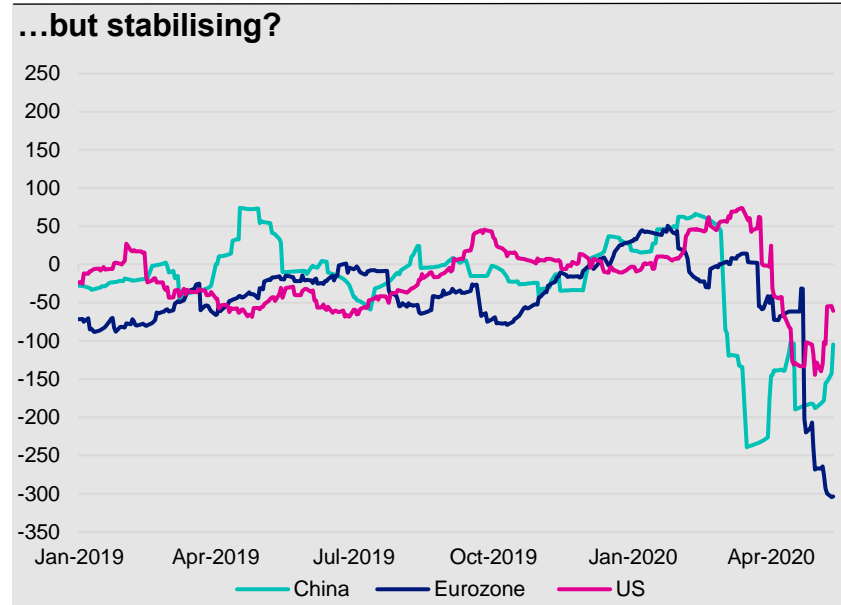
	2019	2020	2021	2019/20	2020/21	2021/22
Very Best	3.0	2.3	4.5	1.7	5.7	1.7
Best	3.0	1.0	6.6	1.7	4.9	2.4
Worst	3.0	-0.8	9.8	1.7	4.4	2.6
Very Worst	3.0	-3.4	14.1	1.7	1.8	6.5

Note: in Figure 1, the baseline forecast is for 3% GDP growth in each year, with growth equally spread throughout the year. The numbers in the table show the percentage variation in the level of GDP versus what would have been seen in the baseline. In Figure 2, the growth rates are based on the quarterly profiles shown in Figure 1. 2019/20, 2020/21, 2021/22 show the growth rates for the year starting 2019 Q2, 2020 Q2 and 2021 Q2, respectively. These scenarios are for illustrative purposes only and are not forecasts. Source: Invesco

Citigroup economic surprise indices

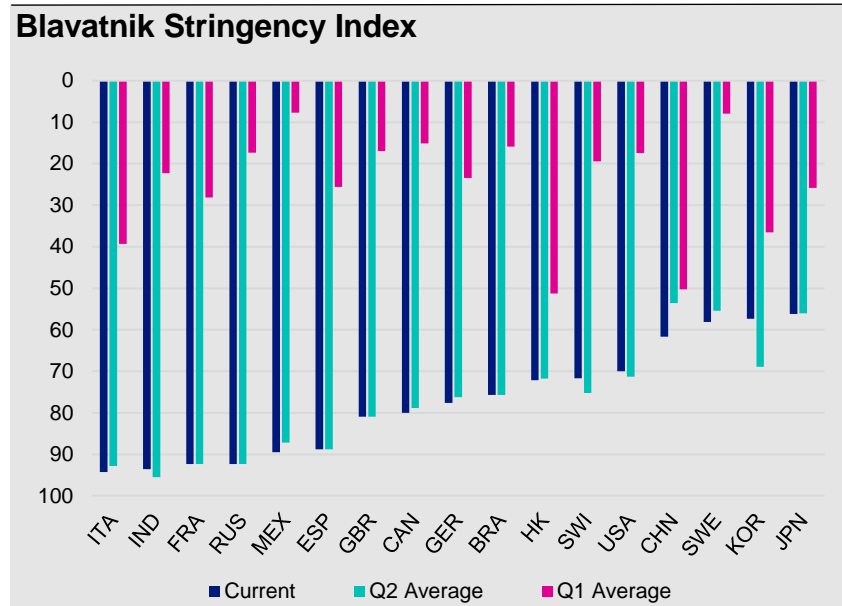
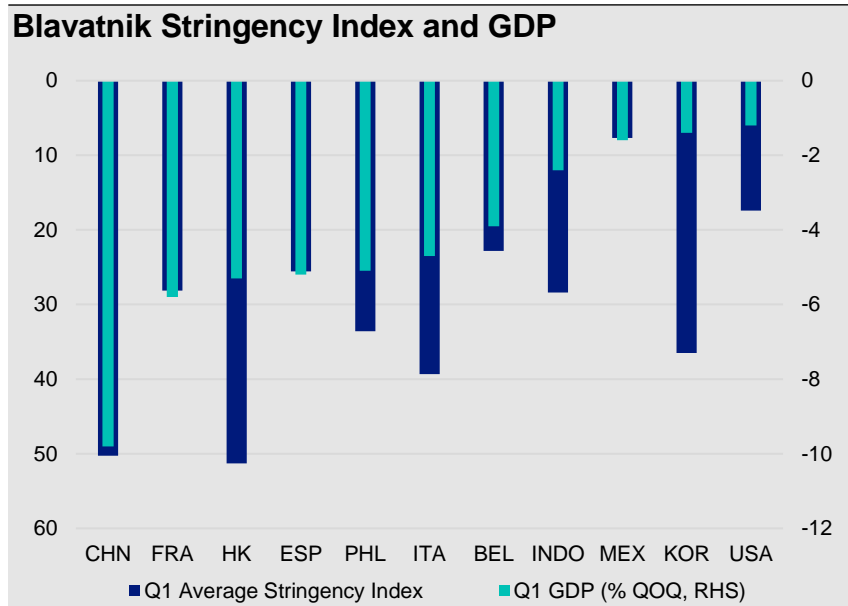


