The Little Book of Data 3

Ways of seeing

December 2020
If ever there was a year for data visualisation, 2020 was it. The global coronavirus pandemic that cascaded its way through the interconnected global system, causing devastating loss of life and bringing countries to a standstill, made us all experts in exponential charts. Armchair statisticians popped up aplenty and reminded everyone of the importance of timely, accurate and transparent data.

First and foremost, COVID-19 is a global health crisis, but the importance of real-time data to understanding events and making informed decisions has perhaps never been so vital. Policymaking is reliant on the quality of information fed into decision-making and visualising it in a way that allows for effective understanding is essential. Investing is no different.

Another topic that rightly grabbed the public’s attention this year was the Black Lives Matter movement, sparked by the tragic killing of George Floyd on May 25 in Minneapolis, Minnesota. It therefore seems fitting that this edition includes a chart by W. E. B. Du Bois, a sociologist, historian and human rights activist, who was an early pioneer of data visualisation. His exhibit at the Exposition Universelle in Paris in 1900, which aimed to challenge the racist caricatures and stereotypes of the day, contained many creative charts, graphs and maps.

We do not have space to cover every corner of the globe or every important story that unfolded in 2020. Instead, as with previous editions of the Little Book of Data, we try to lay out insightful and provocative charts and data visualisations that will get you thinking about the world and where we are headed. Our investment philosophy is grounded in the humility that comes with understanding the limits to knowledge and the endless quest to conquer it. This year’s book marks another part of that journey.

Enjoy.

Euan Munro
CEO, Aviva Investors
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Major macro trends and key developments taking place across the globe.
The bigger picture

Major macro trends and key developments taking place across the globe.
A visual history of pandemics

Why did the coronavirus surprise us?

Densely clustered populations pressing into new habitats, closely connected by fast transport links, increase the risk of new infections emerging and spreading around the world.

Epidemiologists know the pattern well. For centuries, different pathogens have emerged, disrupted society and unsettled their human hosts. In some cases, millions have died, and the details are etched in cultural history.
Under threat: The interconnectivity of the biggest global risks

With the world more connected than ever, the majority of key risks listed in the World Economic Forum’s Global Risks 2020 report are interlinked. The materialisation of one risk could have unintended and unpredictable knock-on effects elsewhere.

Although the top five risks in 2020 are environmental, they could lead to governance failures, food crises and involuntary migration, destabilising entire societies.
Natural disasters

Infectious diseases

Failure of urban planning

Extreme weather

Food crises

Biodiversity loss

Water crises

Climate action failure

Human-made environmental disasters

Global governance failure

Weapons of mass destruction

Interstate conflict

Illicit trade

Terrorist attacks

State collapse

Energy price shock

Fiscal crises

Social instability

Involuntary migration

National governance failure

Unmanageable inflation

Deflation

Financial failure

Asset bubbles

Unemployment

Adverse technological advances

Data fraud or theft

Cyberattacks

Information infrastructure breakdowns

Critical infrastructure failure

Number and strength of connections ("weighted degree")

Economic risks

Geopolitical risks

Technological risks

Environmental risks

Societal risks
Just when you think interest rates can’t go lower

Nominal loan rates and resulting falling real rate trend over past 700 years

- Simon van Halen to Edward III: 35 per cent
- Amadi/Rommel loan to King Sigismund: 18 per cent
- Charles II Dunkirk sale and cash discount: 16 per cent
- Rothschild loan to Beni dell Appannaggio (Papal Treasury): 6 per cent

US savings bonds, series EE 2018 actual real: 0.51 per cent
Trend-implied: 0.19 per cent
Annual real rate trend: -1.96bps p.a.

Real rate trend
10-period moving average, real rate personal loans
Spanish crown
Genoa
Papal States: venal offices
US
Flanders, States General, and Burgund
French crown

Other and state unions
Milan
Paler/Rehlinger and Austrian loans
English crown
Emperor, Habsburg, and German princes
Papal States: short term and monti
King of Denmark
Real rate personal loans
Ever since then Federal Reserve chief Paul Volcker began taming inflation in the early 1980s, nominal and real interest rates have been in near uninterrupted decline across the developed world. That trend has helped fuel spectacular returns for investors in government bonds and, in turn, most other asset classes.

However, while there may seem little prospect of yields rising for the foreseeable future, the golden age for bonds is unlikely to to be repeated. That presents a big challenge for investors: how to secure satisfactory returns without loading up portfolios with excessive levels of risk.
In challenging the scientific evidence for human-driven global warming, climate deniers often cite fluctuations in temperatures that occurred before the advent of civilisation. It is true the planet has heated and cooled throughout history. But as this chart (showing the annual mean temperatures compared to the 20th Century average) starkly indicates, the sudden spike that has occurred over the past century is completely unprecedented.
First traces of human settlements in Jericho

Fifth extinction event comes to an end

Writing is developed

Crucifixion of Jesus Christ

Chinese start to use compasses

The internal combustion engine kickstarts the Industrial Revolution

This year (Jan-Jul) 2020 AD | +1.0 °C

End of Last Ice Age 10000 BC | −1.4 °C

Wheat and barley start to be cultivated

The bigger picture 15
In her recent book *The Age of Surveillance Capitalism*, the academic Shoshana Zuboff argues that we have entered a new phase of economic history, in which powerful companies’ business models depend on gathering and monetising vast quantities of user data.

