Tracking Pandemic: COVID-19

Assessing the spread of the disease and responses to it

Monthly Market Focus from the Global Market Strategy Office

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Letter to Investors

The coronavirus, in a matter of weeks, has plagued the global economy and brought unprecedented shutdowns of economic activity across the world. Travel is restricted, commerce is severely depressed, and millions have lost their jobs. Here, we provide an overview of the market and macro environments, and the policy responses to date.

We are watchful of new infection rates as an indicator of the extent of lockdown orders issued by governments. Confirmed infections have exploded globally, breaking 10,000 on February 1, 100,000 on March 6, and 1 million on April 2. Today, as of April 16, 2,152,646 confirmed cases have been reported worldwide. With each passing week, it seems additional measures have been enacted and existing ones extended. Until we see a meaningful and prolonged flattening of new infections, we expect governments across the world to continue these radical actions. We look to the University of Oxford's Stringency Index as a key measure of the extent of government lockdown orders.

The evolution of lockdowns has spelled trouble for the macro environment, evolving first from a story of depressed consumption to today where we observe widespread economic distress resulting from extensive and widespread lockdowns. Our base case in the US relies on the assumption of economic lockdowns lasting no longer than three months. In this scenario, we expect a recovery to take place beginning after the lifting of lockdown orders, first registering a recession followed by a budding recovery to make for a U-shaped path for growth. This recovery is dependent on the health of the consumer coming out of this crisis, specifically the duration and permanence of layoffs and any debt build-up on household balance sheets, and the ability of companies to remain solvent for the duration of the crisis.

After a historically sharp drop in March, markets have recovered substantially, though most broad stock market indices remain down more than 10% year-to-date as of this writing. With widespread economic lockdowns, our attention has been focused on the health of credit markets. We look to option-adjusted spreads as a signal of credit distress, which have cooled in recent trading following the passage of the US CARES Act. In equities, we expect forward-looking returns to be depressed by reduced or suspended dividends and a steep drop in stock buybacks. The return to risk assets has been substantial, but we suspect heightened volatility to persist until the pandemic risk abates.

Encouragingly, governments across the globe have put forward radical and substantial stimulus and support programs. In the US specifically, a host of Federal Reserve specialized facilities combined with the $2.2 trillion CARES Act Policy have signaled deep policy backing to get the American economy through the worst of the COVID-19 crisis.

Our view is that this crisis will deeply impact the global economy, but the worst of equity performance may be behind us. We are not out of the woods yet, and even after this crisis is behind us the effects will be felt for years to come. A potential build-up in sovereign and private debts also looms.

Our Assessment

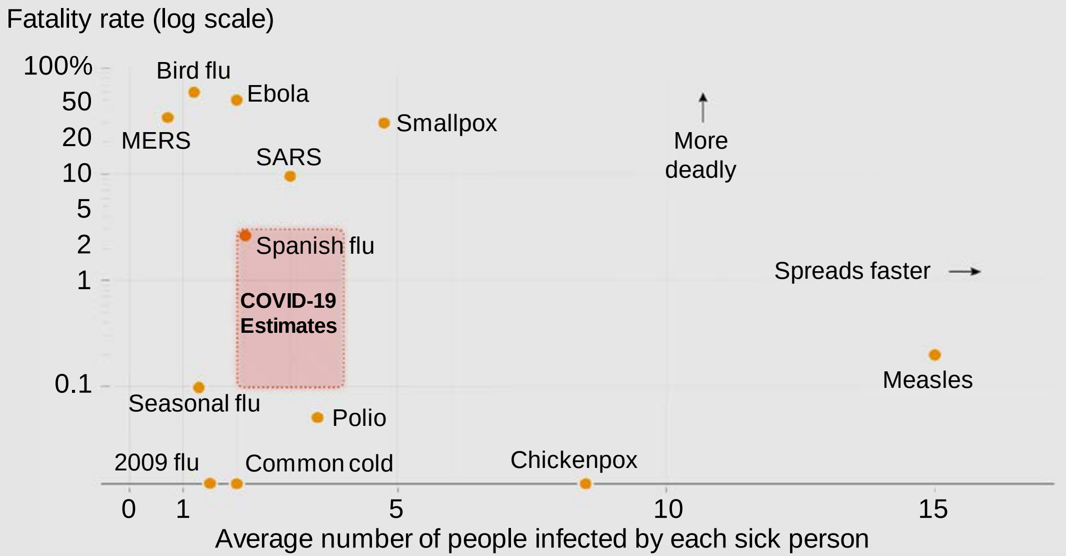
1. Countries have ratcheted up their lockdowns as new infections exploded in each country. We expect that a significant and sustained downtrend in infections will spell the beginning of the end to economic lockdowns.
2. Our base case is for a U-shaped recovery following the end of economic shutdowns, though this presumes shutdowns last no longer than about three months.
3. Markets have suffered meaningfully, and we are watchful of renewed pressures on global markets, especially in debt.
4. Widespread and substantial fiscal and monetary policy across the globe have stabilized global economies, but we suspect more stimulus may be necessary, especially if lockdowns persist.

Source: Invesco, as of 4/16/2020. Infection numbers are from Johns Hopkins Center for Health Security.

Agenda

Comparison of Coronavirus with Other Infectious Diseases

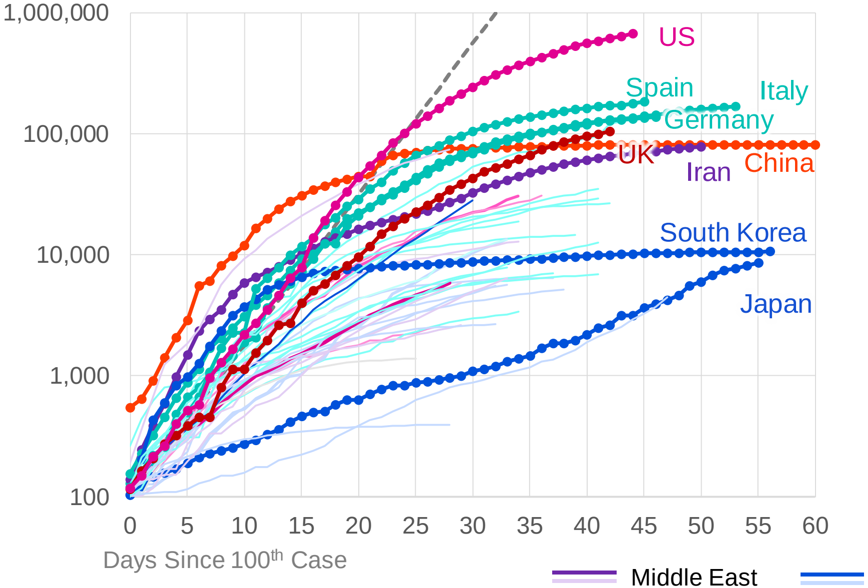
Fatality vs. Infection Rates



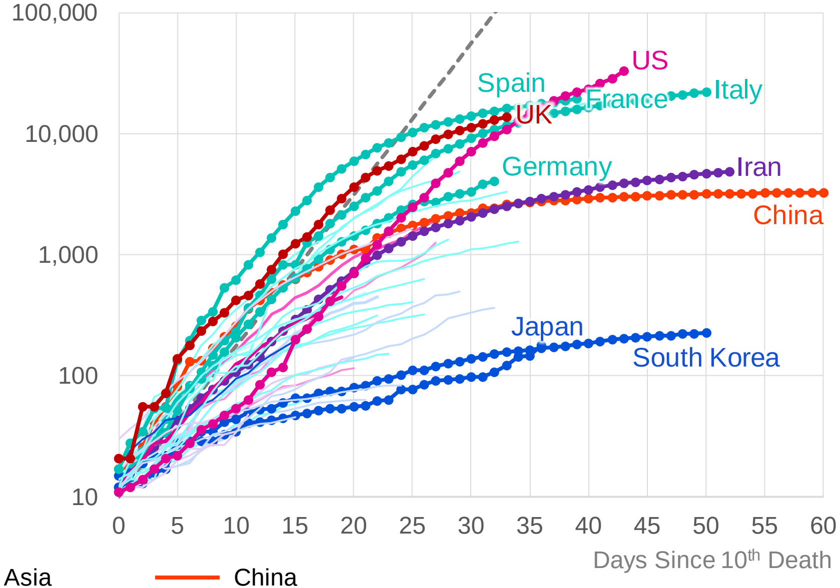
Source: Philosophical Transactions of the Royal Society, World Health Organization, New York Times, Estimate based on preliminary figures as of 2/29/2020.

Tracking Pandemic: The Affliction of COVID-19 Across the Globe
Observing curve-flattening on a relative scale

Cases, Countries with Greater Than 100 Cases



Deaths, Countries with Greater Than 10 Deaths

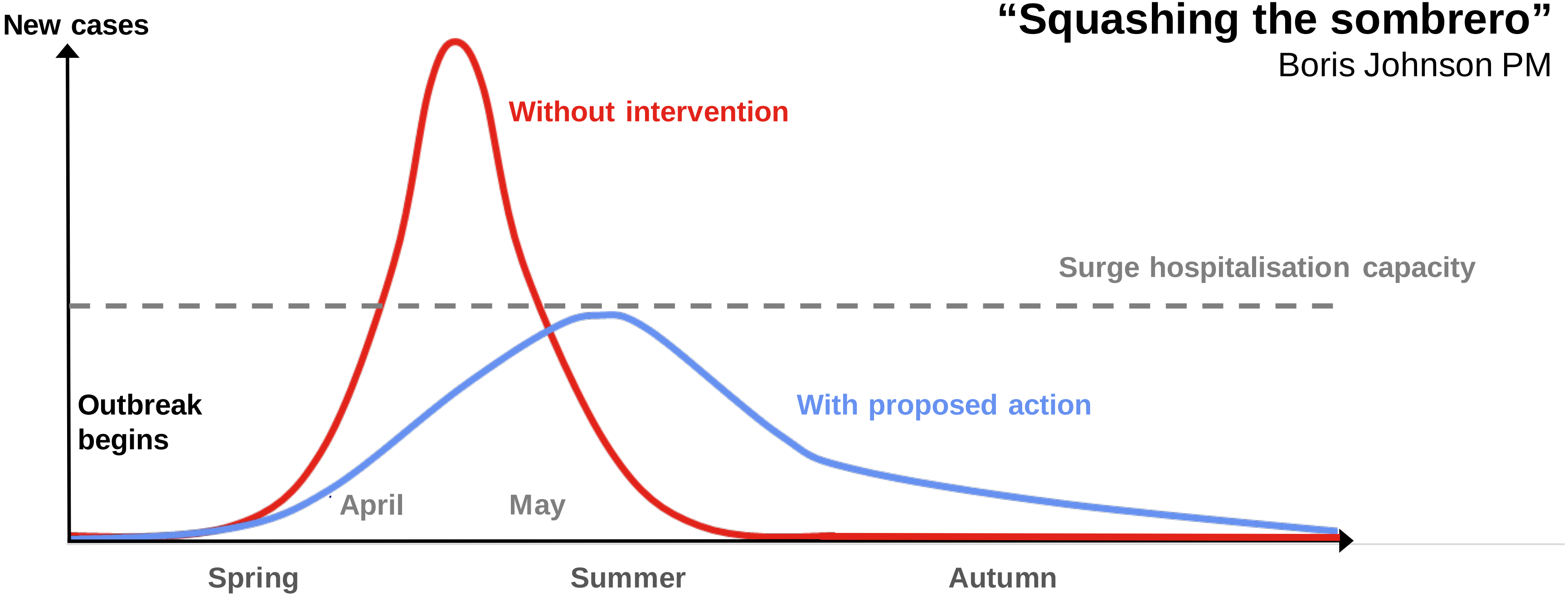


Source: Invesco, Johns Hopkins, 4/16/2020. Vertical scale in both charts is logarithmic with a factor base of 10.