Daily data since 1 January 2003. As of 12 May 2020.
Source: Citigroup, Refinitiv Datastream, Invesco



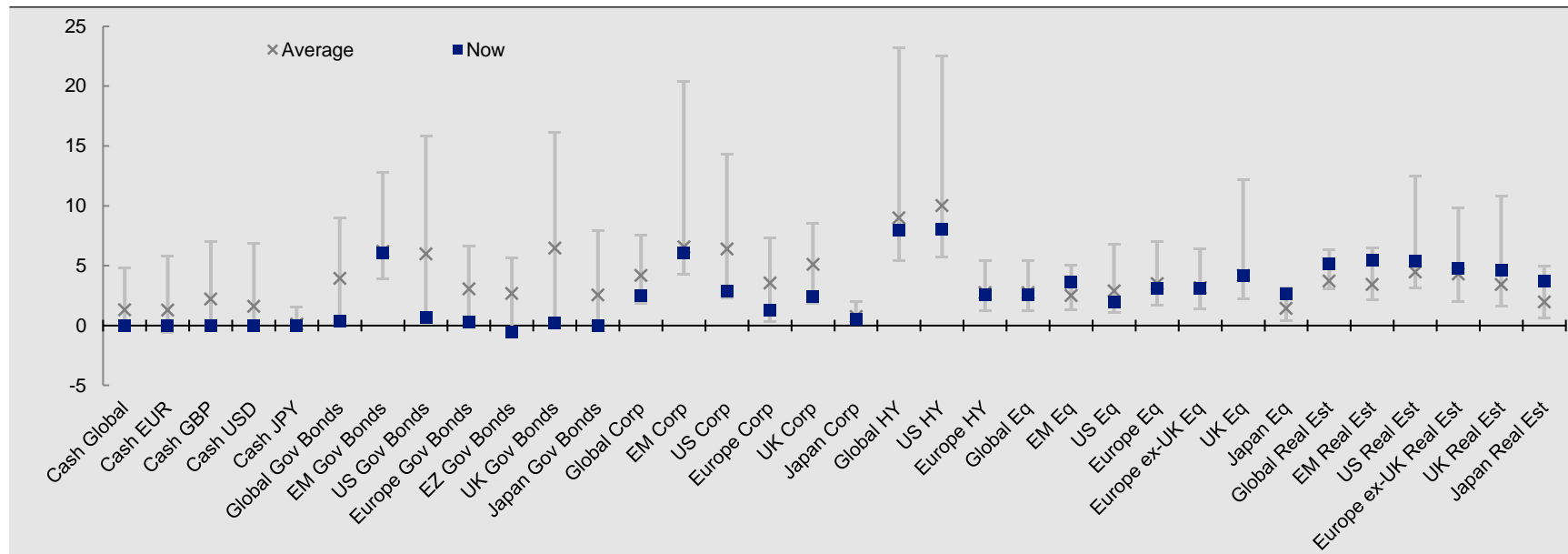
Daily data since 1 January 2019. As of 12 May 2020.
Source: Citigroup, Refinitiv Datastream, Invesco

Shutdowns and lost economic activity



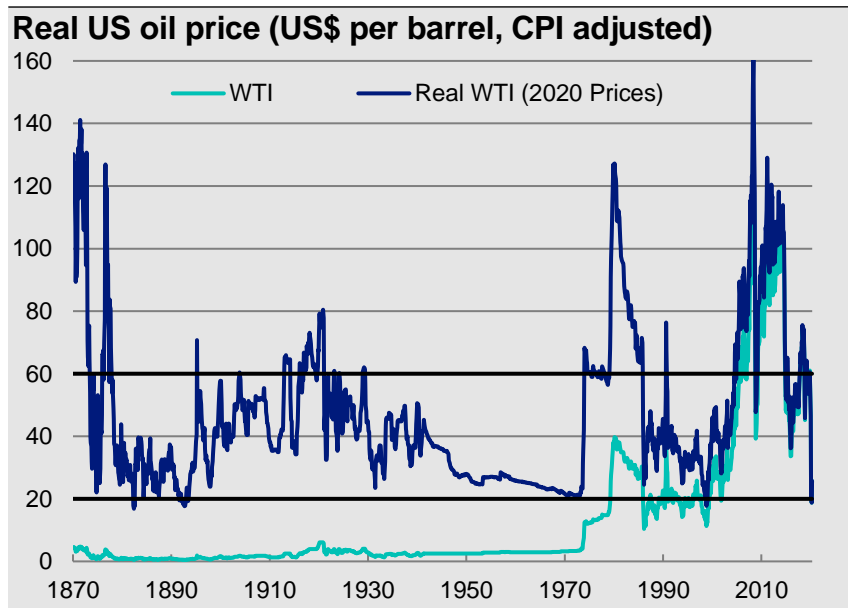
The "Blavatnik Stringency Index" is the Oxford Covid-19 Government Response Stringency Index from the Blavatnik School of Government, Oxford. It measures the stringency of government responses to Covid-19, including the extent of school, business and travel shut-downs but also includes policy measures (both monetary and fiscal) and healthcare actions (testing etc.). The index ranges from 0 to 100, with higher scores indicating a more stringent response. The current value is as of 5 May 2020 and the Q2 average is calculated up to that date. GDP is calculated as the seasonally adjusted quarter on quarter change during 2020 Q1 (not annualised). See appendices for country abbreviations. Source: Blavatnik School of Government, University of Oxford, Bloomberg and Invesco

Asset class yields within historical ranges (%)

