

THE LITTLE BOOK OF DATA

SEARCHING
FOR SIGNALS

The little book of data

DECEMBER 2018

Foreword

As bytes of data multiply by the second, we are increasingly bombarded by poorly-presented data. This seems highly strange given we process visual information 60,000 times faster than text.

If we are to turn data into information and, crucially, information into insight, the visual depiction of data demands our attention. To this end, displaying information has been a neglected art form within finance for far too long. In this little book we aim to rectify matters, in however small a way. Part curation, part creation, we have drawn from experts in this field – the late Hans Rosling, LSE Cities and Our World in Data to name just a few.

The subject matter is not exhaustive; it can't be. What we hope to do is to provide easy to comprehend and visually-arresting snapshots of some of the most important factors shaping the financial world around us. It is a collection of visual vignettes we hope will help you, as they have us, see the world more clearly – and perhaps even differently.

Bad data visualisation confuses and wastes time. Good visualisations save time, draw you in, and shine a light.

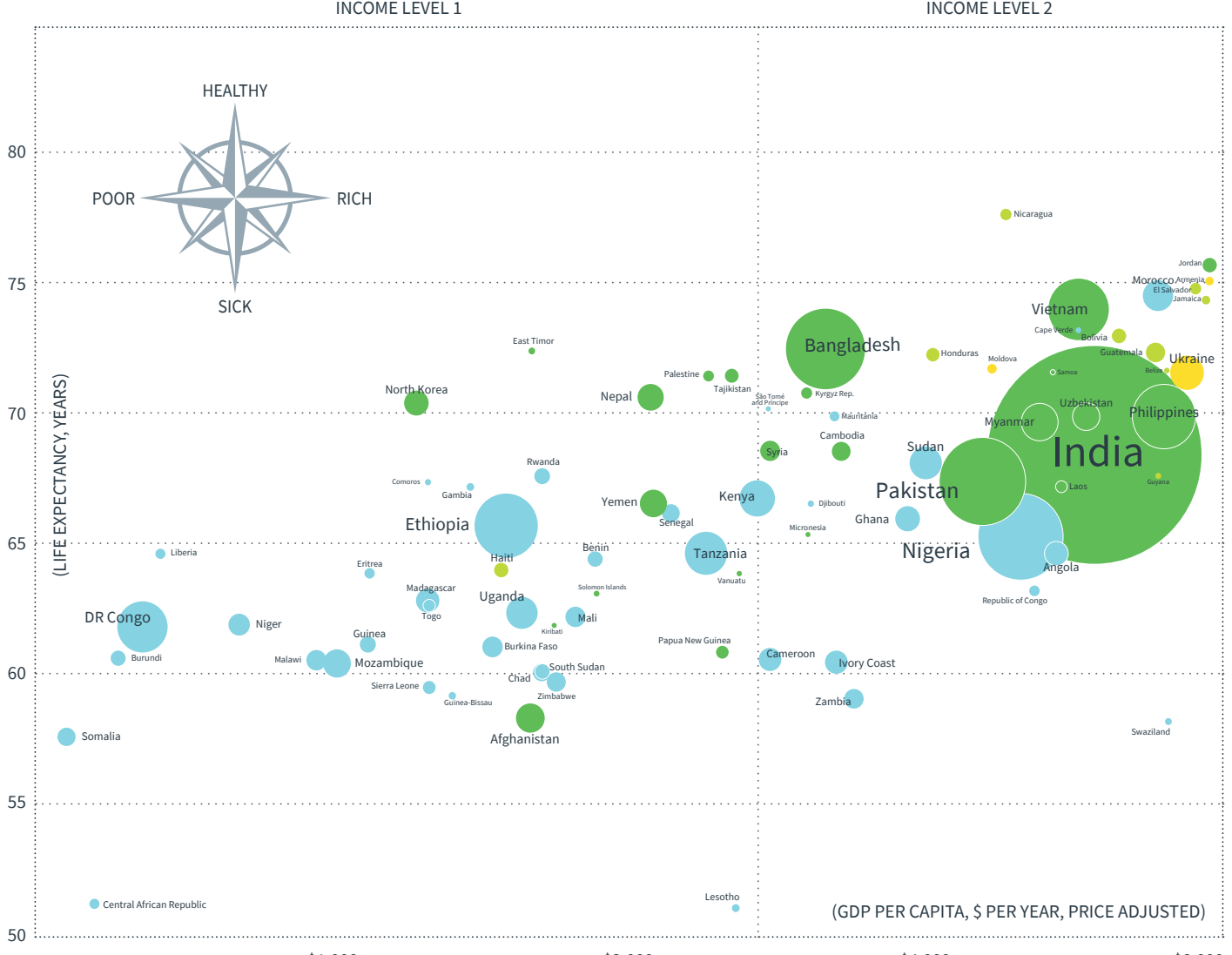
Euan Munro

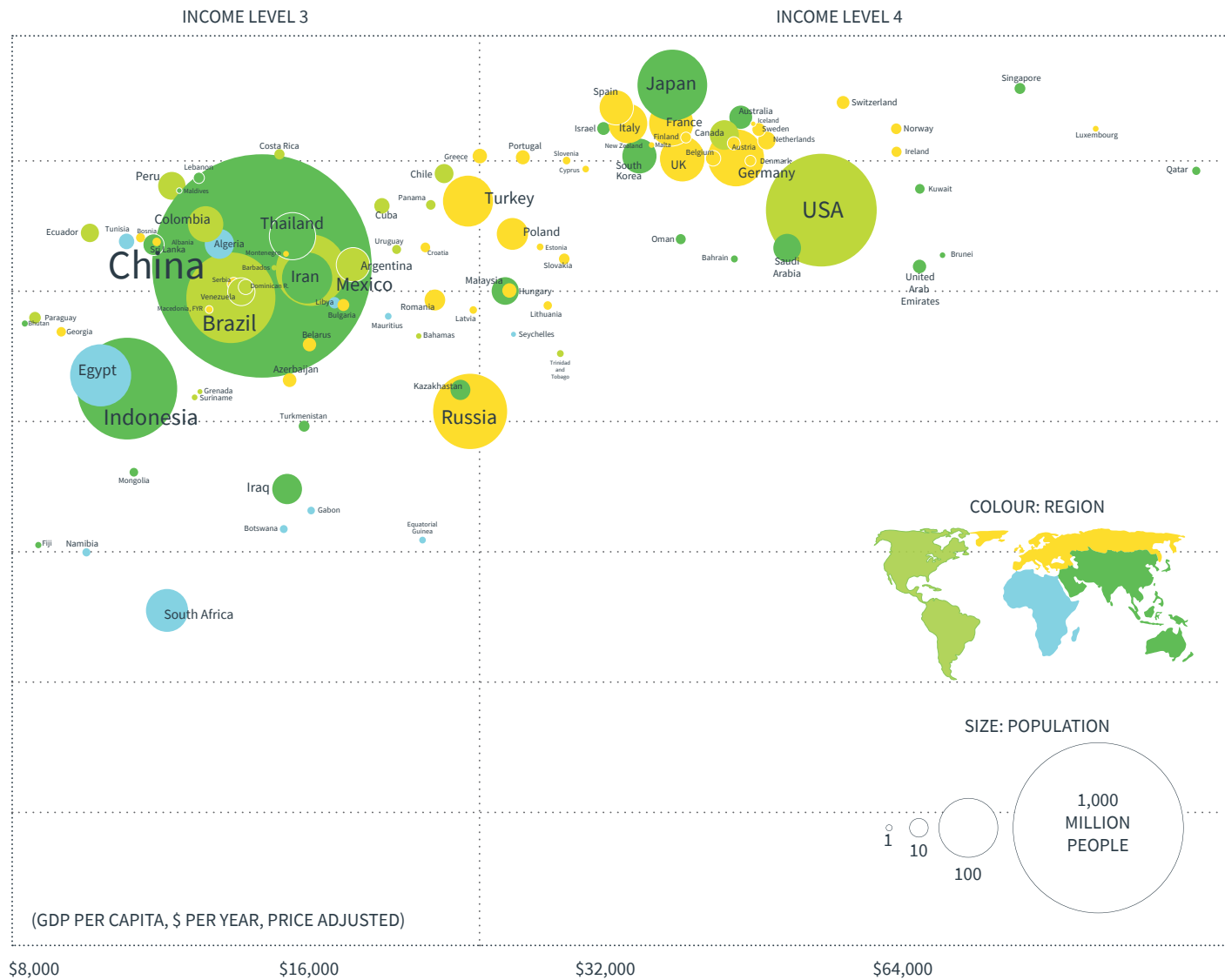
CEO, Aviva Investors

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Big picture

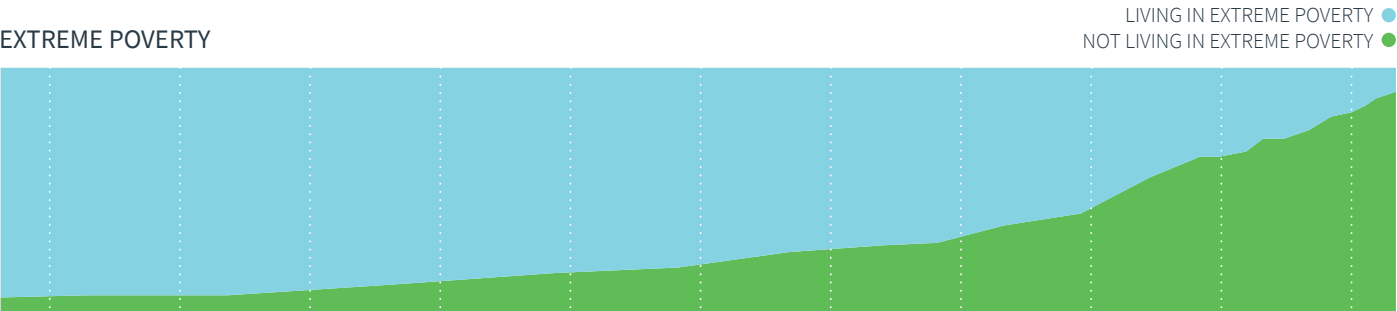
Visual depictions of major macro trends to help investors gain perspective and distinguish the key trends taking place across the globe.