Epidemiology Drives Public Health Policy to "Flatten the Curve": Social Distancing, Self-Isolation, Contact Tracing/Sequestration

Stylised caseload profile

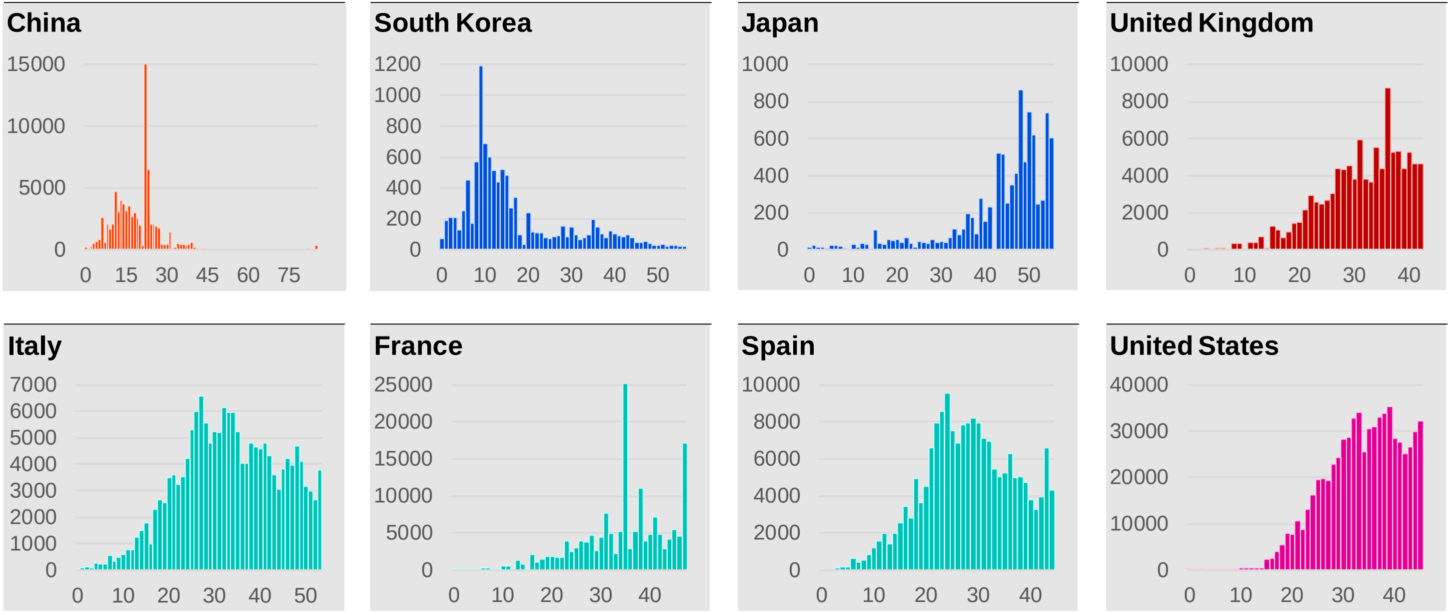
"Squashing the sombrero"
Boris Johnson PM



Sources: United Kingdom Department of Health, Invesco. For illustrative purposes only.

Lessons in Curve-Flattening
Until New Infections Fall, We Expect Lockdowns to Continue

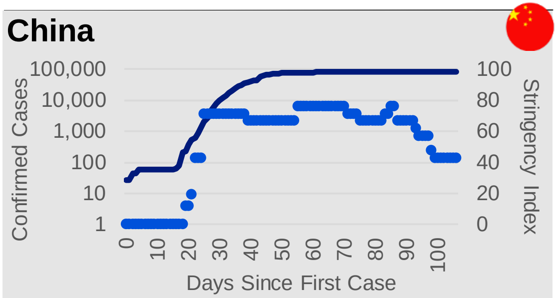
Daily New Infections in Selected Countries, Days Since 100 Infections

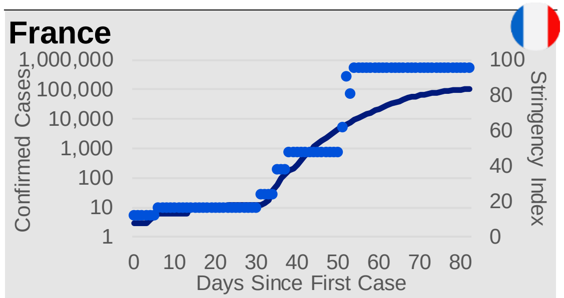


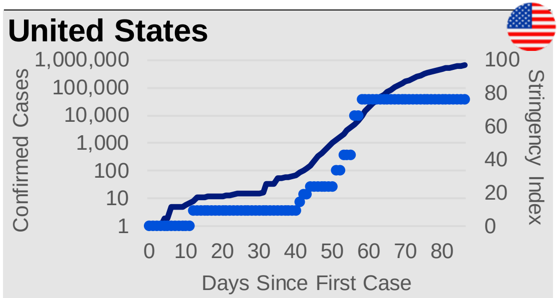
Source: Bloomberg, 4/16/2020.

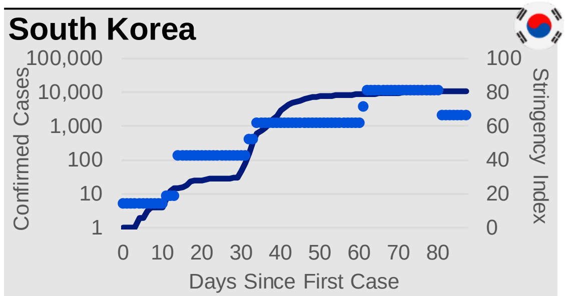
Proactive Lockdown Stringency Has Flattened Curves in Asia

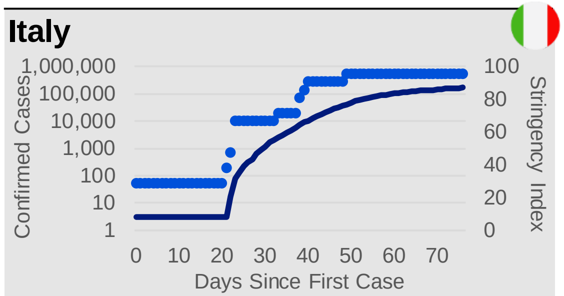
EU Curves are flattening now; UK, US Curves have yet to flatten…

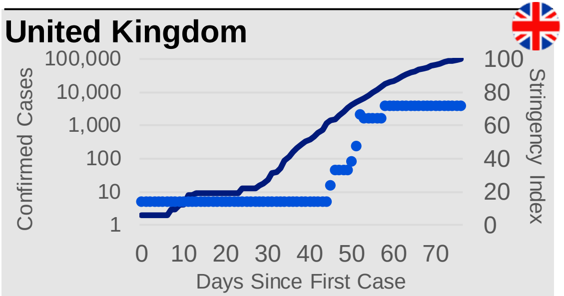












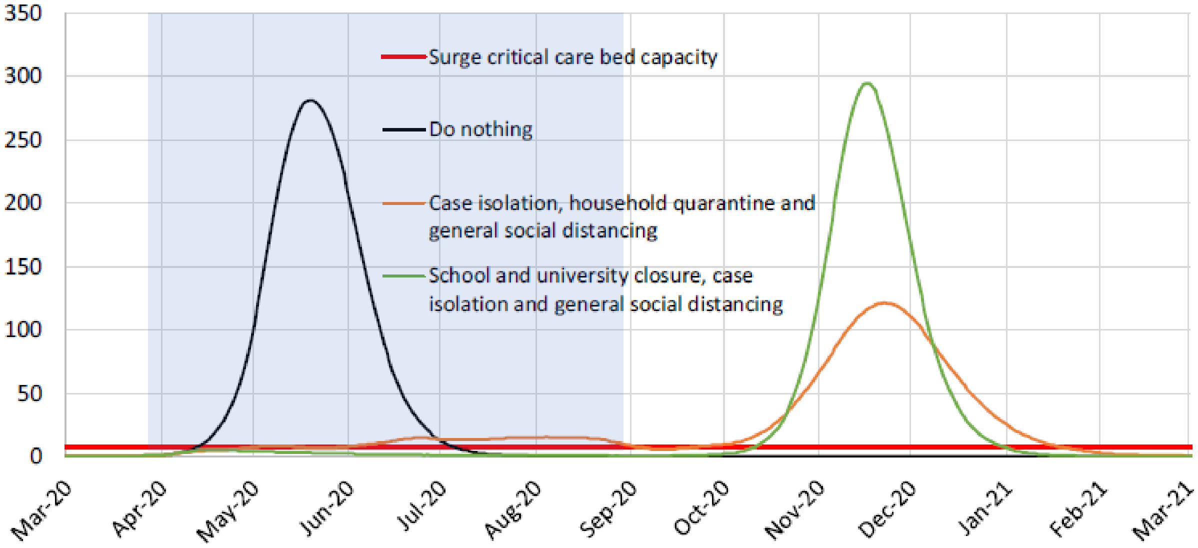
Infections (Left Axis) ● Stringency Index (Right Axis)

The Stringency Index tracks policies such as school closures and travel bans. Left-hand vertical scale in all charts is logarithmic with a factor base of 10.
Source: University of Oxford, Blavatnik School of Government, Oxford COVID-19 Government Response Tracker, 4/16/2020.

Scenario Uncertainty: What If… There's a Second Wave?