This graphic shows the types of information collected, as stated in privacy policies, by the “big five”: Amazon, Apple, Facebook, Google and Microsoft. From our birthdays and credit card details to our political views and even the tone of our voices, these firms know more about us than we might like to think.

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Only the metadata on when the text messages (in iMessage) were made

Including a personal photograph in your profile

Including both what you've joined and what you've been invited to

Only Apple device purchases and maintenance

Including photo metadata

Including discussion boards, community features, and reviews

Only your time zone

If you've made purchases on Facebook

Including photo metadata

After you've given Twitter permission

Only the IP address used to open the Apple ID account
The POTUS effect
Stock market performance under recent US presidents

Dow Jones Industrial Average returns, rebased to zero from first month in office

Term length in months

Per cent

Donald Trump
Barack Obama
George W. Bush
Bill Clinton
What moves a stock market is complex. It involves a range of financial factors, such as corporate earnings, and non-financial ones, such as climate change. President Trump, however, has often claimed personal credit for the rises, although some of his late night Twitter ramblings have been quickly followed by a fall. But how much of an impact do leaders really have on market valuations?

Despite his administration’s many efforts to influence markets, Donald Trump still trails his predecessor Barack Obama, at least as measured by the performance of the Dow Jones Industrial Average. Maybe when it comes to markets, presidents have much less influence in the long term than investors believe in the short term. This belief was especially relevant during the 2020 US elections.
Despite the warnings, few saw it coming. We look at how communities, companies, industries and nations have fundamentally changed in its wake.
Despite the warnings, few saw it coming. We look at how communities, companies, industries and nations have fundamentally changed in its wake.
Pandemonium
How modern transport hastened the spread of COVID-19

The rapid spread of coronavirus around the world in early 2020 illustrates the connectedness and complexity of the modern world.

We know COVID-19 first emerged in Wuhan in central China, but tracking its subsequent spread with any precision is almost impossible. This graphic shows the most likely routes of transmission, based on air connections to the Chinese city. Every circle represents an airport, and size correlates to traffic.
Spreading routes for COVID-19, based on effective distance*
The lockdown trade-off: Public health versus the economy

Risk and cost versus benefits of re-opening businesses, by sector
Governments around the world have this year walked a fine line between protecting citizens and economic growth, with a key ingredient being when to impose and lift lockdown measures. For investors in real assets, such decisions are having significant ramifications for their portfolios.

In this chart, the benefits of returning to the normal place of work in various sectors are weighed against the risk of doing so. The more attractive risk-reward profile for sectors such as logistics, grocery stores and utilities is due to their higher likelihood of reopening first or remaining open during lockdowns. Retail and leisure businesses, in contrast, not only face prolonged revenue losses during a lockdown, but also higher risks to society upon reopening.
How much fiscal support is enough?

Pressure on governments in advanced countries to get finances under control suddenly evaporated with the pandemic. While policymakers no doubt felt they had little option but to respond in dramatic fashion, many commentators are wondering how such vast sums will ever be paid back and what the long-term impact on economic growth will be.

COVID-19 relief bills passed by US Congress as of June 2020

$2.6 trillion

- 26% Paycheck Protection Program (Small Business Administration)
- 19% Economic Stabilization and Assistance to Distressed Sectors (Department of the Treasury)
- 15% Unemployment Insurance (Department of Labor)
- 11% Internal Revenue Service’s Economic Impact Payments (Department of the Treasury)
- 9% Public Health and Social Services (Department of Health and Human Services)
- 6% Coronavirus Relief Fund (Department of the Treasury)
- 14% Other
Change in fiscal balance as a percentage of global GDP

- **China**
- **Rest of world**
- **Euro area**
- **US**
- **Emerging markets**

Per cent

- **Expansions**
- **Contraction**

How have our spending habits changed?

What a difference a year makes. US retail research firm Stackline analysed online consumer trends in March 2020 compared to March 2019 and found consumer stockpiling of products including personal protection equipment (PPE), cleaning supplies and lockdown food staples accounted for the fastest sales increase.

Meanwhile, summer travel essentials such as luggage, swimwear and rash guards were among the worst-hit categories. Notably, bridal wear and men’s formal wear also decreased as about 650,000 weddings were postponed in the US alone, as estimated by wedding planning app Bridebook.

The pandemic has tested markets, as well as relationships.
Fastest growing categories:
- Dish washing supplies
- Toilet paper
- Fitness goods
- Vitamins
- Dog food
- Pain relief

Fastest declining categories:
- Luggage
- Briefcases
- Cameras
- Men's swimwear
- Bridal wear
- Women's swimwear
- Men's formal wear

Categories with sales decreases greater than 70%:
- Coolers
- Golf clubs
- Drones
- Store fixtures and displays
- Party and event supplies
- Gym bags
- Rash guards
- Boy's athletic shoes
- Party and event supplies
- Gym bags
- Rash guards
- Boy's athletic shoes

Categories with sales increases greater than 100%:
- Milk and cream
- Fitness goods
- Vitamins
- Dog food
- Pain relief
- Milk and cream
- Fitness goods
- Vitamins
- Dog food
- Pain relief

Categories with sales increases greater than 300%:
- Milk and cream
- Fitness goods
- Vitamins
- Dog food
- Pain relief
- Milk and cream
- Fitness goods
- Vitamins
- Dog food
- Pain relief

Categories with sales increases greater than 500%:
- Milk and cream
- Fitness goods
- Vitamins
- Dog food
- Pain relief
- Milk and cream
- Fitness goods
- Vitamins
- Dog food
- Pain relief
Trump versus coronavirus

Speed is critical in the response to COVID-19. Yet for many governments around the world, including the United States, delays to their response in the first three months of the COVID-19 outbreak were caused not by a lack of information, but how the information was either misinterpreted or, worse, played down.