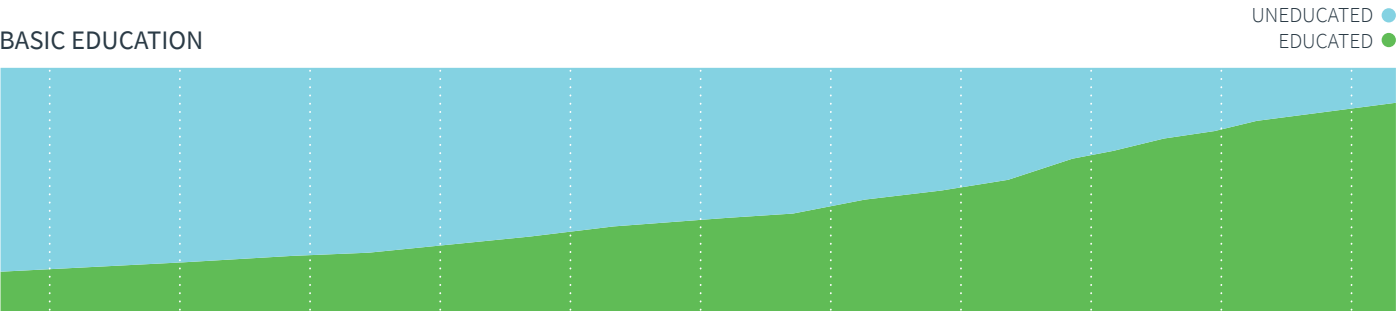


The world as 100 people

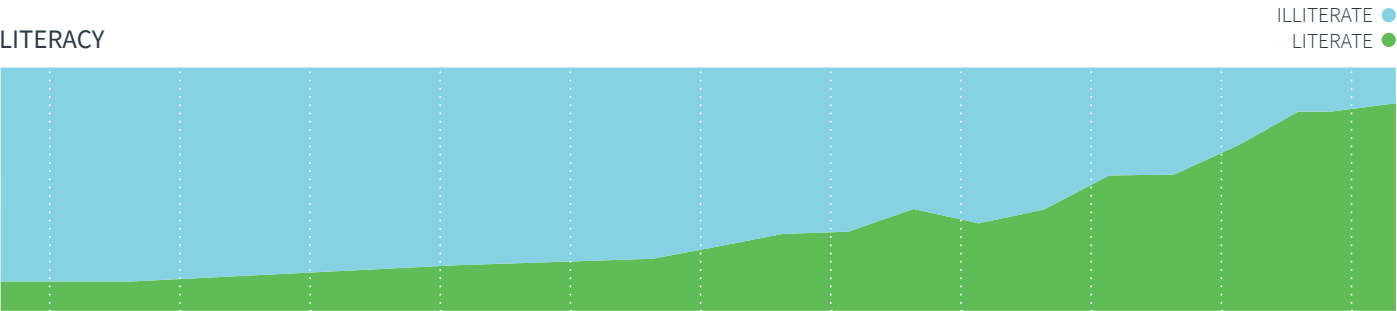
EXTREME POVERTY



BASIC EDUCATION

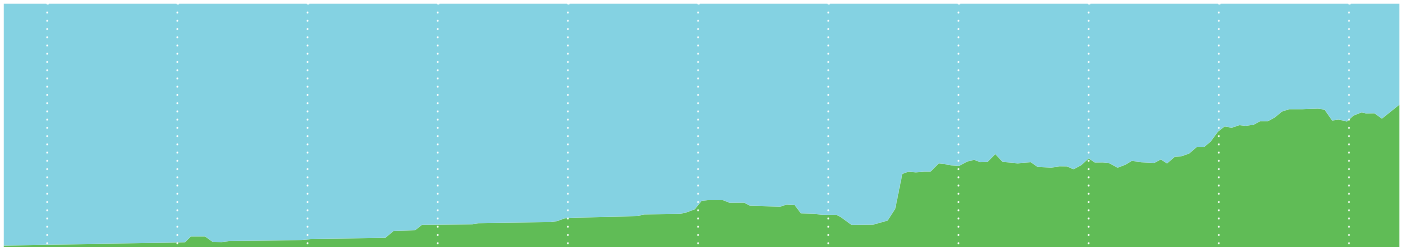


LITERACY



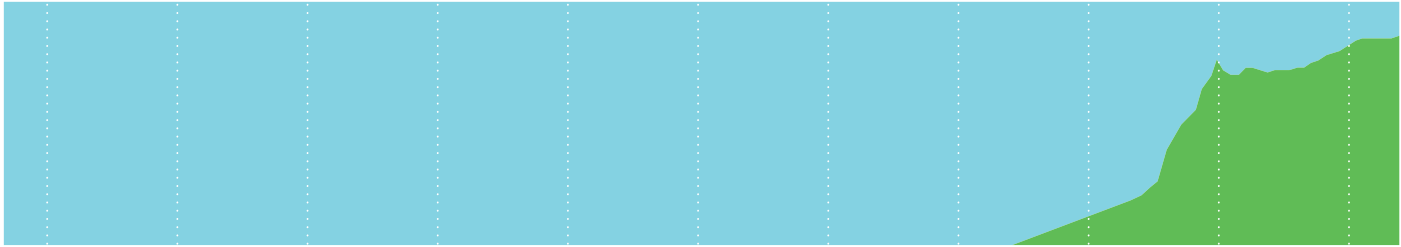
DEMOCRACY

NOT LIVING IN DEMOCRACY ●