W-Shaped Double Dip Conceivable but Should Be Less Severe

UK Scenarios: Critical Care Beds Occupied, per 100k of population



- Private Spending unlikely to experience another, such severe shock – basic needs must be met
- Depression threat? We think it very unlikely:
  - NBER – 33 US recessions since 1854; 47 since 1790; 6 depressions, *all* without active fiscal or Fed policy
- Pandemics past suggest we can and will overcome

Note: NBER US business cycle/recession dating has been back-built to 1854; NBER and academic economists have made estimates going back to the establishment of the US federation and Treasury in 1790. Source: Imperial College COVID-19 Response Team paper commissioned for HM Government and the White House Coronavirus Task Force, 16 March 2020; Invesco

Agenda

Macro Scenarios for the US Economy

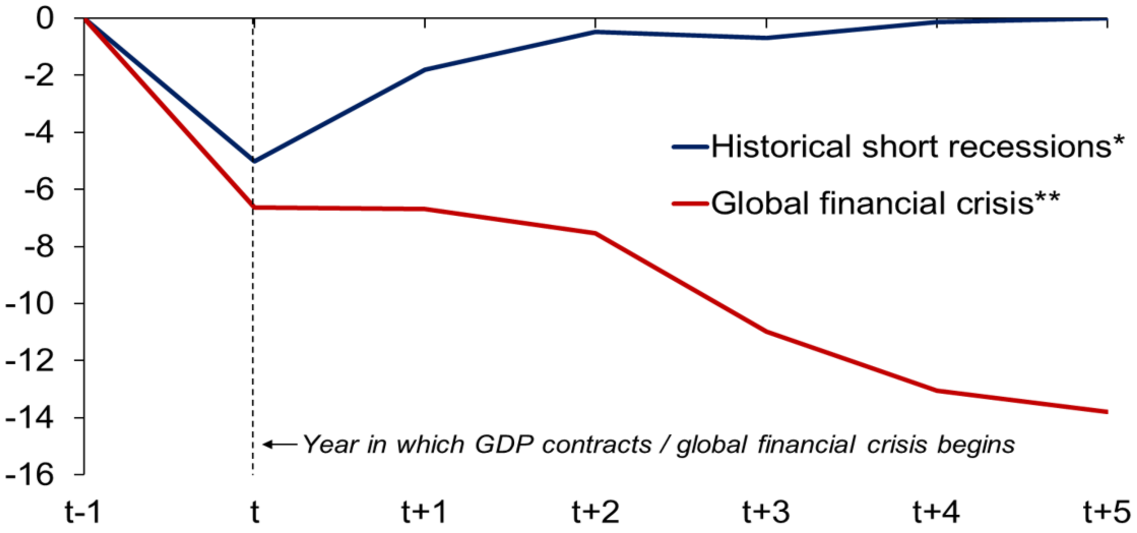
Invesco

Probability: Low	Probability: Medium	Probability: Low
Worst Case Scenario	Base Case Scenario	Best Case Scenario
COVID-19 is widespread and difficult to contain Lockdowns last 4 or more months Prolonged economic slump lasting throughout the year **L-shaped recovery** Severe Recession	COVID-19 is widespread, containment slow but effective Lockdowns last 3 or fewer months Sharp dip in economic activity **Between U- and V-shaped recovery** Recession	COVID-19 is widespread and containment measures effective Lockdowns last 2 months Short sharp dip in economic activity **V-shaped recovery** Short & Sharp Recession

Source: Invesco Scenario Analysis, 4/13/2020. Chart is shown for illustrative purposes only and is not intended as investment advice.

V-, U-, W-, L- or Square-Root-Shaped Recovery?
Depends on Extent of Lockdowns and Maintaining Financial Stability

Percentage Gap from Pre-Recession Cross-Country GDP Trend



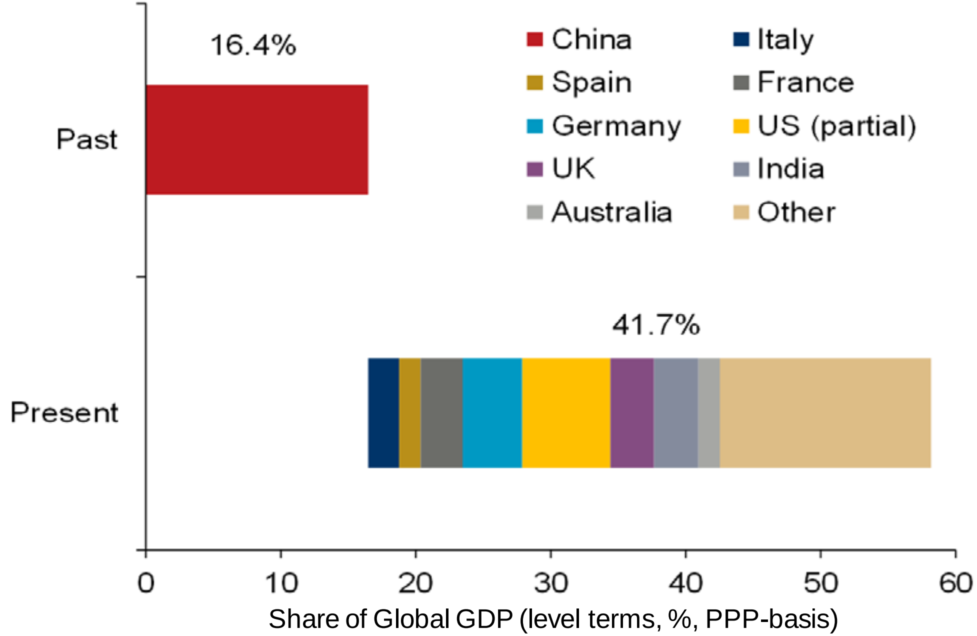
- Most modern, developed market recessions have been "garden-variety"
- Financial boom/bust cycles were much more common in the past and in emerging markets
- Depressions (multi-year recessions with repeated year-on-year declines have happened in the US
- Active Fed and Fiscal policy very likely to mean that we avoid depression

Notes: *Classical "V-Shape" recession and recovery – the median of 410 short recessions over the last 200 years – GDP contracted in the prior calendar year (t-1 to t) before recovering to or above trend growth rate in the following year. **Median across developed market economies which experienced systemic banking crises from 2007-08.
Source: Oxford Economics, Haver Analytics, Maddison Project Database; Invesco. Data through calendar 2018.

The Rise of Economic Shutdowns

While China reopens, much of the rest of the world is shuttered

Potential Geographic Impact of Lockdowns on Global GDP

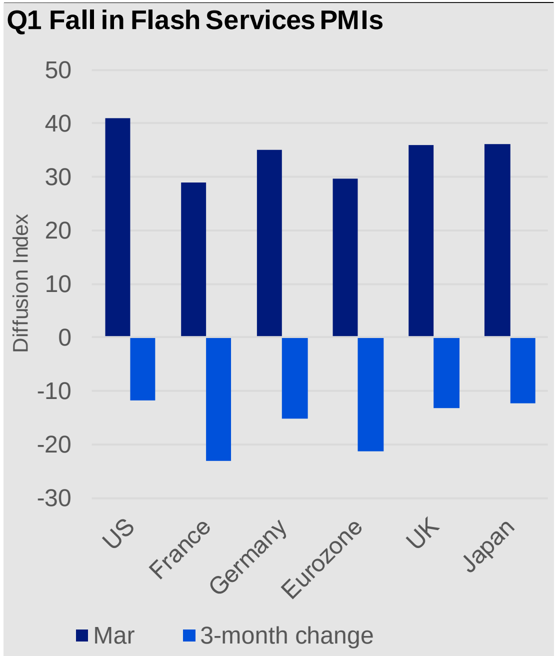


- Abrupt shifts in national, global economic activity
- Households shift to basic needs
- SMEs and large firms cut spending – purchasing, investment and staff
- Sudden shift in activity prompts cash hoarding

Source: IMF, Oxford Economics, Haver Analytics, Invesco. Data for Calendar 2018.

Recession in Fast-Forward

Fall in services PMIs accelerates during the course of Q1 2020



Recessionary Collapses in PMIs

		Composite	Manufacturing	Services
US	**Feb**	49.6	50.7	49.4
	Mar	40.9	48.5	39.8
	Change	**-8.7**	**-2.2**	**-9.6**
France	**Feb**	52.0	49.8	52.5
	Mar	28.9	43.2	27.4
	Change	**-23.1**	**-6.6**	**-25.1**
Germany	**Feb**	50.7	48.0	52.5
	Mar	35.0	45.4	31.7
	Change	**-15.7**	**-2.6**	**-20.8**
Eurozone	**Feb**	51.6	49.2	52.6
	Mar	29.7	44.5	26.4
	Change	**-21.9**	**-4.7**	**-26.2**
UK	**Feb**	53.0	51.7	53.2
	Mar	36.0	47.8	34.5
	Change	**-17.0**	**-3.9**	**-18.7**
Japan	**Feb**	47.0	47.8	46.8
	Mar	36.2	44.8	33.8
	Change	**-10.8**	**-3.0**	**-13.0**

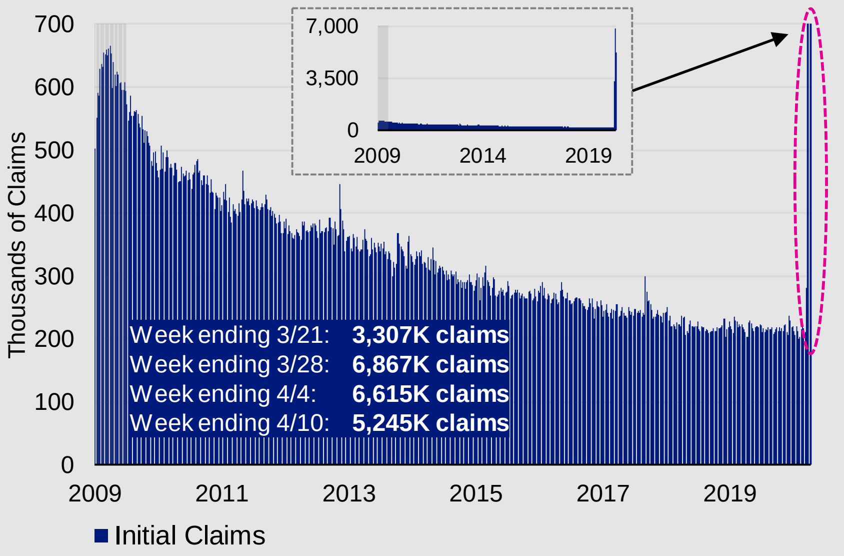
- Manufacturing, Trade and Investment had suffered from the trade war but had been recovering
- Consumption and Services now taking a COVID-19 hit
- Fall in Services PMIs has accelerated sharply in Q1
- A recession's worth of private spending contraction in one quarter…

Sources: IHS Markit, Bloomberg, and Invesco, 4/3/2020.