“Tt will go away. Just stay calm. It will go away”

“We have it totally under control”

“We pretty much shut it down coming from China. It’s gonna be fine”

First US case is announced in Washington state

Wuhan lockdown

Trump restricts entry into US from China

China alerts WHO of unusual pneumonia cases in Wuhan

January 2020

February 2020

New reported cases
“It will go away. Just stay calm. It will go away”

“The coronavirus is very much under control in the USA”

“CDC and my administration are doing a GREAT job at handling Coronavirus”

“Stock market starting to look very good to me!”

“Yeah, no, I don’t take responsibility at all”

“I’ve always known this is a real – this is a pandemic”

“US declares national emergency”

“WHO declares COVID-19 as pandemic”

Stock market plummets, DJIA plunged by more than 1,000 points

First batch of CDC tests shown to be faulty

March 2020

Events related to COVID-19

Daily reported cases trend
How many ‘years’ have we lost?

Estimated years of life lost from premature deaths due to COVID-19, Italian victims over 50

- **50-59 year olds**: 30 years lost on average
- **60-69**: 21 years lost
- **70-79**: 12 years lost
- **80-89**: 5 years lost
- **90+**: 1 year lost on average

- **Four per cent of COVID-19 victims were in their 50s with one long-term condition**
- **Most victims in their 60s and 70s could have lived for more than ten years**
The elderly and immune-compromised have been the most vulnerable in the coronavirus pandemic. But how much life has been lost?

One study by academics at Scottish universities combined mortality data with information on patients’ underlying health and concluded that in Italy, one of the worst-hit countries initially, the average person who died of COVID-19 lost more than a decade.
Will we be more prepared next time?

As Bill Gates said in a 2015 TED Talk, “We’re not ready for the next epidemic. The greatest risk of global catastrophe looks [like a virus]. Not missiles, but microbes”. Public health preparedness prior to COVID-19 was patchy at best worldwide, as shown in the left-hand chart.

With the growing realisation that COVID-19 will not be the last pandemic, what can be done to prepare for the next global health crisis? In the right-hand chart, McKinsey suggests an adequate sum spent on prevention will likely pay off numerous times over in the future if we act now.

Health emergency preparedness capacity prior to COVID-19 (per cent)
Estimated cost of preparing for future epidemics versus estimated economic loss from COVID-19 ($USbn)

An initial 2-year investment of...

...followed by annual maintenance investments of...

...over 10 years could dramatically reduce the risks of future outbreaks

Minimum economic loss from COVID-19 pandemic

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Social challenges in place long before COVID-19 came home to roost during the pandemic.
Justice and inequality

Social challenges in place long before COVID-19 came home to roost during the pandemic.
Unequal opportunities
The heredity of the black-white wealth gap

Black and white children raised in different quintiles of wealth distribution (per cent)

Where they end up as adults (per cent)

- Black
- White
The wealth structure in the US is marked by large racial gaps, with the average black household holding less than one tenth the net worth of the average white household. The extent to which these gaps persist depends on how many children move up, down, or remain in the same wealth position as their parents.

Whatever their parents’ wealth, black American children are more likely than white American children to fall below their parents’ position. This reaffirms their disadvantage in attaining wealth.
In North America, black workers commonly experience lower rates of progression – and compensation – than white workers throughout their career.

This is true at each successive level of responsibility, so that by the time they get to the top, white men make up 68 per cent of the C-suite, up from 36 per cent of entry-level jobs.
Share of professionals by role category (per cent)

White men

- A: Entry-level professional
- B: Manager
- C: Senior manager/director
- D: Vice president
- E: Senior vice president
- F: C-suite professional

Ethnic minority men

Black men

White women

- A: Entry-level professional
- B: Manager
- C: Senior manager/director
- D: Vice president
- E: Senior vice president
- F: C-suite professional

Ethnic minority women

Black women

Entry level → C-suite
No-one has any say in where they are born. But when it comes to the factors that determine the quality of someone’s living conditions, their place of birth isn’t just more important than all their other characteristics; it’s more important than all their other characteristics put together.

In a place where the average child can only expect five years of education, it will be incredibly hard for them to obtain the 15 or 20 years the average child gets in a rich country.