LIVING IN DEMOCRACY ●



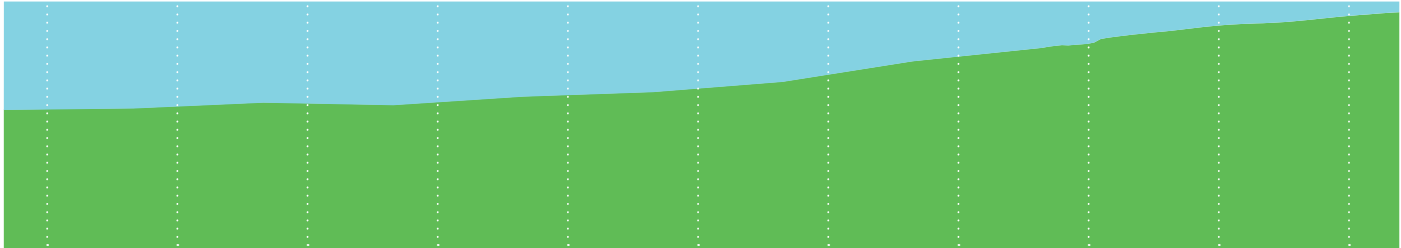
VACCINATION

NOT VACCINATED ●
VACCINATED ●



CHILD MORTALITY

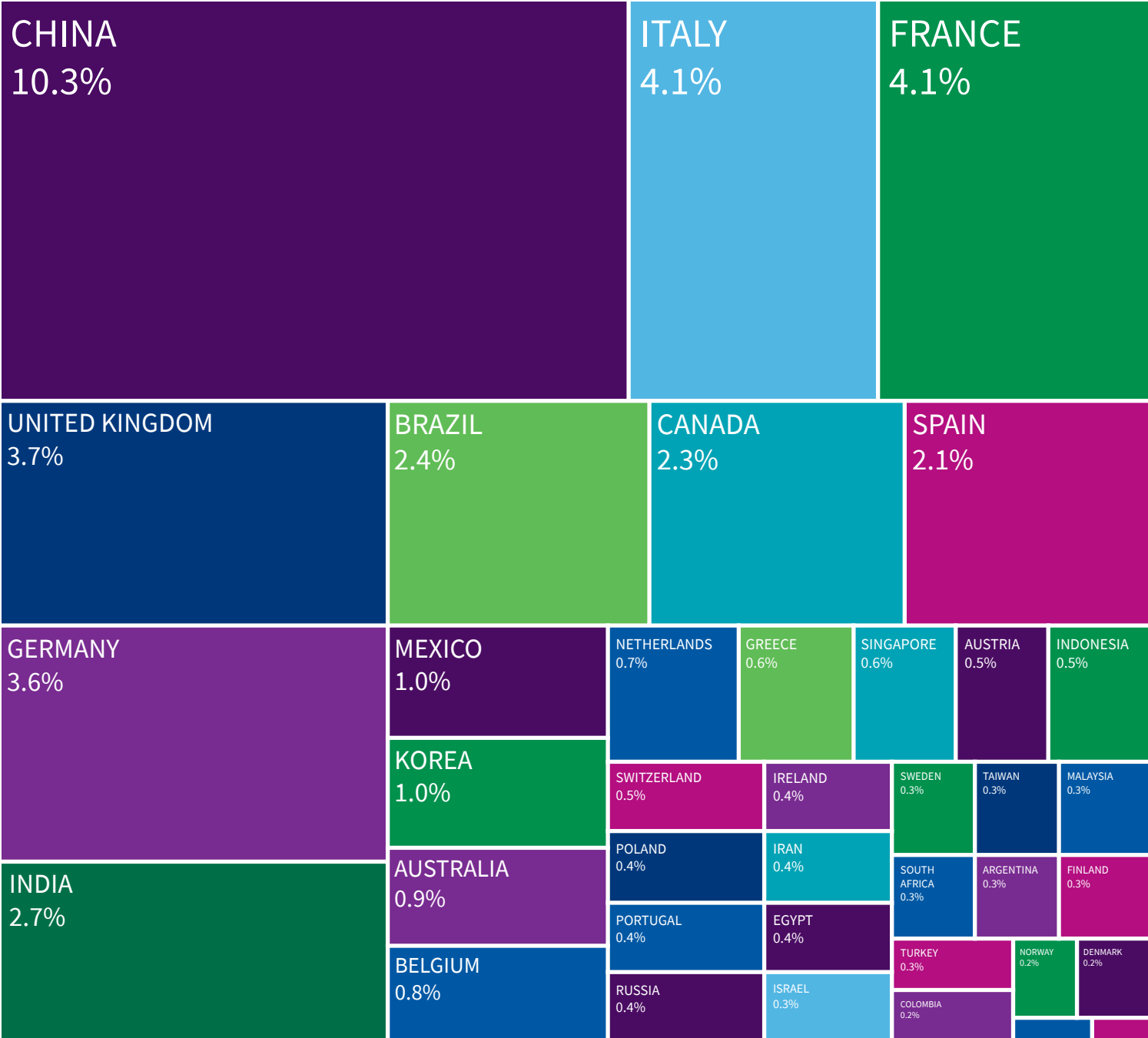
DIED BEFORE 5 YEARS ●
SURVIVED THE FIRST 5 YEARS ●



Global gross external debt breakdown (% of global total)