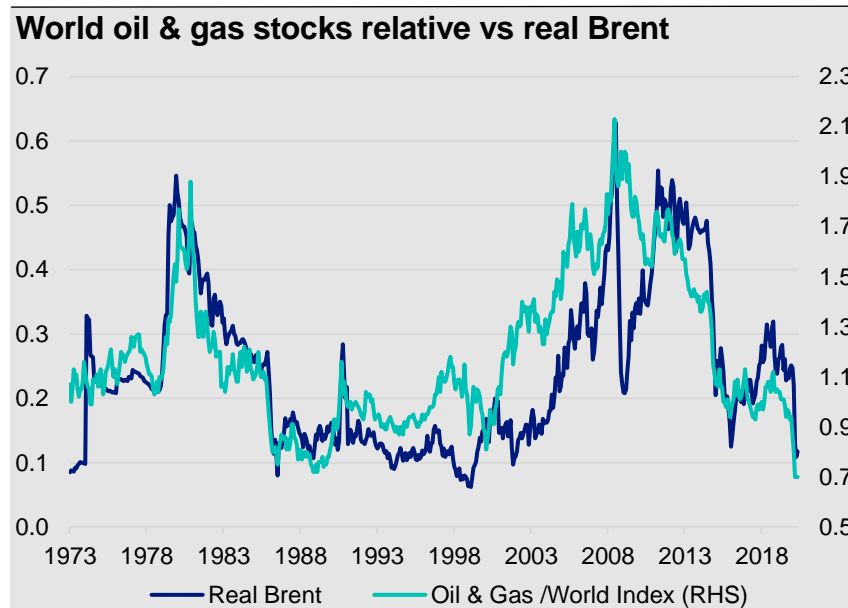


Notes: As of 12 May 2020. Past performance is no guarantee of future results. See appendices for definitions, methodology and disclaimers. Source: Bloomberg Barclays, BofAML, FTSE, JP Morgan, Refinitiv Datastream, Invesco

We think oil assets are cheap

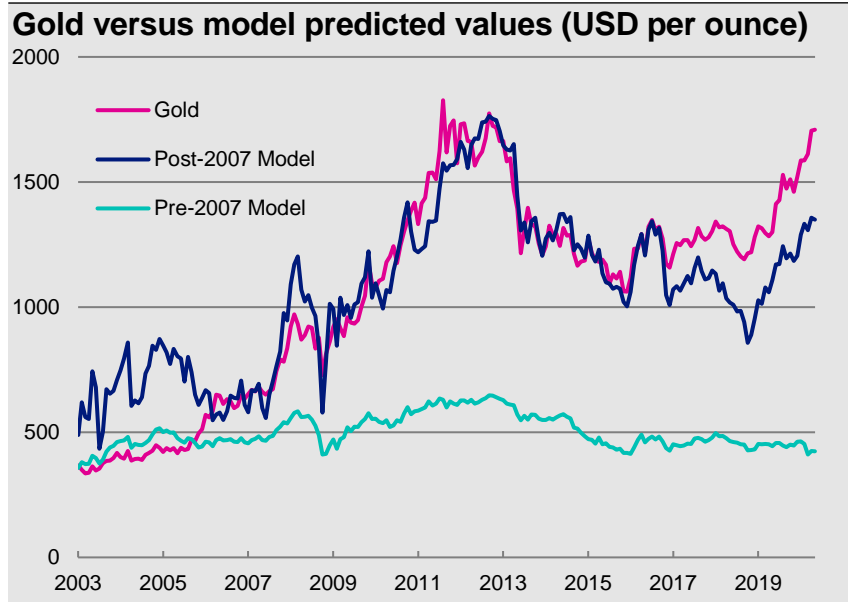


Monthly data since January 1870. As of 12 May 2020. WTI is West Texas Intermediate. Past performance is no guarantee of future results.
 Source: Global Financial Data, Refinitiv Datastream, Invesco

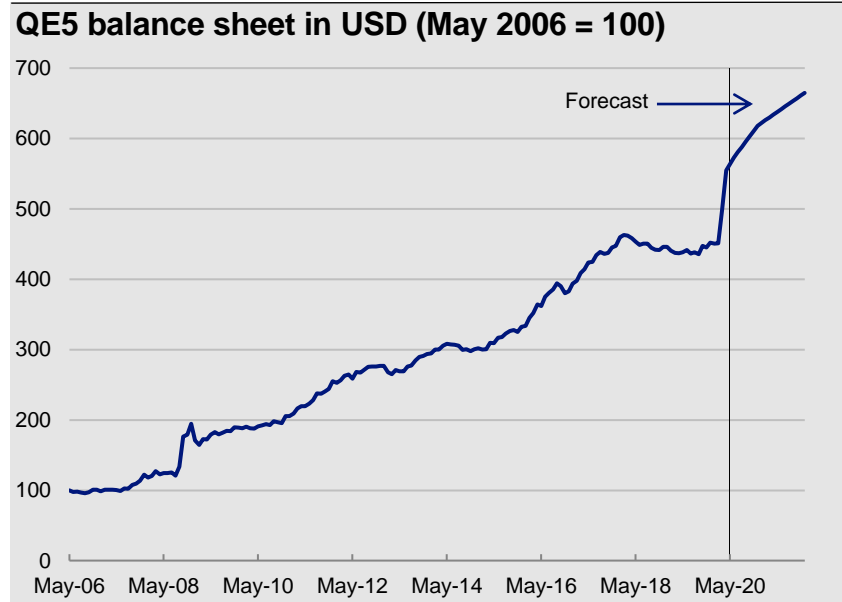


Note: Monthly data from January 1973 to May 2020 (as of 12 May 2020). Oil & gas relative is the Datastream World Integrated Oil & Gas Index divided by the Datastream World Index. Real Brent is the USD price per barrel of Brent of oil divided by the US CPI index. Past performance is no guarantee of future results. .
 Source: Refinitiv Datastream and Invesco