People’s life chances increase when their whole country develops; so what was only attainable for the lucky few comes within reach for the majority.
Living conditions between the world’s worst-off and best-off countries

- **Mortality rate of children under the age of 5**
  - Global average 3.9 per cent
  - 12.7 per cent in Somalia
  - 0.21 per cent in Iceland

- **Life expectancy at birth**
  - Global average 72.2 years
  - 84.1 years in Japan
  - Global average in 1800: 29 years
  - 52 years in Sierra Leone

- **Mean years of schooling received by people older than 24**
  - Global average 8.4 years
  - 14.1 years in Germany
  - Global average in 1800: <1 year
  - 1.5 years in Burkina Faso

- **Expected years of schooling for a child of school entrance**
  - Global average 12.7 years
  - 22.9 years in Australia
  - 15-20 years in most countries in Western Europe
  - Global average in 1800: <1 year
  - 4.9 years in South Sudan

- **Average income GDP per capita adjusted for price differences between countries**
  - Global average $15,469
  - $116,936 in Qatar
  - $57,410 in Switzerland
  - $54,225 in the US
  - Global average in 1800: <$1,000
  - $661 in Central African Republic

**Mean years of schooling received by people older than 24**

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**Global income GDP per capita adjusted for price differences between countries**

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<td>Global average in 1800</td>
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**Remittances: Trickle-down economics**

Money sent home by migrant and guest workers is one of the most important sources of income in many emerging markets, surpassing foreign direct investments, debt and equity inflows, and foreign aid. The US is the world’s top originator for remittances, with Mexico the largest recipient nation.

Generally, remittances are uncorrelated to specific country risks and therefore help cushion emerging nations against the impact of economic shocks. During the COVID-19 crisis, however, foreign direct investments, portfolio inflows and remittances all dried up at the same time, as shown in the chart below, adding pressure on organisations such as the International Monetary Fund to take up the slack.
Top ten remittance routes, by value (US$bn)
Across the world, anti-government demonstrations are increasing in frequency, scope and size. In 2019 alone, mass protests were reported across 114 countries, having risen annually by 11.5 per cent between 2009 and 2019, according to the Center for Strategic and International Studies.

In the US, millions marched against police brutality following the tragic deaths of black Americans, most notably George Floyd, Breonna Taylor and Ahmaud Arbery. Uprisings in Belarus called for the removal from office of President Alexander Lukashenko. Meanwhile, students in Hong Kong resumed fresh rounds of demonstrations against policies imposed by the People’s Republic of China. While the protests differ in context, they shared a common theme of a deteriorating relationship between governments and their citizens.
Percentage change in quarterly civilian anti-government protests, by region

Per cent
800
600
400
200
0


Mass protests in 37 countries

Anti-Trump protests

Start of Arab Spring

Occupy Wall Street

Ukrainian revolution

Middle East and North Africa
Asia
North America
Sub-Saharan Africa
Europe
Rest of world

800 Mass protests in 37 countries

Anti-Trump protests

Start of Arab Spring

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Ukrainian revolution

Middle East and North Africa
Asia
North America
Sub-Saharan Africa
Europe
Rest of world
Social purpose: Putting your money where your mouth is

In August 2019, in a new ‘Statement on the Purpose of a Corporation’, 181 CEOs from many of America’s largest companies committed to “lead their companies for the benefit of all stakeholders – customers, employees, suppliers, communities and shareholders”.

Yet companies have been steadily reducing their fiscal contributions for years. Global value chains and the rise of the digital economy mean firms can easily shift production to lower-tax jurisdictions, pushing countries to compete by lowering tax rates and granting incentives.

This raises a serious question: are corporations that shy away from paying their taxes really the “upstanding citizens” they claim to be?

Corporate income tax rates, G-7 countries, 2012 and 2018
Average corporate income tax rates, by country income group, 1990-2018

Per cent

- Low income
- Middle income
- High income
- OECD (Europe)
- OECD (ex-Europe)
Relations between the world's two superpowers stretched to breaking point in 2020. Some commentators went as far as declaring a new cold war, with far-reaching implications for the global economy and beyond.
US-China tensions

Relations between the world's two superpowers stretched to breaking point in 2020. Some commentators went as far as declaring a new cold war, with far-reaching implications for the global economy and beyond.
Tit for tat
How the US-China trade war escalated

The US-China trade war began in earnest in 2017, when the new Trump administration started imposing new tariffs on Chinese goods, ostensibly to rectify a trade imbalance and to retaliate for the alleged theft of intellectual property from American firms. This graphic shows how each side took turns ramping up tariffs in the initial 16 months of the conflict.
A phase one trade deal in January 2020 was designed to bring an end to the spat, but the agreement now looks vulnerable as tensions escalate in the wake of the COVID-19 pandemic.
Patent power
The rise of Asia’s intellectual property prowess

The accusation that China steals technology from Western firms has exacerbated trade tensions between China and the US. But China is becoming an increasingly sophisticated technological superpower in its own right.

This bubble chart shows the proportion of the average number of internationally filed patents awarded annually to different countries between 1980 and 1999 (on the left) and between 2000 and 2018 (on the right). While China still lags the US in innovation, it is catching up fast – and its neighbour South Korea is not far behind.