UNITED STATES
34.3%

JAPAN
17.9%

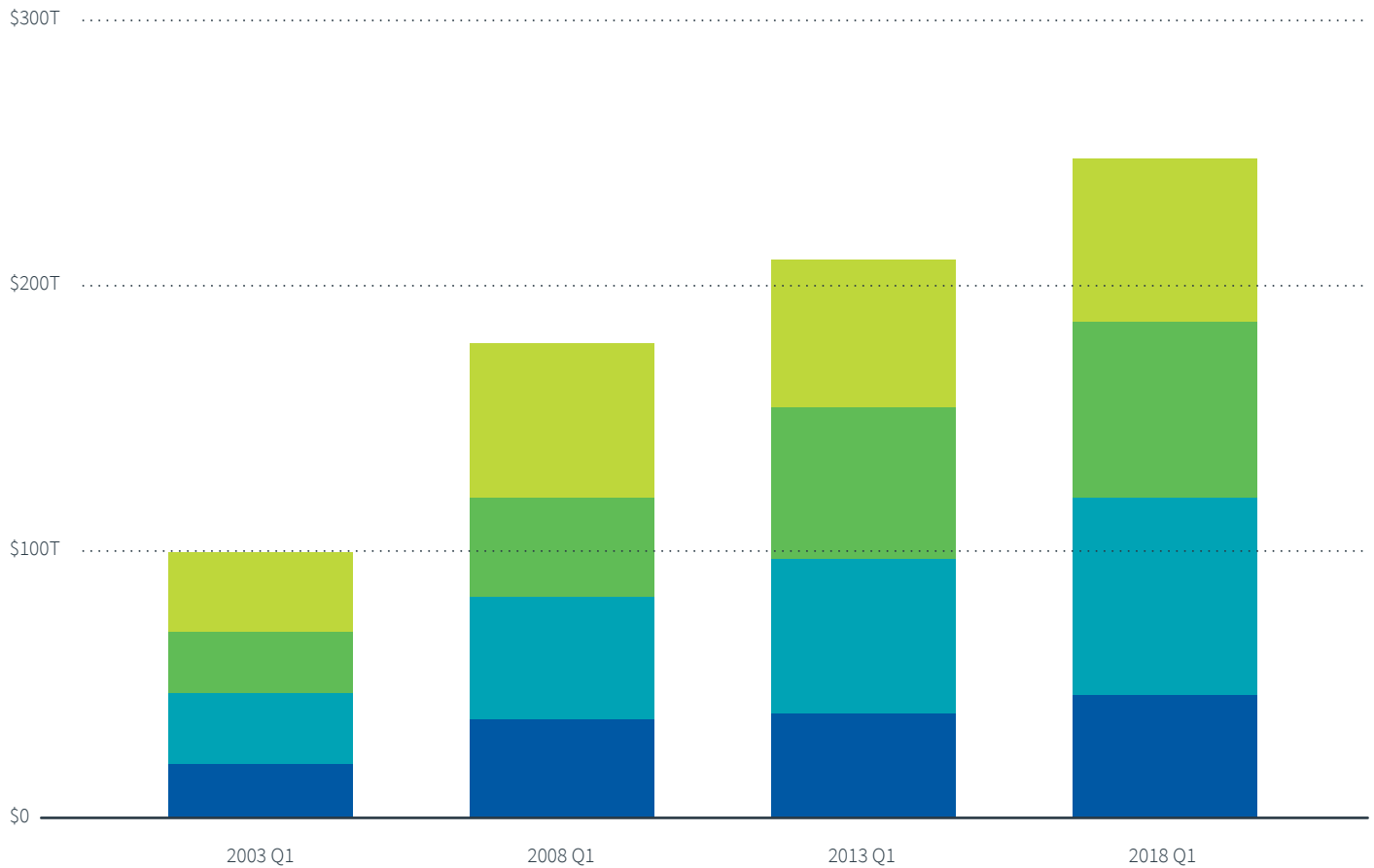


Global debt snowball



Global debt is up almost US\$150 trillion over 15 years

HOUSEHOLDS
NON-FINANCIAL CORPORATIONS
GOVERNMENT
FINANCIAL



Trade wars

Evolution of recent tariffs (USD)

● TARIFFS IMPOSED BY THE US ON IMPORTS

TARIFFS IMPOSED ON US GOODS

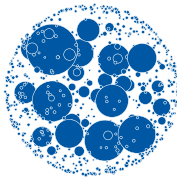
- CHINA
- CANADA
- EUROPEAN UNION
- MEXICO

US: Imposed tariffs of 20% on the first 1.2 million washing machines imported + 20% on all solar panels imports. Total value of goods subject to US tariffs ≈ **\$6 billion**



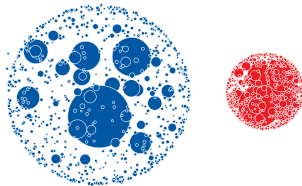
JAN 22
2018

US: Imposed tariffs of 25% on steel imports + 10% on aluminium ones. Cumulative value of goods subject to US tariffs ≈ **\$37 billion**



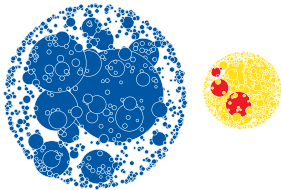
MARCH 8
2018