Drivers of gold



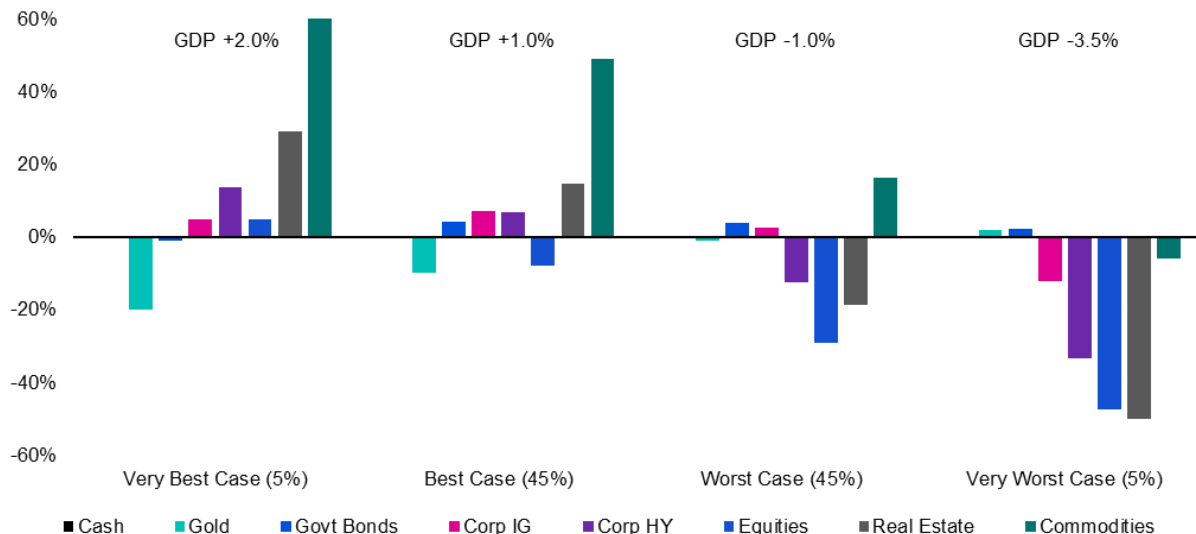
Monthly data from January 2003 to April 2020 (as of 12 May 2020). Gold is modelled as a function of real 10-year US Treasury yield, 10-year US inflation breakeven and trade-weighted USD. “Pre-2007 Model” is based on data from 31 January 1997 to 31 December 2006. “Post-2007 Model” is based on data from 31 January 2007 to 30 June 2016. There is no guarantee that these views will come to pass.
Source: Refinitiv Datastream and Invesco



Note: QE5 balance sheet is the aggregate balance sheet of Fed, ECB, BOE, BOJ and SNB in USD, rebased to 100 in May 2006 (see appendix for forecast assumptions). Monthly data from May 2006 to December 2021. As of 12 May 2020. Source: BOE, Refinitiv Datastream and Invesco

Economic and asset return scenarios

Projected 12m global asset class returns by global GDP scenario



- **Very Best case**
 - S&P 500 = 3000
 - Eurostoxx 50 = 2900
 - Gold = \$1375
 - Brent = \$45
- **Very worst case**
 - S&P 500 = 1400
 - Eurostoxx 50 = 1350
 - Gold = \$1750
 - Brent = \$20

Notes: based on local currency returns. Figures in parenthesis are our subjective probabilities. GDP data shows projected global GDP growth in 2020. See Appendix 2 for more detail. Cash is an equally weighted mix of USD, EUR, GBP and JPY. As of 15 April 2020. There is no guarantee these views will come to pass. See Appendices for definitions, methodology and disclaimers. Source: BAML, MSCI, GSCI, FTSE, Refinitiv Datastream and Invesco

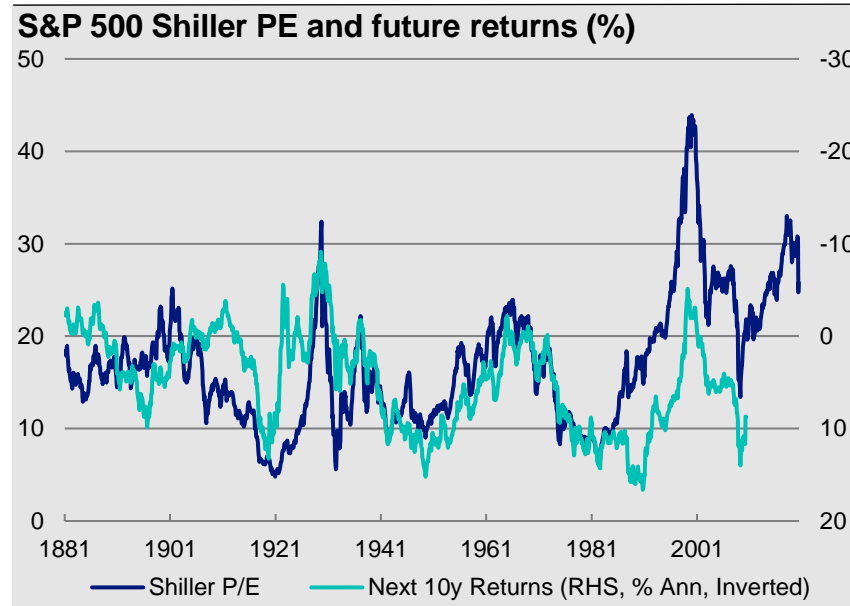
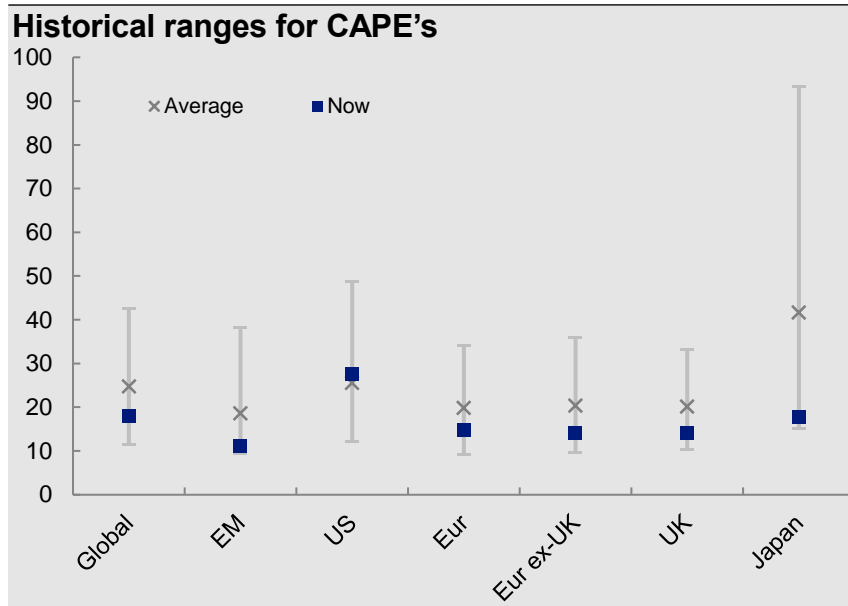
Model asset allocation*