119,689
Average patents awarded annually, 1980-1999 (per cent)
283,248
Average patents awarded annually, 2000-2018 (per cent)

- Japan: 24%
- US: 22%
- China: 10%
- South Korea: 7%
- United Kingdom: 3%
- Germany: 11%
- Canada: 2%
- Netherlands: 1%
- Switzerland: 1%
- Italy: 2%
- Sweden: 1%
- Israel: 1%

Asia (inc. Israel)
Rest of the world

US-China tensions 55
As the US-China dispute has escalated, some commentators have argued trade links between the two partners and their respective allies could be unwound. But this is easier said than done. This graphic highlights China’s embeddedness in the global trade network.
Money talks: China extends its influence

China has extended cheap loans to poorer governments as part of its plan to extend its influence and cement alliances abroad. Such is the scale of this programme, China is now the world’s largest official creditor, according to a 2019 study from the Kiel Institute for the World Economy and Harvard University. Sub-Saharan Africa has been the chief recipient of Chinese loans, as this map shows.

In per cent of debtor GDP
- 0 - 1
- 1 - 5
- 5 - 10
- 10 - 25
- 25 - 100
- No data
China has the world’s largest foreign currency reserves, while the US is the world’s most indebted country. About 40 percent of US sovereign debt is held by foreign entities, with China dominating the list in 2019, according to the US Department of the Treasury.

US-China trade tensions, however, appear to have reduced China’s appetite for US bonds just as COVID-19 has forced Uncle Sam to borrow at an unprecedented rate. The US Treasury issued about $3 trillion of new debt in the second quarter alone to fund fiscal programmes in response to the pandemic. But if China stays on the sidelines, more of the burden of buying Treasuries may fall to domestic buyers – including the Fed.
Foreign holders of US debt, 2019

- **Japan**: $1,064bn (16.5%)
- **China**: $1,113bn (17.3%)
- **Brazil**: $306.7bn (4.8%)
- **Other Countries**: $555.5bn (8.6%)

**Countries**
- **Taiwan**: $171.1bn (2.7%)
- **Hong Kong**: $205.9bn (3.2%)
- **Singapore**: $139.3bn (2.2%)
- **Australia**: $39.1bn (0.6%)
- **Poland**: $37.2bn (0.6%)
- **Luxembourg**: $223.7bn (3.5%)
- **Spain**: $41bn (0.6%)
- **Italy**: $43.7bn (0.7%)
- **Korea**: $115.1bn (1.8%)
- **Germany**: $72.8bn (1.1%)
- **Netherlands**: $45bn (0.7%)
- **Switzerland**: $226.9bn (3.5%)
- **Sweden**: $46.5bn (0.7%)
- **Saudi Arabia**: $176.6bn (2.8%)
- **Kuwait**: $40.2bn (0.6%)
- **Ireland**: $269.7bn (4.2%)
- **United kingdom**: $300.8bn (4.7%)
- **Belgium**: $179.8bn (2.8%)
- **United Arab Emirates**: $55.7bn (0.9%)
- **Cayman Islands**: $217.2bn (3.4%)
- **Canada**: $102.1bn (1.6%)
- **Bermuda**: $217.2bn (3.4%)
- **Brazil**: $306.7bn (4.8%)
- **United States**: $171.1bn (2.7%)
- **Mexico**: $47.7bn (0.8%)
- **Iran**: $35.4bn (0.6%)
- **United Kingdom**: $300.8bn (4.7%)
- **Nigeria**: $37.2bn (0.6%)
- **Norway**: $97.1bn (1.5%)
- **United Arab Emirates**: $55.7bn (0.9%)

**Other Countries**

**US-China tensions 61**
The war of words between the US and China has led to speculation the two powers could be heading towards outright conflict. This block chart shows that the arms race is – for the time being – one-sided. While Chinese military spending has risen in recent years, US investment in defense is still larger than the next ten nations combined.
COVID-19 brought into sharp focus what can happen if warnings go unheeded, serving as an important lesson for the environmental challenges facing the world.

Sustainability
COVID-19 brought into sharp focus what can happen if warnings go unheeded, serving as an important lesson for the environmental challenges facing the world.
Green lining
The impact of COVID-19 on decarbonisation

Estimates from a May 2020 study showed significant cuts to emissions from air and road travel as a result of public health measures to curb the spread of COVID-19. However, the drop was not as steep as might have been expected given the drastic changes to people’s lives. It was also temporary: once lock downs eased, emissions crept back up.

Change in global daily fossil fuel CO2 emissions by region, 2020

Per cent

Rest of the world
China
India
Europe
US
No structural changes have been made to energy systems, and fossil fuels remain deeply entrenched in the global economy. Decarbonisation will be a tough battle to win.

Change in global daily fossil fuel CO2 emissions by sector, 2020
What a load of rubbish
Wealthier nations may be big on recycling, but they remain wasteful

Over 2.1 billion tonnes of municipal solid waste are generated globally each year, 950 million tonnes of which are disposed of unsustainably. This gulf between what we produce and what we recycle creates huge challenges for governments, companies and populations.

Tougher regulation is an obvious option to address the issue. Companies that produce large volumes of waste may end up footing the bill if they do not find solutions to create a more circular economy.
Weighing up life on Earth

Do we appreciate that we are just one small part of a complex biological system?

Microorganisms far outweigh human life. As populations expand into new habitats, they are forced to live in close proximity to new species. This sets the scene for zoonoses, where pathogens leap from non-humans to humans – like the journey thought to have been made by COVID-19.
Estimated global biomass by taxonomic groups

450
Plants
Going, going, gone: Sixth mass extinction

A study published in *Science Advances* suggests species may be declining up to 100 times faster than the background rate, the normal rate species are expected to disappear without human intervention.