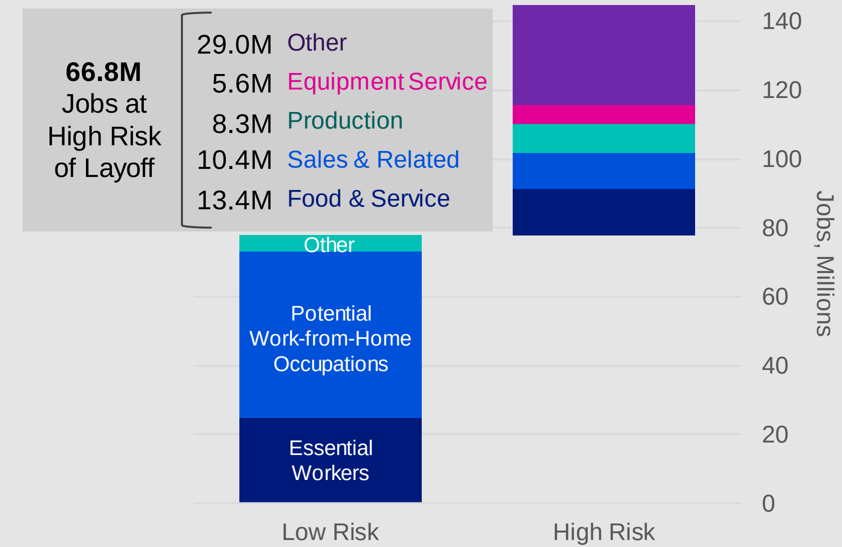
Historic Pace of US Layoffs Is Sure to Be Seen Elsewhere

Policy support necessary to keep households, businesses solvent

Initial Jobless Claims



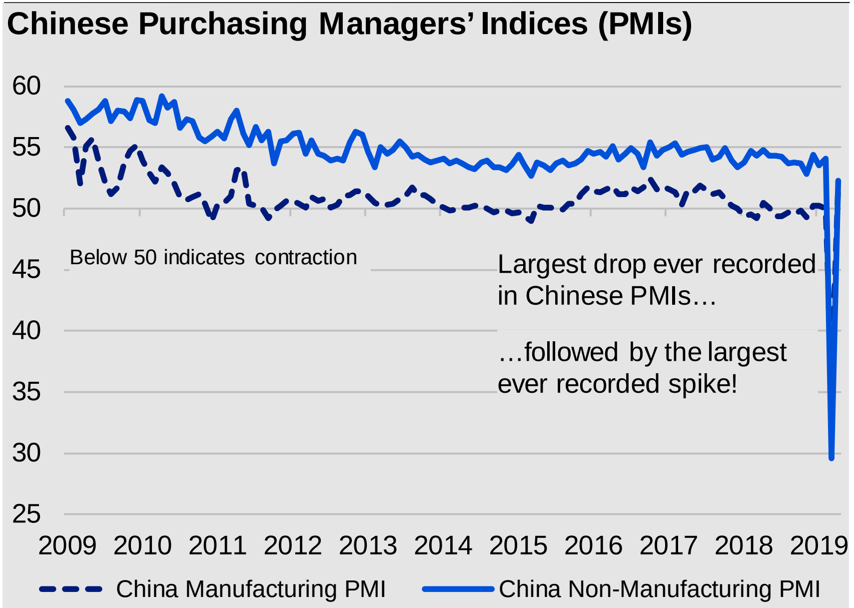
US Jobs at Risk of Layoff Due to COVID-19 Shutdown

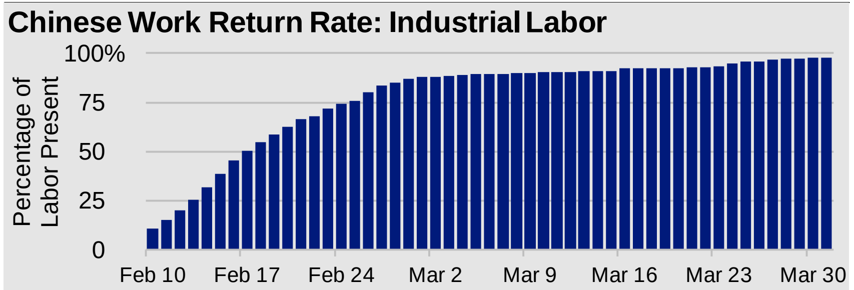


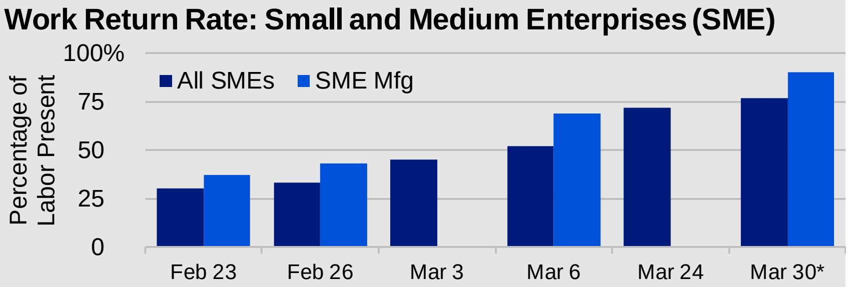
Sources: US Bureau of Labor Statistics Occupational Employment Statistics (2018) and Federal Reserve Bank of St. Louis, 4/16/2020.

V-Shape in Motion? China's Stop-Start-Stall

Bounce-back in activity is likely to unwind as world economy slows







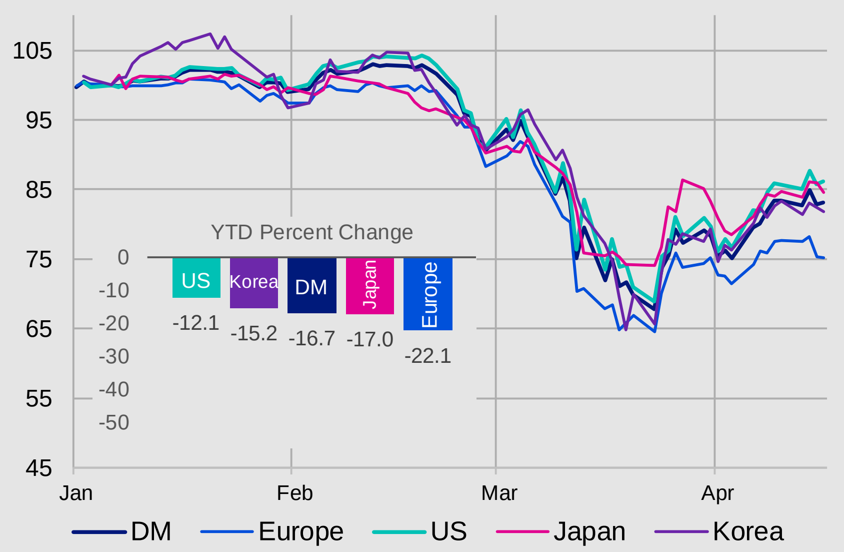
Sources: Bloomberg, TS Lombard, 4/9/2020. * = Estimated using available data.

Agenda

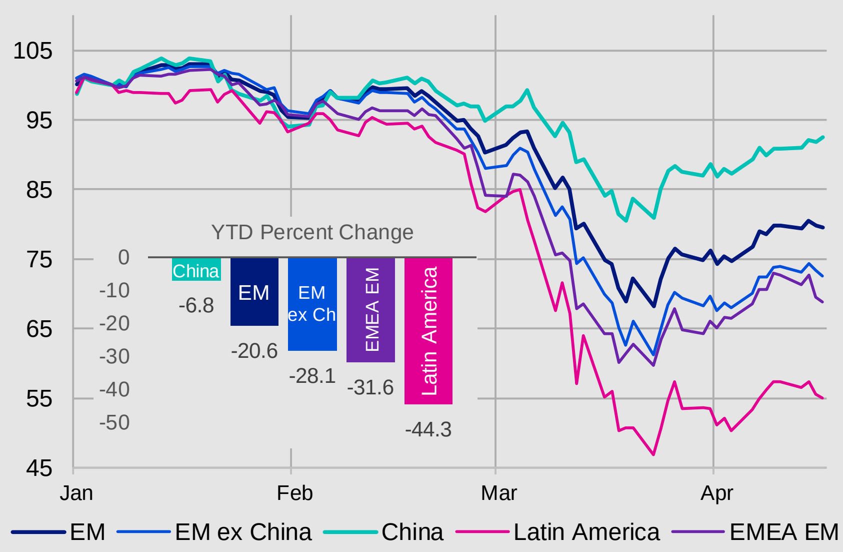
Reviewing Equity Performance

Developed world lags, Latin America heavily hit; China perseveres

Developed Markets: Europe lags developed markets



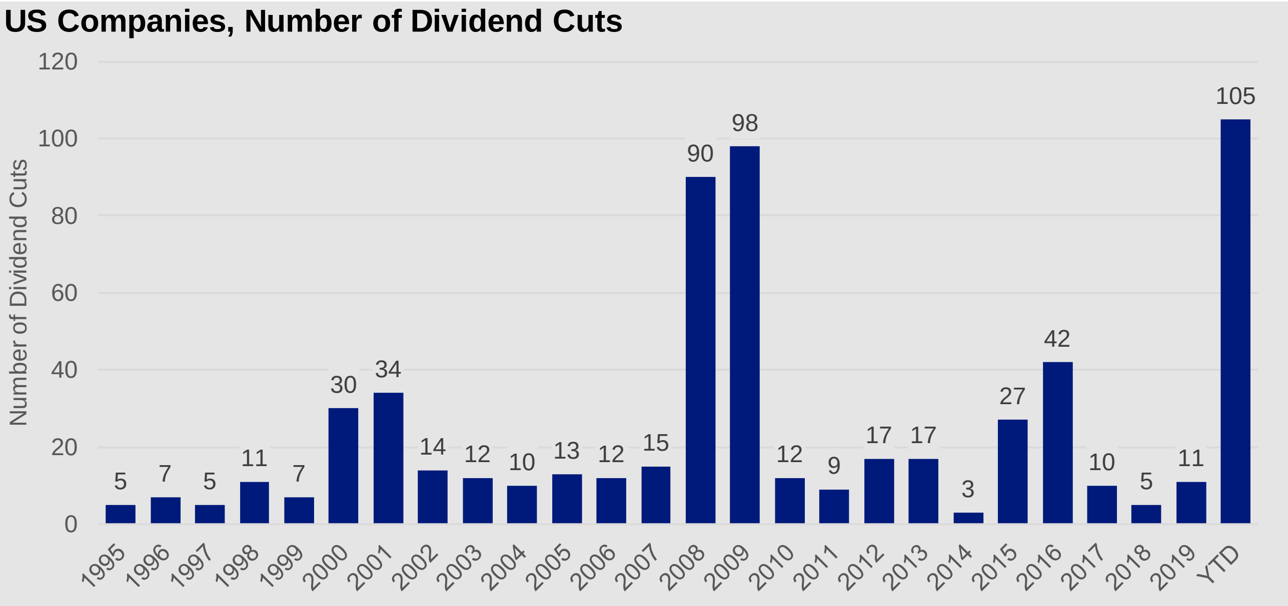
Emerging Markets: LatAm depressed, China leads



Source: Bloomberg, 4/16/2020. DM = Developed Markets, EM = Emerging Markets. The legend items above are calculated using the following indices: DM = MSCI World Index; Europe = MSCI Europe Index; US = S&P 500 Index; Japan = MSCI Japan Index; Korea = MSCI Korea Index; EM = MSCI Emerging Markets Index; EM ex China = MSCI Emerging Markets ex China Index; China = MSCI China Index; Latin America = MSCI Latin America Index; EMEA EM = MSCI Emerging Markets Europe Index. All prices are quoted in terms of USD, benchmarked at 100 on 1/6/2020.