China: Imposed tariffs on **\$3 billion** of American pork, wine and pipes imports



APRIL 2
2018

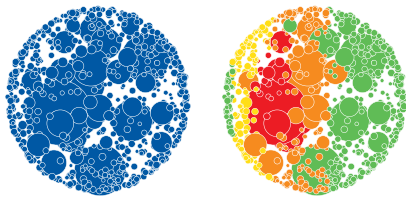
EU: Imposed tariffs on **\$7.1 billion** of various American goods



MAY 18
2018

Canada: Imposed tariffs on **\$12.8 billion** of American products

Mexico: Imposed tariffs on **\$3 billion** of American steel, pork, cheese and whiskey imports

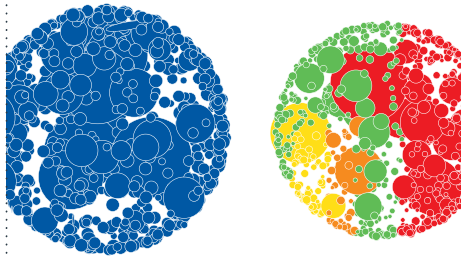


MAY 31 – JUNE 5
2018

US: Imposed tariffs on **\$50 billion** of Chinese goods. Cumulative value of goods subject to US tariffs ≈ **\$87 billion**

China: In response to the new US tariffs, China retaliated with tariffs on **\$50 billion** of additional American goods

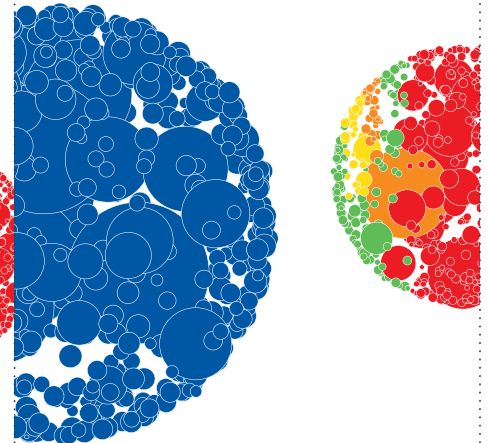
EU: Agreed to impose tariffs on an additional **\$3 billion** of US goods in response to their previous steel and aluminium decision