In the sixth mass extinction, climate change, pollution and changing land use – among other human activities – are placing growing pressure on other species. But we do not fully understand the impacts, because many species are unknown, and their place in ecological food webs is also unknown. As life forms are linked, there are likely to be cascade and multiplier effects.
26% Mammals
91% of 6,495 known species assessed

14% Fish
59% of 35,519 known species assessed

26% Threatened
Mammals

14% Threatened
Fish
Down to earth
Solar power really doesn’t require much land

Surface area needed to power the world with solar in 2030

496,805 square kilometres

Efforts to calculate just how much of the world’s surface would need to be covered by solar panels to power transport, machinery and electrical appliances suggest it could be done by using a relatively small land area.

Of course, not all energy needs can be met by solar power; air transport is an obvious example. But efficiency improvements continue to be made. This illustration assumes panels with 20 per cent operating efficiency. Scientists at Oxford University recently developed a perovskite crystal covering for solar panelling that could boost efficiency by as much as a third. Such technological advances should reduce the amount of surface space required even further.
Surface area needed to power the world with solar in 2030:

496,805 square kilometres
Amazon versus Amazon

Amazon market capitalisation (US$bn)

Jeff Bezos started the company we now know as Amazon a quarter of a century ago, naming it after the world’s largest river that runs through nine countries in South America. As of September 30, 2020, that company is worth about three times the continent in which that river is located, based on the MSCI Emerging Markets Latin America Investable Market Index, which covers 99 per cent of the free float-adjusted market capitalisation of the continent’s six largest economies.

At least when it comes to how investors value assets, the worth of Amazon – the river – has far to go to catch up with its namesake.
MSCI EM Latin America IMI Index market capitalisation (US$bn)

- Brazil: 337
- Mexico: 119
- Chile: 38
- Peru: 15
- Columbia: 12
- Others: 12
Without nature, there would be no life. But the obsession with economic growth dictates we invest more in produced and human capital (accumulated knowledge and skills) at the expense of natural capital. For developing economies with relatively high levels of natural capital (as illustrated in the map) but low levels of produced and human capital, the trade-off is especially worrying.

If society fails to reflect nature’s worth, we will continue to mismanage natural capital, threatening the lives and livelihoods of future generations. All this suggests it is time to place a far greater value and emphasis on natural capital than we currently do.
Data visualisations highlighting the opportunities and risks in equities, bonds and alternative assets, as well as major global economic trends.
Markets and economies

Data visualisations highlighting the opportunities and risks in equities, bonds and alternative assets, as well as major global economic trends.
Mixed signals: Economic cliff and the V-shaped equity market recovery

Percentage change in GDP, quarter-on-quarter

OECD
World

Mixed signals: Economic cliff and the V-shaped equity market recovery
Global equity markets have staged a stunning recovery since March, far outstripping the pace of the rebound that followed the global financial crisis (GFC). The rally has been most pronounced in the US, where major indices have gone on to hit record highs, led by the Nasdaq Composite.

Markets are hopeful massive fiscal and monetary support from policymakers will help deliver a so-called V-shaped recovery, and that looking further ahead, economic growth will not be badly impaired as this support is withdrawn. Only time will tell if that view is too optimistic.

Performance of S&P 500, COVID-19 crisis versus global financial crisis
Labour’s lost
Spike in US jobless claims highest since the Great Depression

In the week ending March 28, more than 6.6 million Americans filed for unemployment. Total non-farm payroll employment shrank in March and April by more than 22 million – more than erasing all the jobs created since the global financial crisis.
Although the economy has since recouped around half of those jobs, that still means about five-years’ worth of new jobs had been wiped out. With the pace of hiring slowing as the country struggles to get the pandemic under control, it could be a long road to a US jobs recovery.
Nothing is certain but debt and taxes

Fiscal deficits have skyrocketed to record highs as governments around the world attempt to limit the damage caused by the pandemic. For now, huge government debt issuance is being absorbed by equally vast bond-buying programmes from central banks.

But is this a permanent solution? While tax rises may be part of the answer for some, the kind of austerity policies that followed the global financial crisis in a number of countries no longer appears politically acceptable. Investors face a difficult task trying to determine if, how, and when deficits will be brought back under control.
Asset purchases as share of aggregated nominal GDP

Per cent of GDP


Forecast

US Federal Reserve
Bank of Japan
European Central Bank
Bank of England

Advanced markets
Emerging markets
Before and after: COVID-19’s impact on correlations

All historical relationships can break down and must be constantly reassessed. In a ‘normal’ market environment, many assets behave differently from each other, providing a good level of diversification. This is in sharp contrast to the market stress created by COVID-19 when most assets started behaving in the same way, stripping portfolios of their protection. Only a few safe havens remained, including government bonds.

52-week correlations as of January 3, 2020
52-week correlations as of April 15, 2020

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Infrastructure project evaluation

Significant new infrastructure investment is fundamental to the achievement of the Sustainable Development Goals (SDGs). Yet determining a project’s potential contribution – positive and negative – is not a linear process.

Using the recent case study of a European utility company, our infrastructure investment team illustrate how the ESG elements of due diligence and decision making help assess a project’s contribution.