Major Shifts in Corporate Finance

US Dividend Cuts past historic peaks



Political pressures on buybacks, dividends, bonuses may persist but macro, company fundamentals likely to dominate

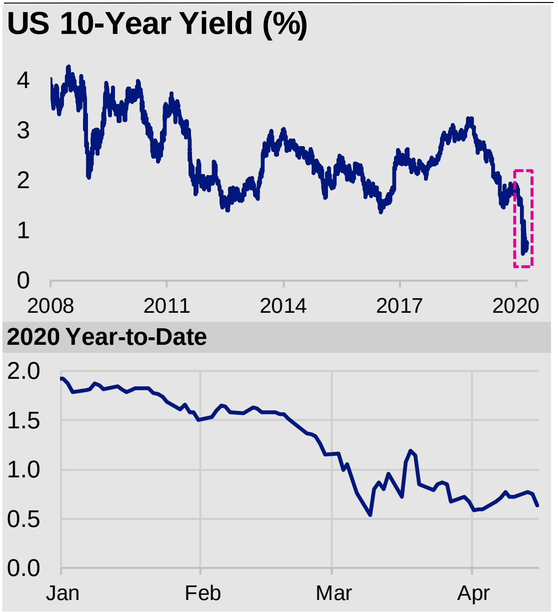
Firms preserving cash. Debt vs. equity finance at firm, sector levels to matter.

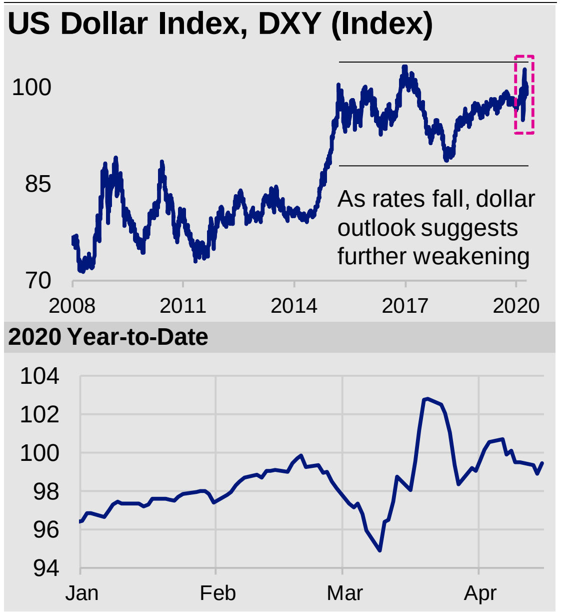
Cashflow pressure to depend on intensity, duration of lockdowns and economic sector

Fed commercial paper facility to help US firms

Sources: Wolfe Research, Russell 5000 Index, Invesco, 4/8/2020.

US Market Indicators Indicate Perceived Safe-Haven Trades Underway



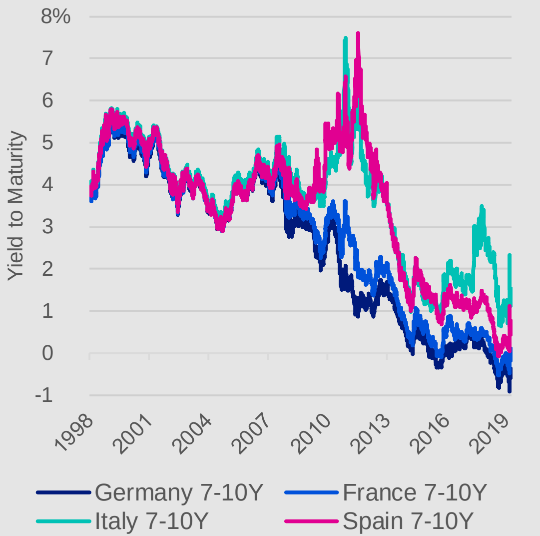


Source: Bloomberg, 4/15/2020.

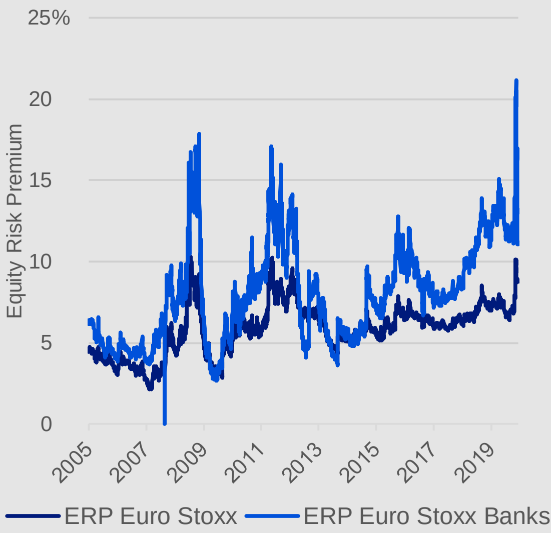
Weak Links in the Eurozone

Demonstrating the Urgency of EZ Fiscal, Banking and Capital Markets Unions

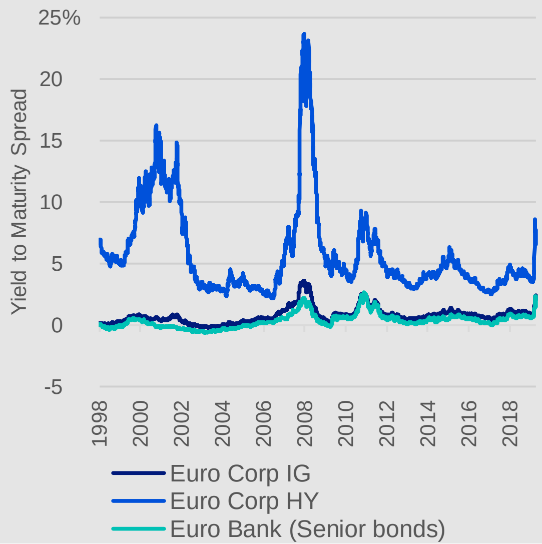
Key Euro Government 7-10Y Yields to Maturity (%)



Euro Stoxx; Euro Stoxx Bank Equity Risk Premium



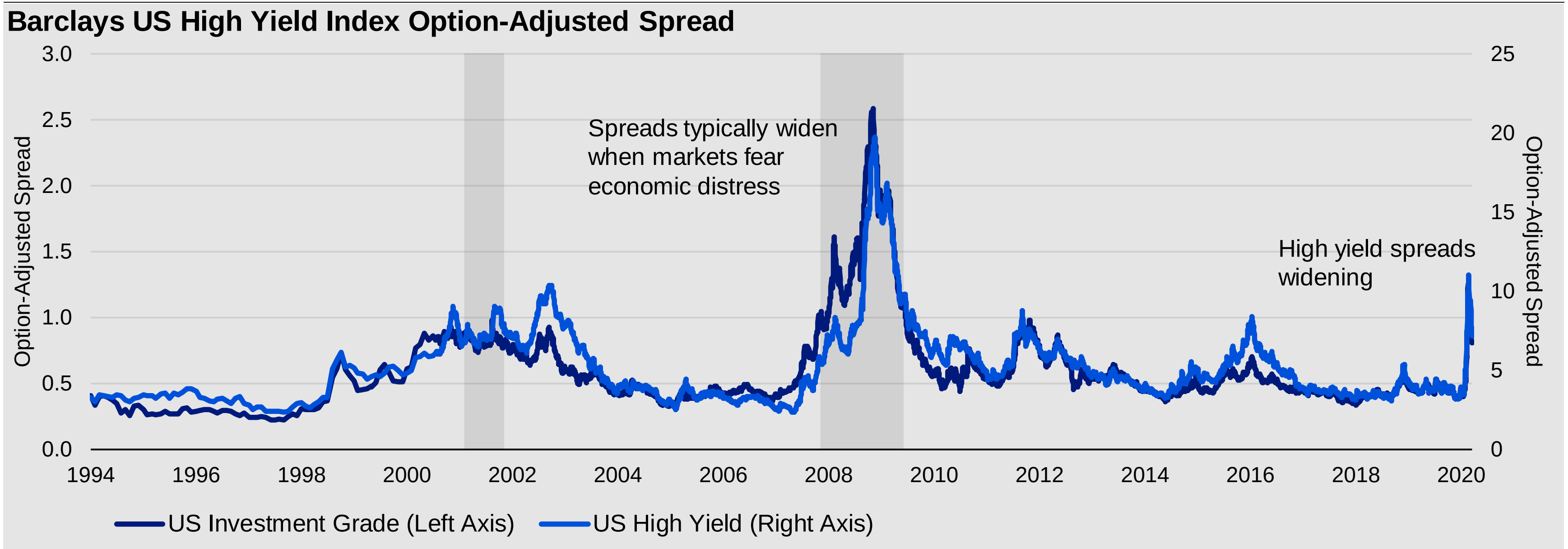
Spreads YTM vs Germany Govt 7-10Y (%)



Note: Equity Risk Premium – Earnings Yield less 10-year Bond Yield (EZ Government Bond Aggregate). The Earnings Yield is the reciprocal of the Price/Earnings Ratio.
Sources: Bloomberg, Macrobond, Invesco calculations, 4/10/2020.