JUNE 15
2018

US: Threatened to impose tariffs on **\$200 billion** of Chinese goods (which came into effect on September 24), and stated it is prepared to impose tariffs on an extra **\$267 billion** in case China retaliates

China: In September, threatened to add tariffs on **\$60 billion** additional US goods

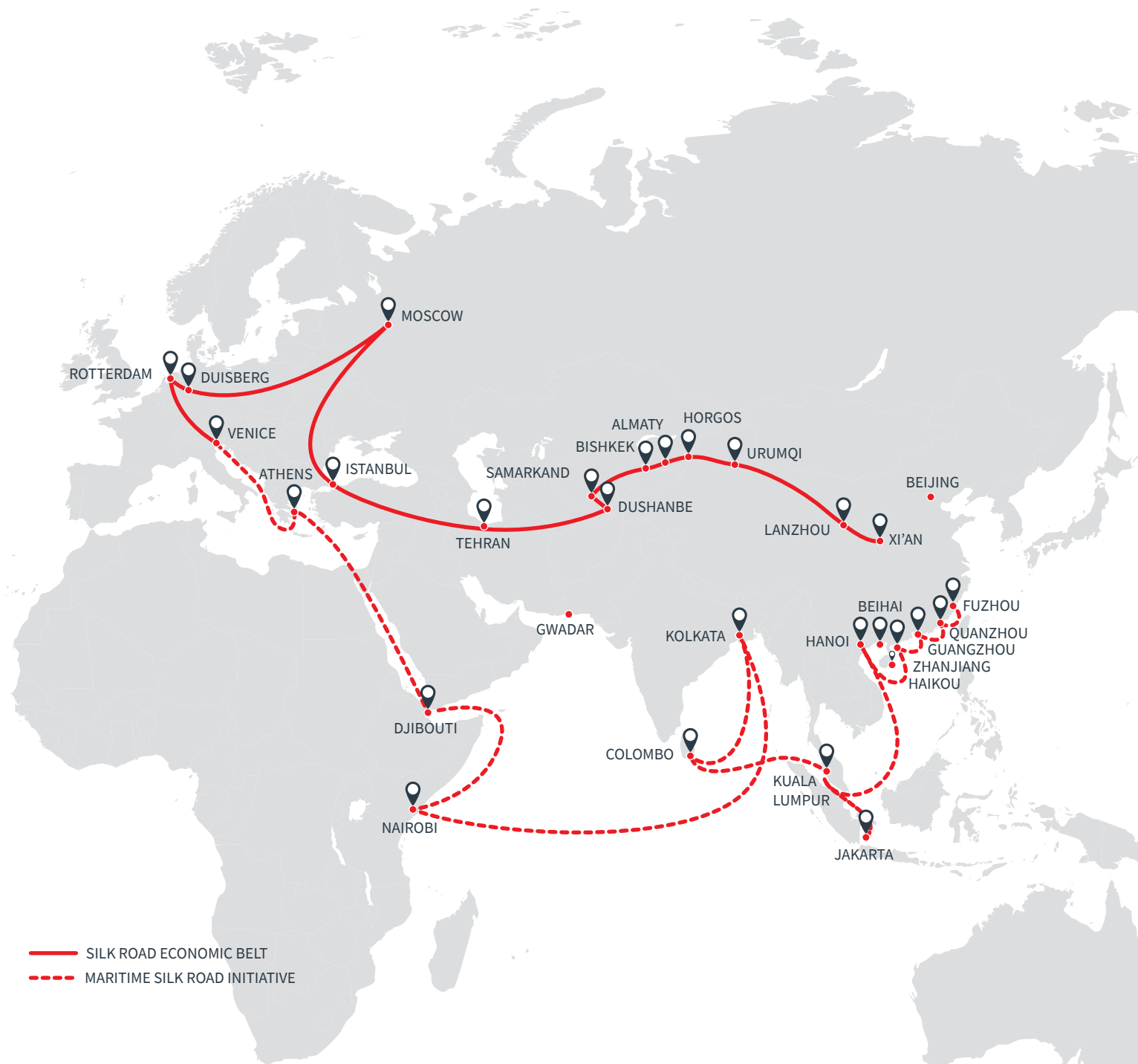


JULY 10
2018

China's belt and road initiative

China's Belt and Road Initiative (BRI) encompasses two main trade routes: the 'belt', which loosely follows the ancient Silk Road through central Asia towards Europe, and the 'road', a string of maritime connections between Southeast Asia, South Asia and East Africa. BRI spans 65 countries, accounting for 29 per cent of global output and 63 per cent of the world's population.

China says the idea is to promote "open and efficient international cooperation". Critics suggest the real aim is to project Chinese political influence abroad.