Background: We were considering an investment in a company that builds, refurbishes and operates small-scale power plants supplying energy to local customers. The company aims to improve the energy efficiency of its plants.
Due diligence

ESG due diligence revealed minor exposure to lignite. Legal due diligence:

Technical due diligence:

Still supplies a small amount of energy from highly polluting lignite. Clear roadmap for decarbonisation. Lignite exposure in decline. The plants are expected to become greener by 2025 in line with regulation.

Management of the asset

We added an ESG-specific covenant to the asset management agreement. It included the following:

- The company cannot build any new lignite or coal plants.
- The company is restricted from buying other firms that build lignite or coal plants.

Approval

Approval of the investment is conditional on the utility company agreeing the ESG covenant and reporting obligations.

Progress must be proven.

Approval depends on the company agreeing obligations and reporting.

Reporting

We needed to make sure the company kept to its decarbonisation plan. The company must report every year to Aviva Investors on progress.

Result: The investment will contribute to SDG 7 on affordable, clean energy, and to SDG 13 on climate action.
Real exposure: Balancing sources of portfolio diversification

Real assets can be used to achieve different investment outcomes. Understanding what drives risk and return is as important as measuring the factors themselves.

Our analysis highlights risk contributors in each equity asset class; power prices (for renewables), rental value growth and inflation are the three main drivers. This contrasts with fixed income, where the main risk driver is the level of defaults. In this respect, infrastructure and real estate may help diversify a fixed income portfolio.
Risk drivers of income in real assets

- GDP-sensitive
- Inflation
- Idiosyncratic
- Power price
- Rental growth
- Property yields

<table>
<thead>
<tr>
<th>Category</th>
<th>UK renewables</th>
<th>UK real estate (all property)</th>
<th>UK long lease</th>
<th>Euro long lease</th>
<th>UK income strip</th>
</tr>
</thead>
<tbody>
<tr>
<td>GDP-sensitive</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Inflation</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Idiosyncratic</td>
<td></td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Power price</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rental growth</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Property yields</td>
<td></td>
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<td></td>
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</tr>
</tbody>
</table>
Crowding out
Big Tech just got bigger

Bigger companies have seized market share from smaller ones in recent years, especially in the technology sector, where digital platforms tend to favour incumbents and first movers.

As this bubble chart shows, the trend is most pronounced in China and the US, where huge platform companies now hold sway. These companies provide the public with convenient services – often for free – but some economists say that this level of market concentration is unhealthy, because it dampens competition and removes incentives for smaller firms to invest.

Market capitalisation of global platforms as percentage of total, by region

Data as of September 30, 2020
Crowding out

Big Tech just got bigger
Constructive alignment
Illiquidity premia in private markets

Over the last decade, dwindling yields in fixed income markets have pushed investors to look elsewhere to boost returns, by allocating to riskier public assets or to less liquid private assets such as real estate, infrastructure and private corporate debt.

A key driver for the increase in allocations to private assets was the belief they could deliver illiquidity premia: higher expected returns than publicly traded assets of broadly similar quality. In the uncertainty brought by COVID-19, though, that premia came under intense pressure in the first half of 2020 as spreads widened. However, they quickly contracted again as unprecedented central bank and fiscal support worldwide boosted markets, with safer assets benefitting the most.
Telling stories through data visualisation has shaped how we view the world through the ages. We pay homage to some pioneering work and provide a more modern interpretation.
Telling stories through data visualisation has shaped how we view the world through the ages. We pay homage to some pioneering work and provide a more modern interpretation.
Relative number of African Americans in businesses, by types (ca. 1900)

- Estimated capital: $8,784,637
- General merchandise stores
- Grocers
- Bankers
- Undertakers
- Building contractors
- Druggists
- Publishers
- Building and loan associations

W.E.B. Du Bois
Black employment history: Life after emancipation for African Americans
The Harvard-educated sociologist, historian and civil rights activist W. E. B. Du Bois first visualised the evolution of black life since emancipation through a series of charts, graphs and maps exhibited at the Paris Exposition Universelle in 1900.

At the time, Du Bois wrote that he was striving to present “life and development without apology or gloss”. The chart to the left, for example, simply illustrates the types of black-owned businesses such as grocery stores, pharmacies and publishing companies. More recent US Census data indicate occupations among African Americans are more concentrated in service roles relative to whites. While about 30 per cent of black workers are employed as managers, professionals or related roles, this falls far short of the 40 per cent occupied by whites in the same category.

**US labour force by occupation, race and ethnicity (per cent)**

<table>
<thead>
<tr>
<th>Race or Ethnicity</th>
<th>Management, professional and related</th>
<th>Service</th>
<th>Sales and office</th>
<th>Natural resources, construction and maintenance</th>
<th>Production, transportation and material moving</th>
</tr>
</thead>
<tbody>
<tr>
<td>White</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>White</td>
<td>11</td>
<td>10</td>
<td>23</td>
<td>16</td>
<td>40</td>
</tr>
<tr>
<td>Black or African American</td>
<td>15</td>
<td>6</td>
<td>24</td>
<td>25</td>
<td>30</td>
</tr>
<tr>
<td>Asian</td>
<td>10</td>
<td>3</td>
<td>20</td>
<td>16</td>
<td>51</td>
</tr>
<tr>
<td>Hispanic or Latino</td>
<td>16</td>
<td>16</td>
<td>21</td>
<td>25</td>
<td>22</td>
</tr>
</tbody>
</table>
**Florence Nightingale**
Why you need to understand the causes of death to prevent it

The Lady with the Lamp is best known as the founder of modern nursing, but she was also a data visualisation pioneer who understood the power of statistics to persuade. In the graphic comparing the monthly rate and causes of death of the British army in 1855 and 1856 during the Crimean War, she demonstrated that the mortality rate significantly decreased when sanitary practices improved, helping to convince the government to raise hygiene standards in the military.