US High Yield Credit Spreads Are a Key Indicator of Credit Stress

Credit Spreads Widening with COVID-19 Outbreak

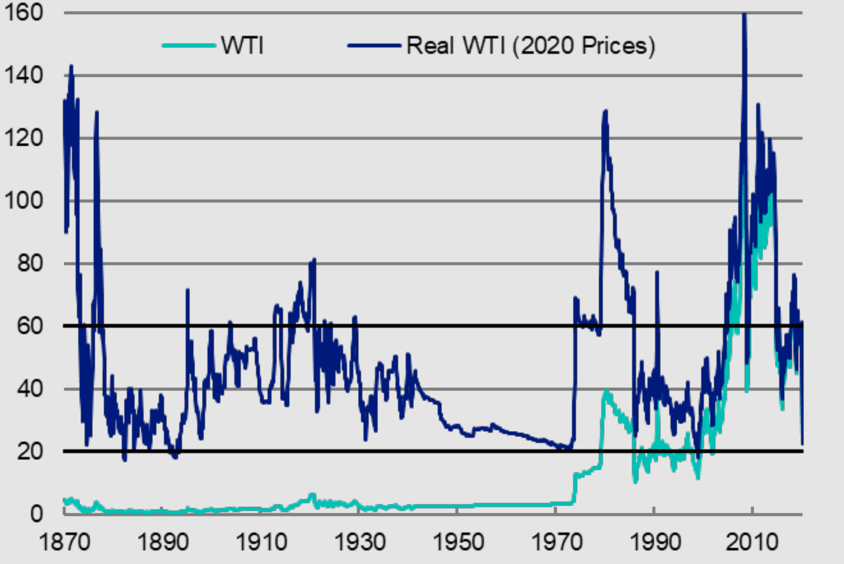


Source: Bloomberg, 4/15/2020.

Oil and Oil Company Valuations near Extreme Lows

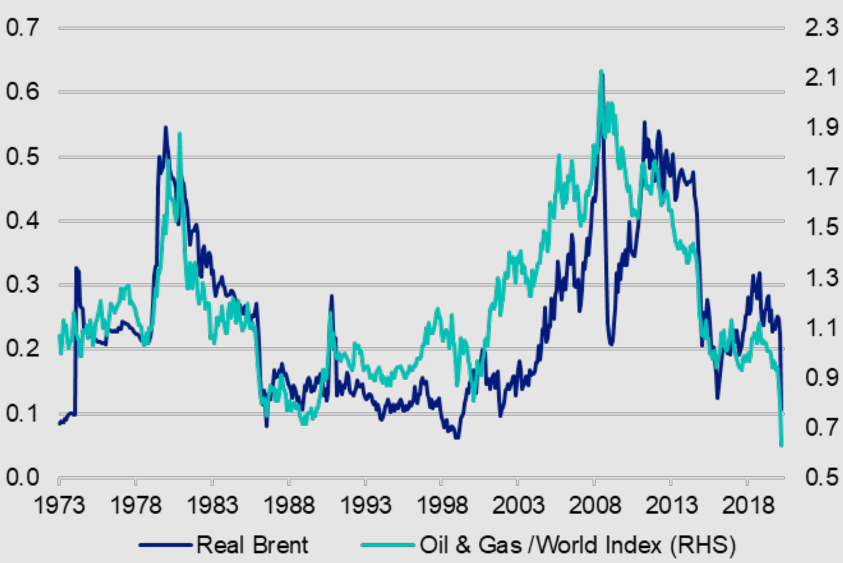
Joint COVID demand shock, supply glut are probably unsustainable

Real US oil price (US$ per barrel, CPI adjusted)



Monthly data since January 1870. As of 20 March 2020. WTI is West Texas Intermediate.
Past performance is no guarantee of future results.
Source: Global Financial Data, Refinitiv Datastream, Invesco

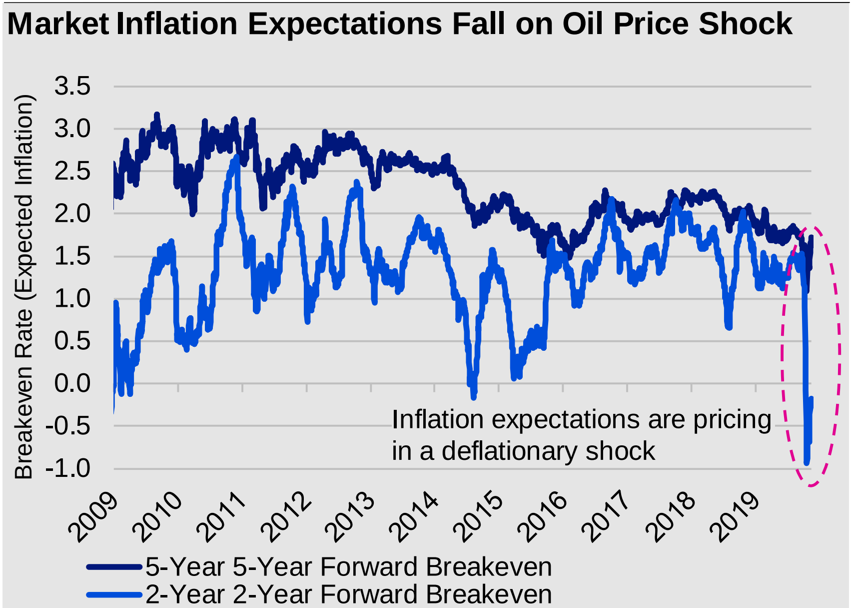
World oil & gas stocks relative vs real Brent

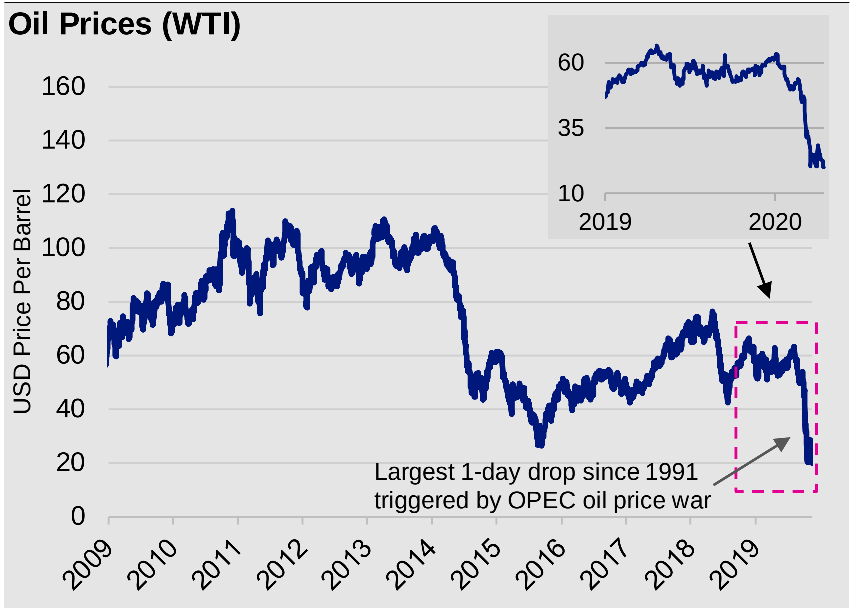


Note: Monthly data from January 1973 to March 2020 (as of 20 March 2020). Oil & gas relative is the Datastream World Integrated Oil & Gas Index dividide by the Datastream World Index. Real Brent is the USD price per barrel of Brent of oil divided by the US CPI index. Past performance is no guarantee of future results. .
Source: Refinitiv Datastream and Invesco

COVID-19, Oil Price Shocks Send Inflation Signals Reeling

OPEC supply glut crowds markets amid weakening demand

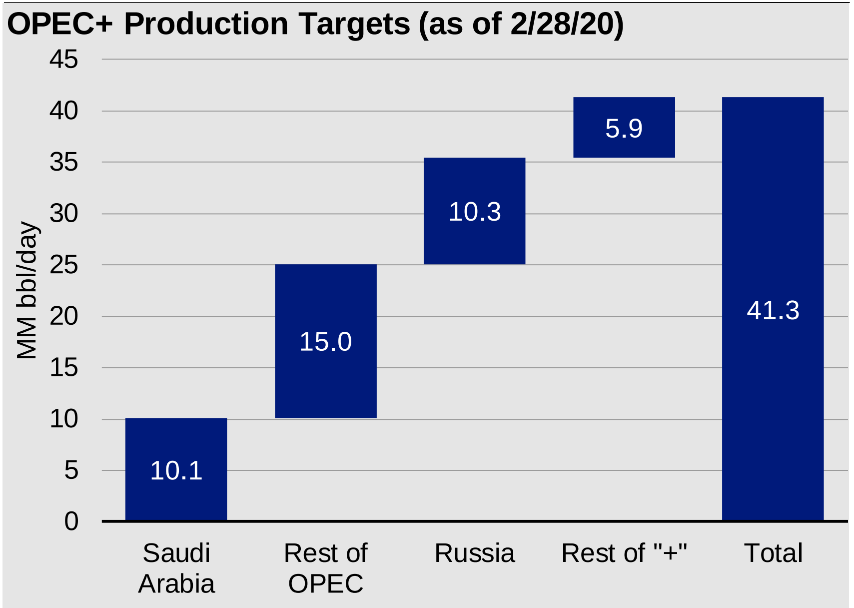


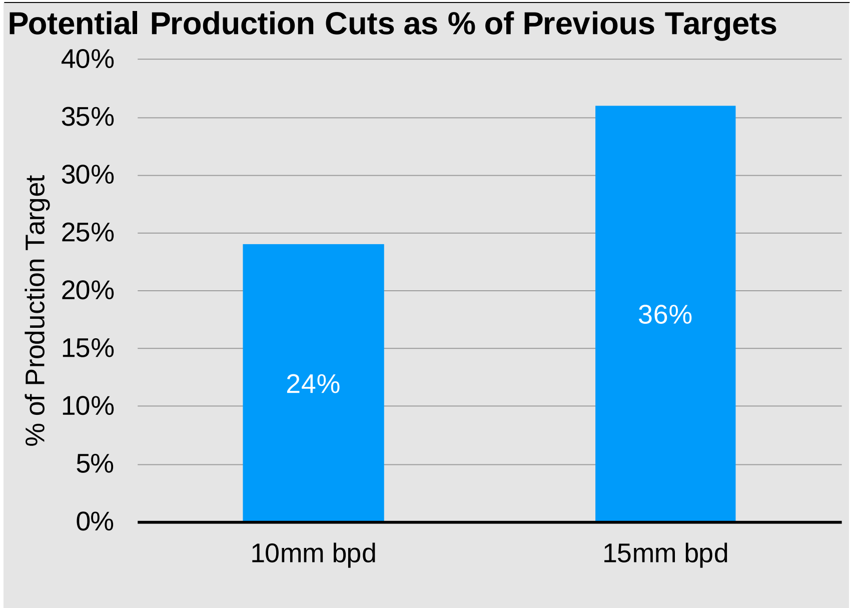


Source: Bloomberg, 4/15/2020.