	Neutral	Policy Range	Allocation Position vs Neutral			Neutral	Allocation Position vs Neutral	
Cash	5%	0-10%	↑	10%	Cash	2.5%	5%	
					Gold	2.5%	↑ 5%	
Bonds	45%	10-80%		40%				
Government	30%	10-50%	↑	20%	US	10%	↑ 9%	
					Europe ex-UK (Eurozone)	8%	0%	
					UK	2%	↑ 3%	
					Japan	8%	4%	
					Emerging Markets	2%	4%	
Corporate IG	10%	0-20%		20%	US Dollar	5%	10%	
					Euro	2%	↓ 2%	
					Sterling	1%	↑ 4%	
					Japanese Yen	1%	↓ 1%	
					Emerging Markets	1%	↑ 3%	
Corporate HY	5%	0-10%	↓	0%	US Dollar	4%	↓ 0%	
					Euro	1%	↓ 0%	
Equities	40%	20-60%	↓	30%	US	24%	↑ 14%	
					Europe ex-UK	6%	↓ 2%	
					UK	3%	↑ 6%	
					Japan	3%	↓ 6%	
					Emerging Markets	4%	↓ 2%	
Real Estate	8%	0-6%		16%	US	2%	↑ 5%	
					Europe ex-UK	2%	2%	
					UK	1%	↑ 1%	
					Japan	2%	↑ 5%	
					Emerging Markets	1%	↑ 3%	
Commodities	2%	0-4%	↑	4%	Energy	1%	↑ 2%	
					Industrial Metals	0.3%	1%	
					Precious Metals	0.3%	0%	
					Agriculture	0.3%	↑ 1%	

Note: *this is a theoretical portfolio and is for illustrative purposes only. It does not represent an actual portfolio and is not a recommendation of any investment or trading strategy. Cash is an equally weighted mix of USD, EUR, GBP and JPY. Arrows show direction of change in allocations. As published in The Big Picture on 22 March 2020. See appendices for definitions, methodology and disclaimers. Source: Invesco

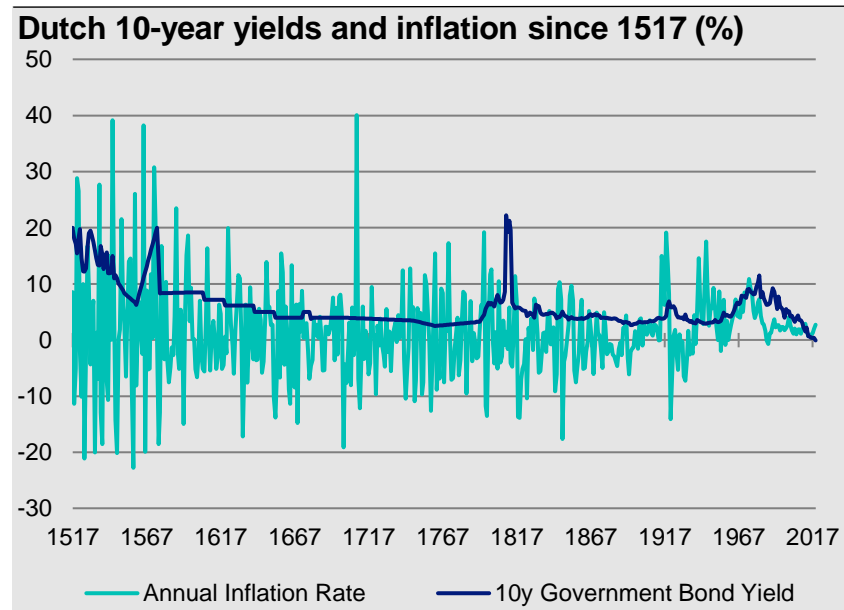
Equity CAPE's lower than usual (except US)



Note: CAPE = Cyclically Adjusted Price/Earnings and uses a 10-year moving average of earnings. From 1983 (except for EM from 2005). As of 12 May 2020.
Source: Refinitive Datastream and Invesco

Monthly data from January 1881 to 30 April 2020. Past performance is no guide to future returns. See appendices for definitions and disclaimers.
Source: Robert Shiller, Refinitiv Datastream and Invesco