When the coronavirus pandemic spread across the globe earlier this year, US President Donald Trump tweeted that it’s no worse than the seasonal flu. But, as a chart of US mortality and causes of death during the week commencing April 6 shows, COVID-19 is clearly not the flu. It is far more deadly, which explains why public officials imposed protective measures.
COVID-19 killed more people from April 6 to April 12 than any other cause of death except heart disease typically does in a normal April week.
**Slave ship**

Illustrating the state of forced labour

In this ‘Brookes’ slave ship diagram by the Plymouth Chapter of the Society for Effecting the Abolition of the Slave Trade, hundreds of enslaved men, women and children are shown packed into tiny spaces. They were often chained or shackled together, making movement more difficult, and the spread of disease, dehydration and malnutrition contributed to a high mortality rate during the journey. The image helped drum up support for the anti-slavery movement in the US and Europe.

Slavery remains widespread, with about 40 million people in either forced labour or forced marriages globally. Unlike the predominance of adult male captives during the transatlantic slave trade, however, modern slavery targets women more than men, even when excluding forced marriages.

Diagram of how slaves were stowed on board Brookes cargo ship, ca. 1789
Modern slavery: Individuals in forced labour or forced marriages

- **World total**
  - Forced labour
  - Forced marriage

- **Type**
  - Exploitation
  - Sex
  - State-imposed

- **Women**
  - Forced labour
  - Forced marriage

- **Men**
  - Forced labour
  - Forced marriage

- **Adult**
  - Forced labour
  - Forced marriage

- **Children**
  - Forced labour
  - Forced marriage

**Estimates for 2016**
- 25 million
- 15 million
- 4 million
- 1 million
- 300,000
Big data is watching you
The pattern of ridges and furrows in our fingerprints begins to develop in the womb and is formed by the time we're born. No two are alike, not even among identical twins. Their individuality and immutability make them one of the most reliable methods of identification. Technology has paved the way to collect methods of identification. The digital traces we leave online to establish who we are, in a way that mimics the uniqueness of our physical fingerprints but on a far grander scale. Analysing visible content such as texts, emails and posts alongside the hidden metadata specific to our devices not only helps identify individuals, but also their preferences, personalities and ultimately behaviours which physical fingerprints cannot do. This makes personal data as valuable to a retailer selling wares as a politician campaigning for votes or a criminal committing blackmail. As with any powerful tool, the potential for abuse is considerable. The other side of the coin is big data's central role in solving global problems. Its ability to mitigate climate risks, improve national security and personalise healthcare is well-documented. During the COVID-19 pandemic, online surveillance helped monitor the spread of the virus and manage the disease. Yet this involves individuals relinquishing privacy rights that history suggests may be difficult to regain once the intended use for them disappears. If personal data is the new oil, as with any new market, effective regulations are required to create a level playing field. As with any new technology, the web to address data security, data audit and developing the world’s general awareness may be challenging. Otherwise, what was meant to connect the world may end up leaving a destructive divide in its wake.

[Tim Berners-Lee, inventor of the World Wide Web, has called for a Magna Carta for the web to address data security, data auditing and data use transparency. Otherwise, what was meant to connect the world may end up leaving a destructive divide in its wake. If personal data is the new oil, as with any new market, effective regulations are required to create a level playing field. As with any new technology, the web to address data security, data audit and developing the world’s general awareness may be challenging. Otherwise, what was meant to connect the world may end up leaving a destructive divide in its wake.]

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Down to earth 'Total surface area required to fuel the world with solar', Land Art Generator, August 13, 2009. Note: Although data estimates for 2030 are based on 2009 data, the IEA's updated estimates in 2015 shows the overall trends to be the same.

Amazon versus Amazon Aviva Investors, Bloomberg, MSCI, data as of September 30, 2020.


Mixed signals: Economic cliff and the V-shaped equity market recovery Aviva Investors, Bloomberg, data as of September 30, 2020. Note: *Rebased to 100 on Day zero, which is the day after Lehman Brothers declared bankruptcy on September 15, 2008 for the GFC and February 12, 2020 for COVID-19 at the general peak of global equity markets before the first quarter sell-off.


Nothing is certain but debt and taxes Aviva Investors. Based on Historical Public Debt Database, IMF WEO, Maddison Database Project, and IMF staff calculations as of June 2020. Note: The aggregate public debt to GDP series for advanced and emerging market economies are based on debt to GDP data for a constant sample of 25 countries and 27 countries, respectively. The averages are calculated using weights derived from GDP in PPP terms.


Infrastructure project evaluation Aviva Investors, September 2020.


Big data is watching you Aviva Investors, 2020.
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