Oil Market Revival: Potential OPEC+ Production Cuts

While demand shortfall likely to persist, supply-side outlook improves



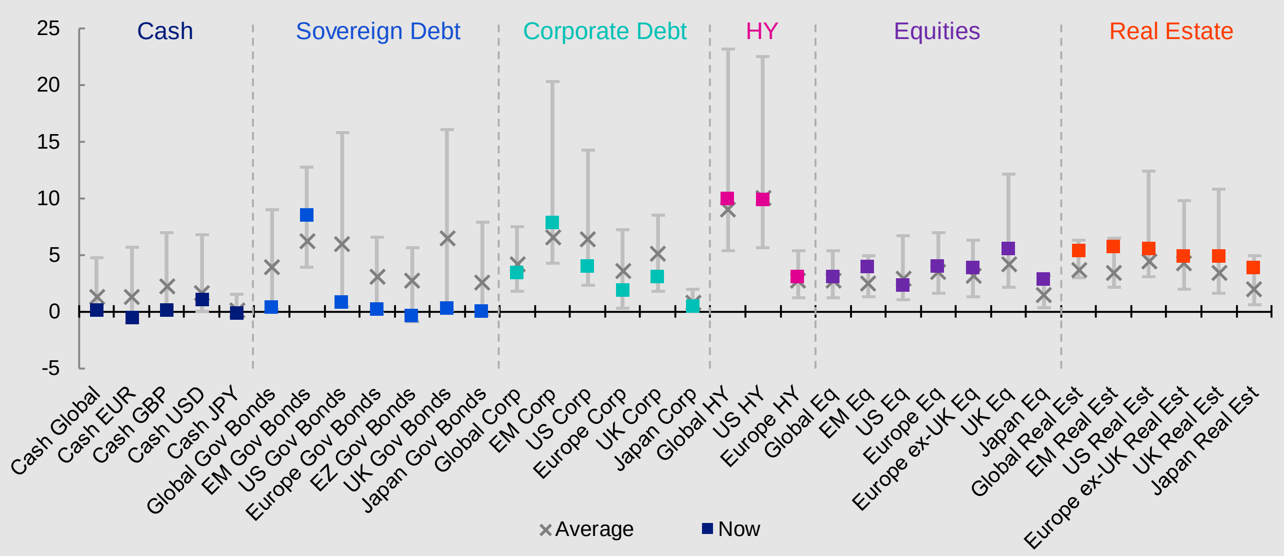


MM bbl/day is the unit of measurement for oil production.
Sources: OPEC Monthly Oil Market Report, Bloomberg, Invesco calculations.

All Global Safe-Asset Yields Well Below Long-Run Averages

Western and EM risk-/growth-geared assets above average

Asset Class Yields within their Historical Ranges, %



- Asset class differences point to high premium on safety, liquidity – in a reversal of recent reach for yield across assets
- However, geographic differences suggest COVID-19 success can pay-off:
  - Most Japan growth-geared and risk asset yields are below long term averages
  - Japan real estate yields, however, are above their long-run average

Notes: As of 26 March 2020. Past performance is no guarantee of future results. See appendices for definitions, methodology and disclaimers.
Sources: Bloomberg Barclays, BofAML, FTSE, JP Morgan, Refinitiv Datastream, Invesco.

Agenda

Invesco

1 Tracking the pace and control of the COVID-19 pandemic

2 Macro scenarios and indicators

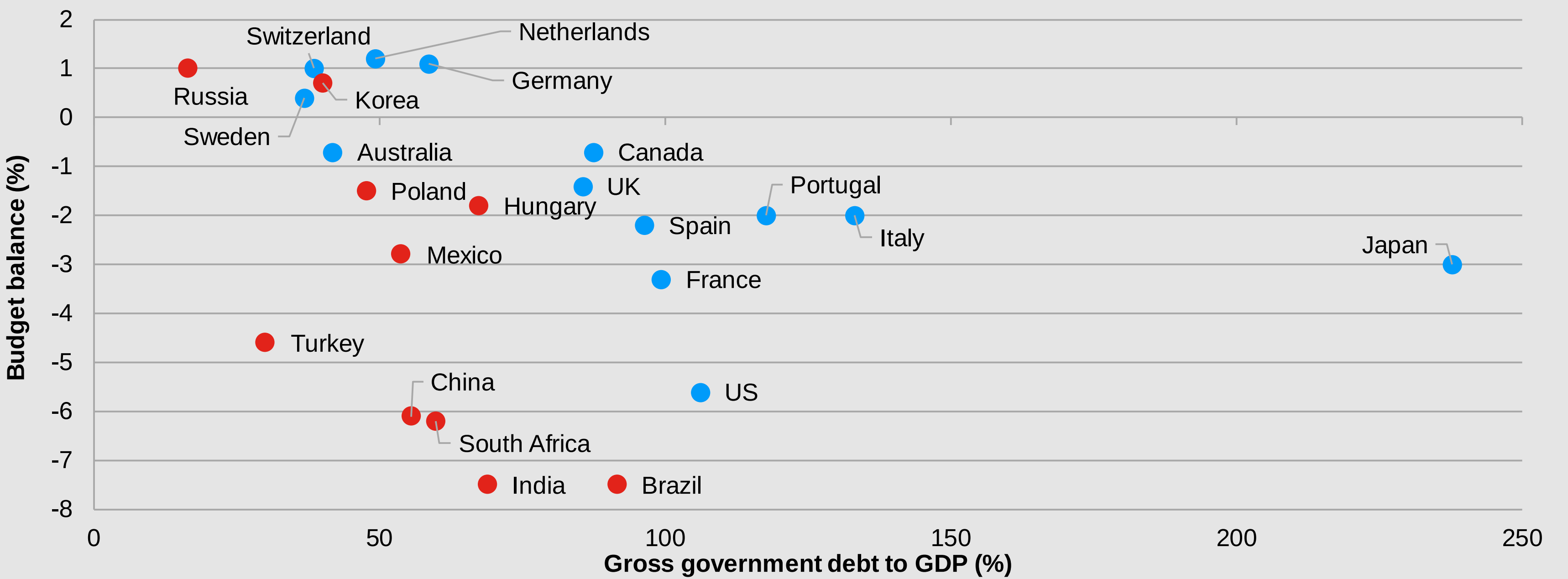
3 Market response & implications

4 Assessing monetary, fiscal policy

Fiscal Policy: Room for Maneuver Varies Widely

Major EM countries bear monitoring – especially those with large COVID-19 risks

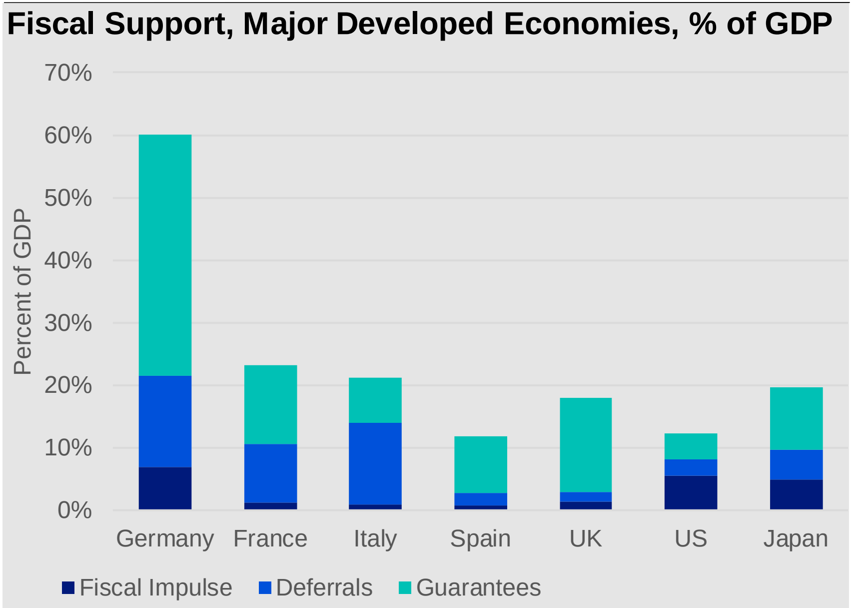
Budget Balance and Gross government debt – 2019 (% GDP)*

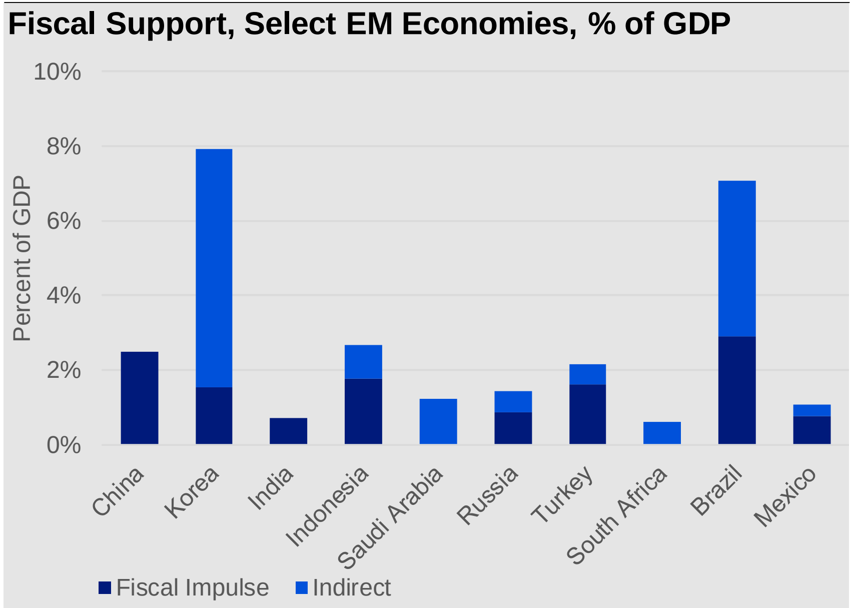


Source: IMF Fiscal Monitor October 2019, Invesco. *Blue blob = Developed Markets, Red blob = Emerging Markets.

Fiscal Policy: Stimulus… in Size

Mounting government actions in the developed world, while EM lags

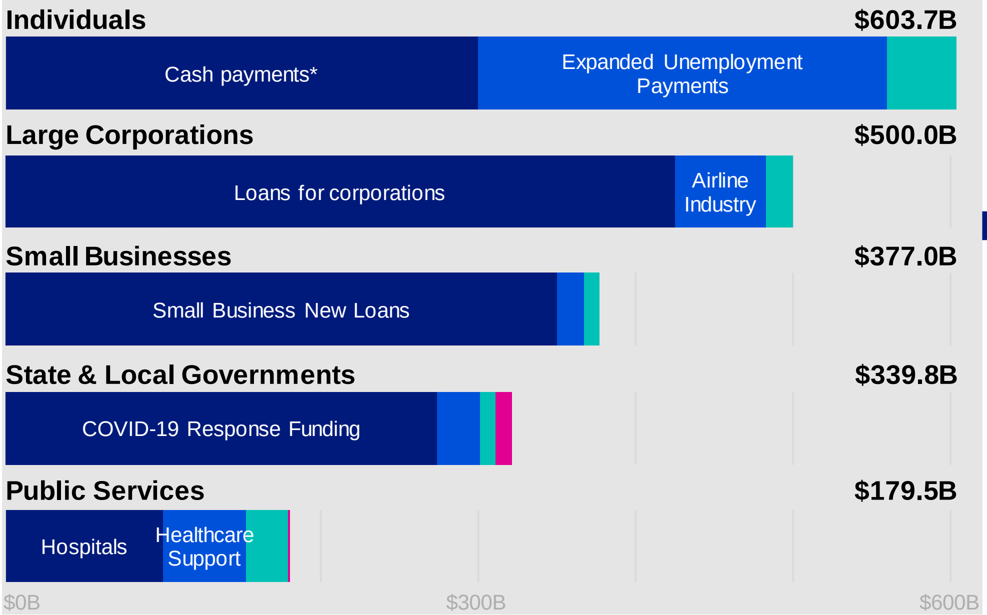




"Fiscal Impulse" refers to direct fiscal spending. "Deferrals" refer to temporary delays in tax filings and payments, and other fees to governments. "Guarantees" refer to loan guarantees and related vehicles. Indirect refers to measures that do not involve direct fiscal revenue or spending, including guarantees, deferrals and other measures.
Sources: Invesco calculations, Breugel Datasets (left-side chart), International Monetary Fund (right-side),as of 30 March 2020.