Sovereign yields are at multi-century lows

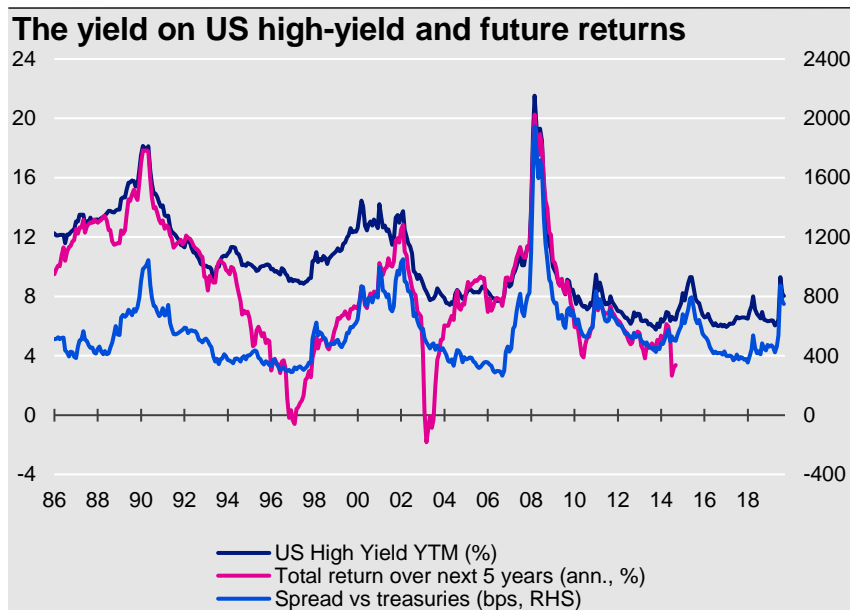


Data is monthly, from December 1790 to April 2020 (as of 30 April 2020). Past performance is no guarantee of future results.

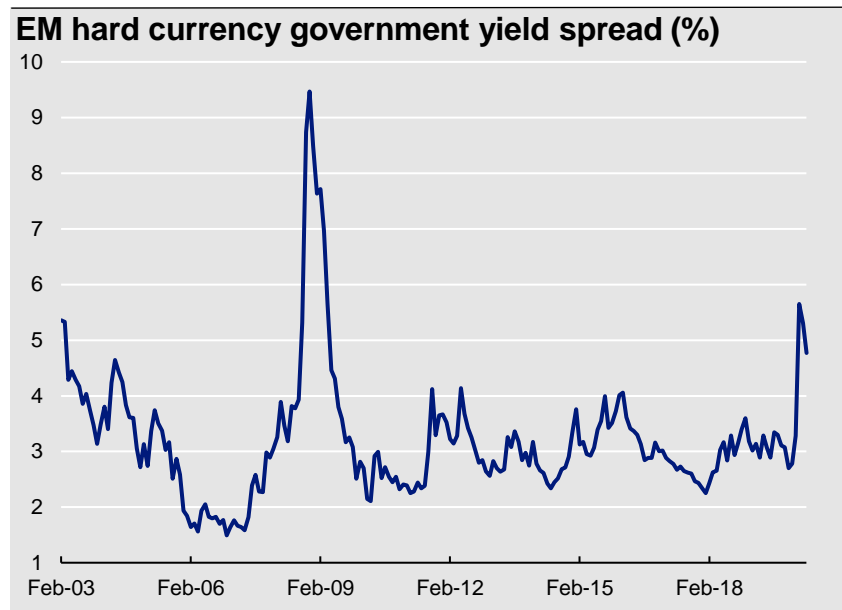
Source: Global Financial Data, Refinitiv Datastream and Invesco

Annual data. 2020 data is as of 30 April 2020. Past performance is no guarantee of future results. Source: Global Financial Data, Refinitiv Datastream and Invesco

Spreads on “riskier” fixed income assets



Note: based on monthly data from September 1986 to May 2020 (as of 12 May 2020). Based on the BofAML US High Yield and US Treasury Indices. “Spread versus treasuries” is the yield on US High Yield minus that on the US Treasury. “Total return” is the annualised five-year total return on the US High Yield Index. Past performance is no guarantee of future results. Source: BofAML, Refinitiv Datastream and Invesco

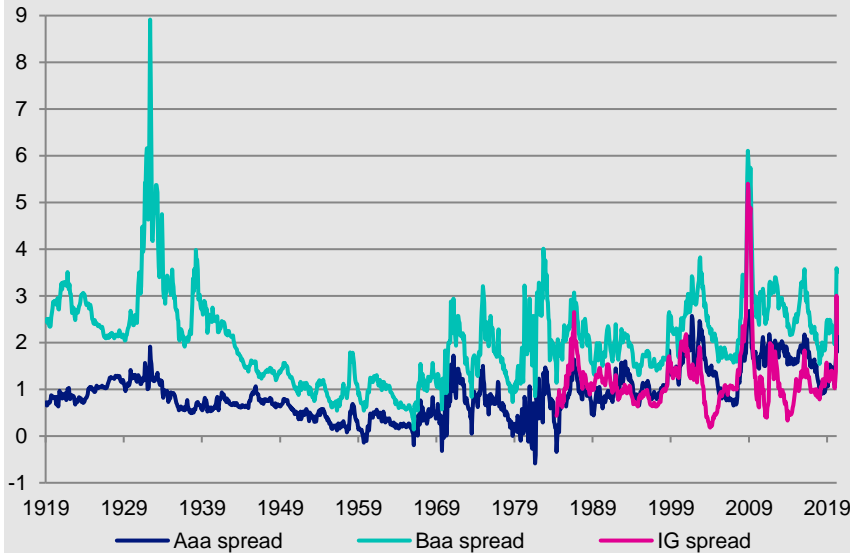


Note: Monthly data from February 2003 to May 2020 (as of 12 May 2020). Yield spread is the yield-to-worst on the Bloomberg Barclays EM USD Aggregate 7-10 Year Index minus the yield on 10-year US treasury notes. Past performance is no guarantee of future returns. Source: Barclays Bloomberg, Refinitiv Datastream and Invesco.

Are credit spreads wide enough?