US Fiscal Response
Broad array of fiscal support to individuals, businesses

Coronavirus Aid, Relief, and Economic Security (CARES) Act



Fiscal Phases in the COVID-19 Response

- **Phase 1:** $7.8B targeting vaccines, R&D
- **Phase 2:** $100-$125B targeting sick leave, unemployment insurance
- **Phase 3:** $2.2T via direct checks, credit lines for small businesses and targeted highly impacted industries

Tax filing deadline extended to July 15, 2020

- **Phase 4:** Expected ?

  May target health care and pension protections, SNAP benefits, additional funding for state and local governments, free coronavirus testing and follow-up treatment, and potentially infrastructure

* Estimated.
Source: Invesco, 3/31/2020.

US Monetary Policy Response
Large-scale asset purchases, zero rates, & huge liquidity provisions

Rates
- FOMC cut rates to 0, through 50 bps and 100 bps cuts
- Discount window credit rate cut by 150 bps to 0.25%, 90-day term, repayable and renewable daily

Reserves & Regulatory
- Reserve requirement ratios reduced to 0%
- Discount window credit rate cut by 150 bps to 0.25%, 90-day term, repayable and renewable daily
- Fed's reserve management purchases extended beyond Treasury bills to full spectrum of Treasury securities

Asset Purchases
- Unlimited Quantitative Easing (QE), including commercial mortgage-backed securities (CMBS)

Liquidity
- Overnight repurchase agreements (repos) up to $175B each, 2-week repos to $45B each, weekly 1-month repos introduced at $50B each, 3-month repos at $500B each
- Dollar liquidity swaps daily, with major & EM central banks
- Targeted liquidity facilities

February 28
Powell: "We will use our tools and act as appropriate to support the economy."

Sources: Federal Reserve Board, Invesco, 4/9/2020.

"Alphabet soup" of Facilities to Support Markets & Economy

Deep and broad-based support for bond, money market activities

Invesco

Financial Crisis-Era Facilities

Commercial Paper Funding Facility (CPFF)

Reactivated March 17 — *until March 17, 2021*

- Purchases commercial paper from American issuers with the highest credit ratings

Money Market Mutual Fund Liquidity Facility (MMLF)

Reactivated March 18 — *until September 30, 2020*

- Provides secured lending to banks for typical money market collateral

Primary Dealer Credit Facility (PDCF)

Reactivated March 17 — *for at least 6 months*

- Provides guaranteed loans to primary dealers at the discount rate with 90-day term, prepay any time
- Expanded acceptable collateral to include investment grade securities
  - BBB- and above: corporate debt, international agency, commercial paper, municipals)
  - AAA only: CMBS, CLOs, and CDOs
  - Equities

Term Asset-Backed Securities Loan Facility (TALF)

Reactivated March 23 — *until September 30, 2020*

- Facilitates the issuance of ABS backed by newly originated consumer and small business loans
- ABS must…
  - have an AAA credit rating, must be issued on or after 23 March 2020
  - have an underlying credit exposure to auto loans, student loans, credit card receivables, small business loans guaranteed by the Small Business Administration
- Also includes AAA CLOs and AAA CMB

Primary Market Corporate Credit Facility (PMCCF)

Activated March 23 — *until September 20, 2020*

- $50B in capital, $500B in capacity
- Purchase bonds from and provide loans to BBB-/Baa3 or higher issuers, rated as of March 22
- Maturities must not exceed 4 years
- Issuers must be US businesses, cannot be banks, and cannot be recipients of other specific support under the CARES Act

Secondary Market Corporate Credit Facility (SMCCF)

Activated March 23 — *until September 20, 2020*

- $25B in capital, $250B in capacity
- Purchase bonds in the secondary market from eligible American issuers at fair market value
- Purchase bond portfolios via ETFs
- Minimum rating of BBB-/Baa3
- Remaining maturity of securities purchased by the SPV must not exceed 5 years

Sources: Federal Reserve Board, Invesco, 4/9/2020.

US Fed Takes Control of the Bond Market

The latest round provides up to $2.3T in loans, roughly 11% of GDP
Small businesses, municipals see deep support

Main Street Lending Program

Activated April 9 *until September 20, 2020*

- $75B in capital, up to $600B in capacity
- Loans cannot be used to repay or refinance existing debt, with the exception of mandatory principal payments
- **New Loan Facility (MSNLF)**
  - 4-year loans to businesses with up to 10K employees or $2.5B in revenues
  - Limited to the lesser of $25M or 4x 2019 EBITDA
  - Priced at SOFR + 250-400bps, with an additional 100bps origination fee with payments deferred for one year
  - Made through commercial banks
- **Expanded Loan Facility (MSELF)**
  - Terms same as MSNLF
  - Loans are limited to the lesser of $150mn, 30% of the borrower's undrawn bank debt, or 6x EBITDA

Municipal Liquidity Facility

Activated April 9 *until September 20, 2020*

- $35B in capital, $500B capacity
- The facility will purchase short-term notes directly from issuers
- Price based on an issuer's credit rating
- Total purchases from any one issuer limited to 20% of an issuer's own-source revenues (as of FY2017)
- Primary aim of this facility is likely to be to help states accommodate near-term revenue declines due to a drop in economic activity as well as the delayed tax filing deadline.
- This program does not plug state government budget gaps – Congressional action needed

Paycheck Protection Program Liquidity Facility (PPPLF)

Activated April 9 *until March 17, 2021*

- $0B in capital, unlimited capacity
- Provide term financing to banks originating Paycheck Protection Program (PPP) loans
- Should incrementally help banks with funding these loans
- Loans are 100% guaranteed by the Small Business Administration (SBA)

Sources: Federal Reserve Board, Invesco, 4/9/2020.

Other Policy Responses Mounting
A review of recent monetary policy action

March 9
Kuroda: “BoJ will take appropriate action without hesitation.”

BANK OF JAPAN

March 12
LaGarde: “[We need] an ambitious and coordinated fiscal policy response.”

	Policy rates	Asset purchases	Liquidity	Bank regulation
ECB	No change	EUR 870B new EUR 1.1T by year end	Additional LTRO funds until TLTRO III in June At lower rates	Banks can use capital and liquidity buffers Broader interpretation of CET1 assets (AT1, say) Delaying inspection processes
BOE	Cut 65 bps to 10 bps	£200B	Term funding for SMEs (could be up to £100bn)	Countercyclical capital buffer reduced to 0% from 1% Total £290B package is around 13% of GDP Stress tests canceled for 2020
PBOC	Some rates cut 10 bps		$70B injected via open market operations	RRRs cut by 100-150 bps (adding $180B of loan potential) SME financing encouraged; interest/repayments delayed
BOJ	No change	$52B additional ETF purchases $10B extra corporate bonds	Will tap Fed’s dollar liquidity swaps	

Source: Invesco, 4/3/2020.

Which direction is the global economy trending?

Accelerating — Stabilizing — Decelerating

How will policymakers react to existing conditions?

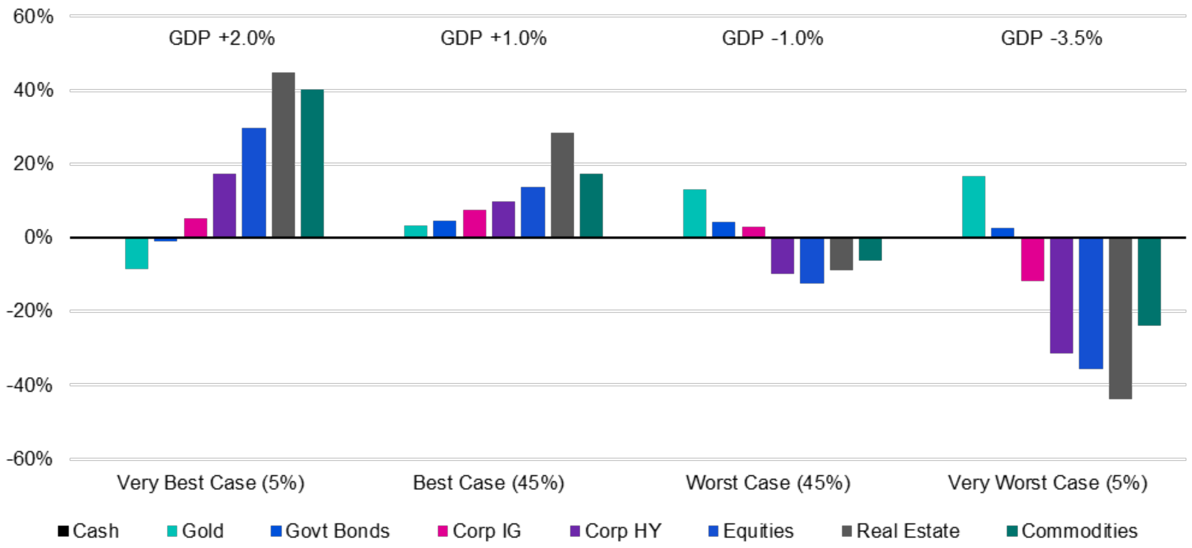
More supportive — Supportive — Less supportive

	More supportive	Supportive	Less supportive
Interest rates	Higher	Low	Lower
Yield curve	Persistently steep	Modestly steep	Flat to inverted
Safe-haven currencies	Weaker	Stable	Stronger
Commodity prices	Stronger	Stable	Weaker
Stocks or bonds	Stocks	Stocks	Bonds
Credit or sovereigns	Credit	Credit (modestly)	Sovereigns
Style	Value-oriented cyclicals	Growth-oriented cyclicals	Defensives
Regional	Emerging	Emerging (modestly)	Developed

Source: Invesco, for illustrative purposes only; not intended as investment advice.

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 16 March 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.

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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 (slides 26 and 36) 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 (slides 26 and 36) 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 Price-Earnings Ratios

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.

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