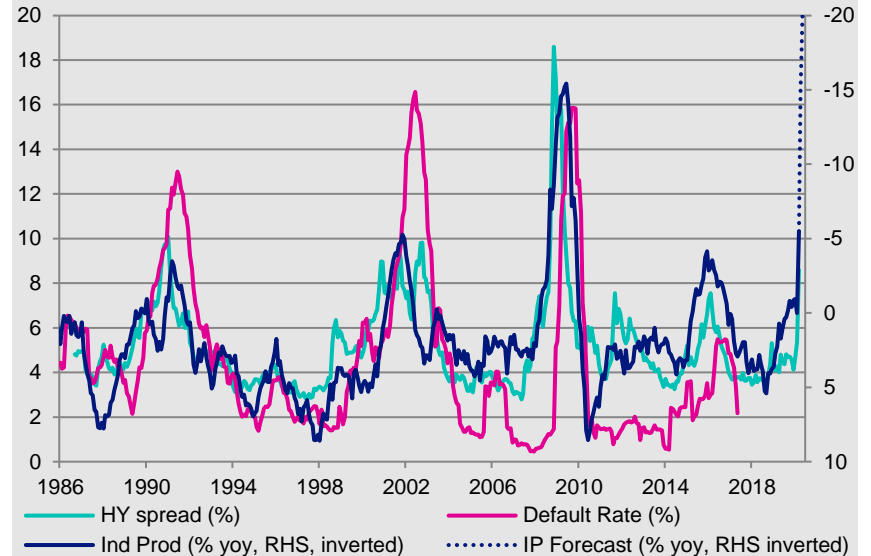


US corporate spreads 1919-2020 (%)



Monthly data from January 1919 to May 2020 (as of 12 May 2020). "Aaa spread" and "Baa spread" are based on the Moody's seasoned corporate Aaa and Baa yields, with both compared to the 10-year US treasury yield. "IG spread" compares the yield to maturity on the BAML US Corporate Index to the 10-year US treasury yield. Past performance is no guarantee of future results. Source: BAML, Global Financial Data, Federal Reserve Bank of St. Louis, Moody's, Refinitiv Datastream and Invesco

The US economic cycle and the high-yield market



Note: Monthly data from January 1986 to May 2020 (as of 12 May 2020). "HY spread" is the difference between the yield on the BAML US High-Yield Corporate Index and that on the 10-year US treasury. "Ind Prod" shows the year-on-year percentage change in US industrial production. "Default rate" is the high-yield default rate as estimated by BAML (the series ends in May 2017). Past performance is no guarantee of future results. Source: BAML, Global Financial Data, Refinitiv Datastream and Invesco

Appendix 1:

asset allocation methodology, definitions and sources



Portfolio construction process

The model asset allocation is theoretical and it is not a real portfolio. We use optimisation processes to guide our allocations around “neutral” and within prescribed policy ranges based on our estimations of expected returns and using historical covariance information. This guides the allocation to global asset groups (equities, government bonds etc.), which is the most important level of decisions. We then allocate across regions within each asset group. Currency hedging can be used. We use long term inputs but the portfolio is constructed with a 12-month time horizon. We intend to update the portfolio and publish on a quarterly basis.

Which asset classes?

We look for investibility, size and liquidity. With that in mind, we have chosen to include: equities, bonds (government, corporate investment grade and corporate high-yield), REITs to represent real estate, commodities, cash and gold (all across a range of geographies). We use cross-asset correlations to determine which decisions are the most important.

Neutral allocations and policy ranges

We use market capitalisation in USD for major benchmark indices to calculate neutral allocations. For commodities, we use industry estimates for total ETP market cap + assets under management in hedge funds + direct investments. We use an arbitrary 5% for cash and gold together as their use as investment instruments is limited. We impose diversification by using policy ranges for each asset category (the range is usually symmetric around neutral). The ranges were established in 2014.

Expected returns

The process for estimating expected returns is based upon yield (except commodities, of course). After analysing how yields vary with the economic cycle, and where they are situated within historical ranges, we forecast the direction and amplitude of moves over the next one and five years. Cash returns are calculated assuming a straight-line move in short term rates

towards our targets (with, of course, no capital gain or loss). Bond returns assume a straight-line progression in yields, with capital gains/losses predicated upon constant maturity (effectively supposing constant turnover to achieve that). Forecasts of corporate and high yield spreads are based upon our view of the economic cycle. Coupon payments are added to give total returns. Equity and REIT returns are based on dividend growth assumptions, using probability-weighted historical rates and adjusting them as appropriate. We calculate total returns by applying those growth assumptions and adding the forecast dividend yield. No such metrics exist for commodities; therefore we base our projections on US CPI-adjusted real prices relative to their long-term averages and views on the economic cycle. All expected returns are first calculated in local currency and then, where necessary, converted into other currency bases using our exchange rate forecasts.

Optimising the portfolio

Using our projected one-year returns and a covariance matrix based on monthly local currency total returns for the last 5 years, we run two optimisation processes: maximising the Sharpe Ratio and maximising returns with volatility no greater than that of the neutral portfolio. The optimiser is based on the Markowitz model.

Currency hedging

We adopt a cautious approach when it comes to currency hedging as currency movements are notoriously difficult to accurately predict and sometimes hedging can be costly. Also, some of our asset allocation choices are based on currency forecasts. We use an amalgam of central bank rate forecasts, policy expectations and real exchange rates relative to their historical averages to predict the direction and amplitude of currency moves.

Appendix 1:

asset allocation methodology, definitions and sources



Asset class descriptions and sources (we source data from Datastream unless otherwise stated)

Cash: returns are based on a proprietary index calculated using the Intercontinental Exchange Benchmark Administration overnight LIBOR (London Interbank Offer Rate). The global rate is the average of the euro, British pound, US dollar and Japanese yen rates. The series started on 1st January 2001 with a value of 100. The same data is used to construct historical comparisons (yields within historical ranges, say).

Gold: London bullion market spot price in USD/troy ounce.

Government bonds: Current values in the market forecast table (figure 34) use Datastream benchmark 10-year yields for the US, Eurozone, Japan and the UK and the Thomson Reuters China benchmark 10-year yield for China. Historical and projected yields and returns (figures 25, 32, 34) are based on Bank of America Merrill Lynch government bond indices with historical ranges starting on 31st December 1985 for the Global, Europe ex-UK, UK and Japanese indices and 30th January 1978 for the US. The emerging markets yields and returns are based on the Barclays Bloomberg emerging markets sovereign US dollar bond index with the historical range starting on 28th February 2003. The same indices are used to construct historical comparisons (yields within historical ranges, say).

Corporate investment grade (IG) bonds: Bank of America Merrill Lynch investment grade corporate bond indices with historical ranges starting on 31st December 1996 for the Global, 31st January 1973 for the US dollar, 1st January 1996 for the euro, 31st December 1996 for the British pound, and 6th September 2001 for the Japanese yen indices. The emerging markets yields and returns are based on the Barclays Bloomberg emerging markets corporate US dollar bond index with the historical range starting on 28th February 2003.

Corporate high-yield (HY) bonds: Bank of America Merrill Lynch High-Yield indices with historical ranges starting on 29th August 1986 for the US dollar, and 31st December 1997 for the Global and euro indices. The same indices are used to construct historical comparisons (yields within historical ranges, say).

Equities: We use MSCI benchmark indices to calculate projected returns and calculate long-term total returns with historical ranges starting on 31st December 1969 for the Global, US, Europe ex-UK, UK and Japanese indices, and 31st December 1987 for the emerging markets index. Equity index valuations (such as yields within historical ranges) are based on dividend yields using Datastream benchmark indices with historical ranges starting on 1st January 1973 for the Global, US, Europe ex-UK and Japanese indices, on 31st December 1969 for the UK index and 2nd January 1995 for the Emerging Markets index. The same indices are used to construct historical comparisons (yields within historical ranges, say).

Real estate: We use FTSE EPRA/NAREIT indices with historical ranges starting on 29th December 1989 for the US, Europe ex-UK, UK and Japanese indices, 18th February 2005 for the Global index, and 31st October 2008 for the Emerging Markets index. The same indices are used to construct historical comparisons (yields within historical ranges, say).

Commodities: Standard and Poor's Goldman Sachs Commodity Total Return Indices with historical ranges starting on 31st December 1969 for the All Commodities and Agriculture indices, 31st December 1982 for the Energy index, 3rd January 1977 for the Industrial Metals index, and 2nd January 1973 for the Precious Metals index. We refer to oil & gas and industrial metals as industrial commodities.

Appendix 2: Coronavirus scenarios and Shiller PE



We consider four scenarios along with our subjective probabilities:

- **Very best case (5% probability):** 2.0% global GDP growth in 2020 (versus our previous estimate of 3.0%). This assumes the global outbreak is contained as rapidly as in China and, with the onset of the Northern Hemisphere spring and summer, the outbreak is well under control by mid-year. We believe this would imply a short, sharp shock to the global economy, with quick recovery and little effect on growth over the next year or so. This implies a slight worsening of our 12-month asset class assumptions about policy rates, yield curves, credit spreads, default rates, commodity prices and equity/real estate yields/growth.
- **Best case (45% probability):** 1.0% global GDP growth in 2020. This assumes a deeper Q2 slump in global GDP. Also, we allow for the potentially disruptive financial effect of the sharp fall in the price of oil. Policy makers (central banks and governments) are assumed to offset some of the short-term economic consequences, providing lifelines to distressed corporates and households. Though there is a GDP growth deficit in 2020, we assume that 2021 growth will be boosted beyond the 3.0% we had originally expected. Effectively, this causes displacement of some economic activity and profits from 2020 into 2021. Though this causes us to downgrade our 12-month assumptions, we suppose the worst of the impact on market risk-premia will be over within the 12-month forecast period.
- **Worst case (45% probability):** -1.0% global GDP growth in 2020. Covid-19 develops into a serious pandemic that is not halted by warming temperatures and that proves difficult to control, with vaccines and cures not available until 2021. This could involve widespread loss of life and the closure of much economic activity for a prolonged period, provoking global recession. Recovery of lost output does not occur until the end of 2020 and into 2021.
- **Very worst case (5% probability):** this assumes a dramatic escalation of Covid-19 to Spanish flu proportions. The World Bank estimated in 2014 that such an outbreak could reduce global GDP by 5% and we assume a 2020 growth rate of -3.5% (versus the original +3%). The downturn could be exacerbated by high debt ratios and the impotence of many central banks. Our asset class assumptions for this scenario assume a return to GFC conditions.

US Shiller PE: the Shiller PE is a price to earnings ratio constructed by dividing price by the average earnings per share in the previous 10 years (with both numerator and denominator adjusted for inflation). It is what is commonly known as a cyclically-adjusted PE ratio. It is constructed by US academic Robert Shiller. Data is monthly from 1881 (source Robert Shiller – see [here](#)).

US stock/equity index: we have calculated a total return index for broad US stocks based on index and dividend data from US academic Robert Shiller and Datastream. The index prior to 1926 is Robert Shiller's recalculation of data from Common Stock Indexes by Cowles & Associates (see [here](#)). From 1926 to 1957, the Shiller data is based on the S&P Composite Index and thereafter is based on the S&P 500 as we know it today.

QE5 balance sheet: QE5 BS is the aggregate balance sheet of Fed, ECB, BOE, BOJ and SNB in USD, rebased to 100 in May 2006. Forecast considers asset purchase plans of the central banks but ignores other sources of growth. The Fed has announced unlimited purchases, which we assume occur as follows: \$120bn per month during May and June 2020, \$60bn per month during 2020 H2 and \$30bn per month during 2021. The ECB has announced plans to purchase €1.1 trillion of assets in 2020 and we assume a halving of purchases thereafter. The BOJ has announced a doubling of the rate of ETF purchases: we assume \$45bn asset purchases per month in 2020 and \$30bn per month in 2021. The BOE has announced £200bn of purchases (we assume they occur smoothly during 2020, with a halving of the rate in 2021). The SNB has announced no plan but we assume \$10bn per month in 2020, with a halving of those rates in 2021.

Appendix 3: Country abbreviations



BRA Brazil
CAN Canada
CHN China
ESP Spain
FRA France
GBR United Kingdom
GER Germany
HK Hong Kong
IND India
INDO Indonesia
ITA Italy

JPN Japan
KOR South Korea
MEX Mexico
PHL Philippines
RUS Russia
SWE Sweden
SWI Switzerland
USA United States of America

Important information



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