Brexit

From hard to soft

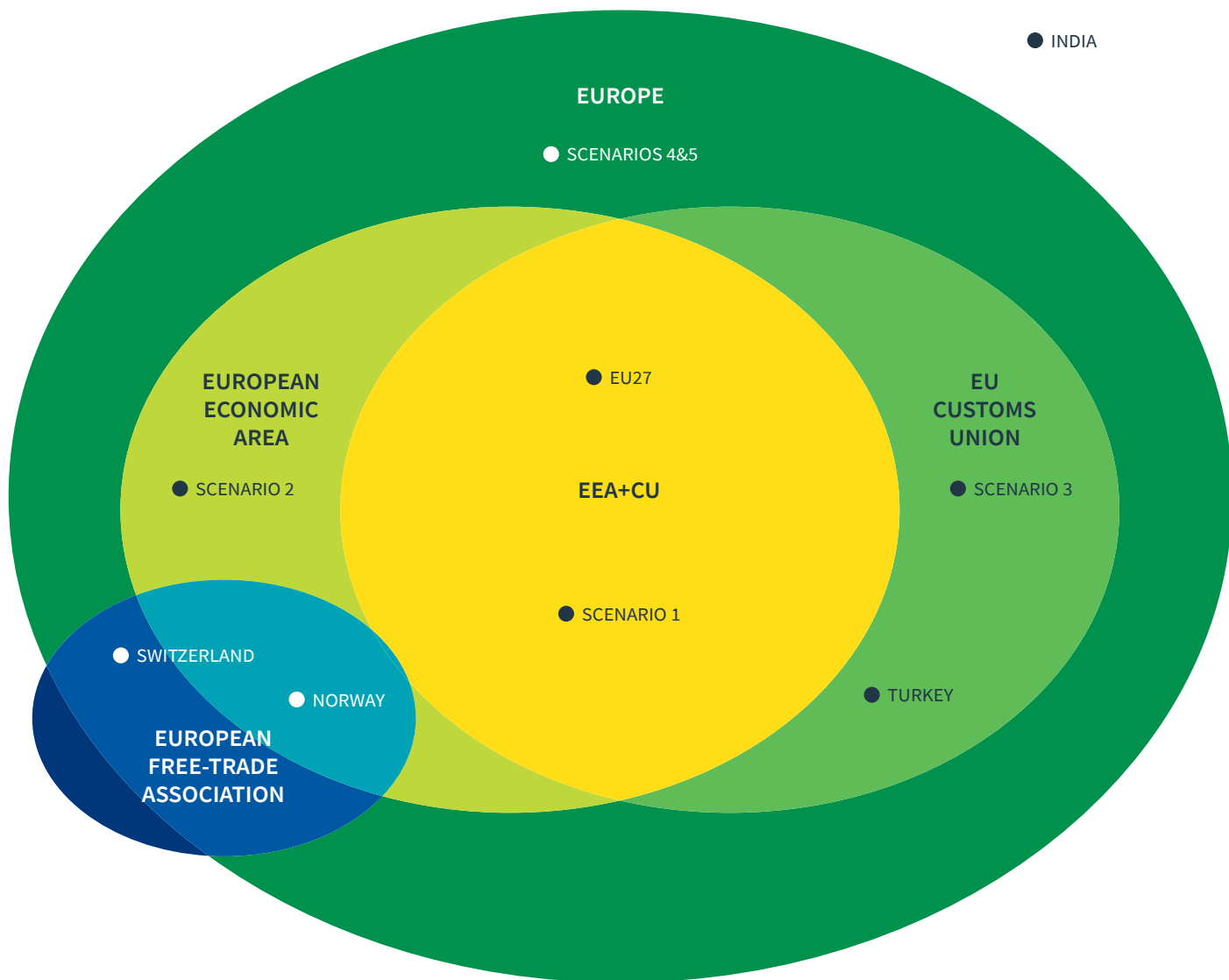
Scenario 1: Baseline assumption, representing business as usual if the UK remains within the Single Market and Customs Union.

Scenario 2: From 2021, after a two-year transition period, the UK would be part of the European Economic Area but not the Customs Union. This scenario is similar to the conditions currently faced by Norway: there would continue to be free movement of goods, services, people and capital within the EEA.

Scenario 3: From 2021, after a transition period, the UK would be part of the Customs Union, but not the EEA. This scenario is similar to the conditions currently faced by Turkey: there would be no tariffs on goods traded between the UK and EU; however, the UK could face barriers to trade in services. As the UK is no longer part of the EEA, it will be able to have control over migration, but EEA countries will also be able to restrict migration from the UK.

Scenario 4: From 2021, after a transition period, the UK would no longer be part of the EEA nor the Customs Union. The UK will be able to freely set economic policy and regulatory standards, and its trade with most of the rest of the world would be under WTO rules. There would be no free movement of people under WTO rules.

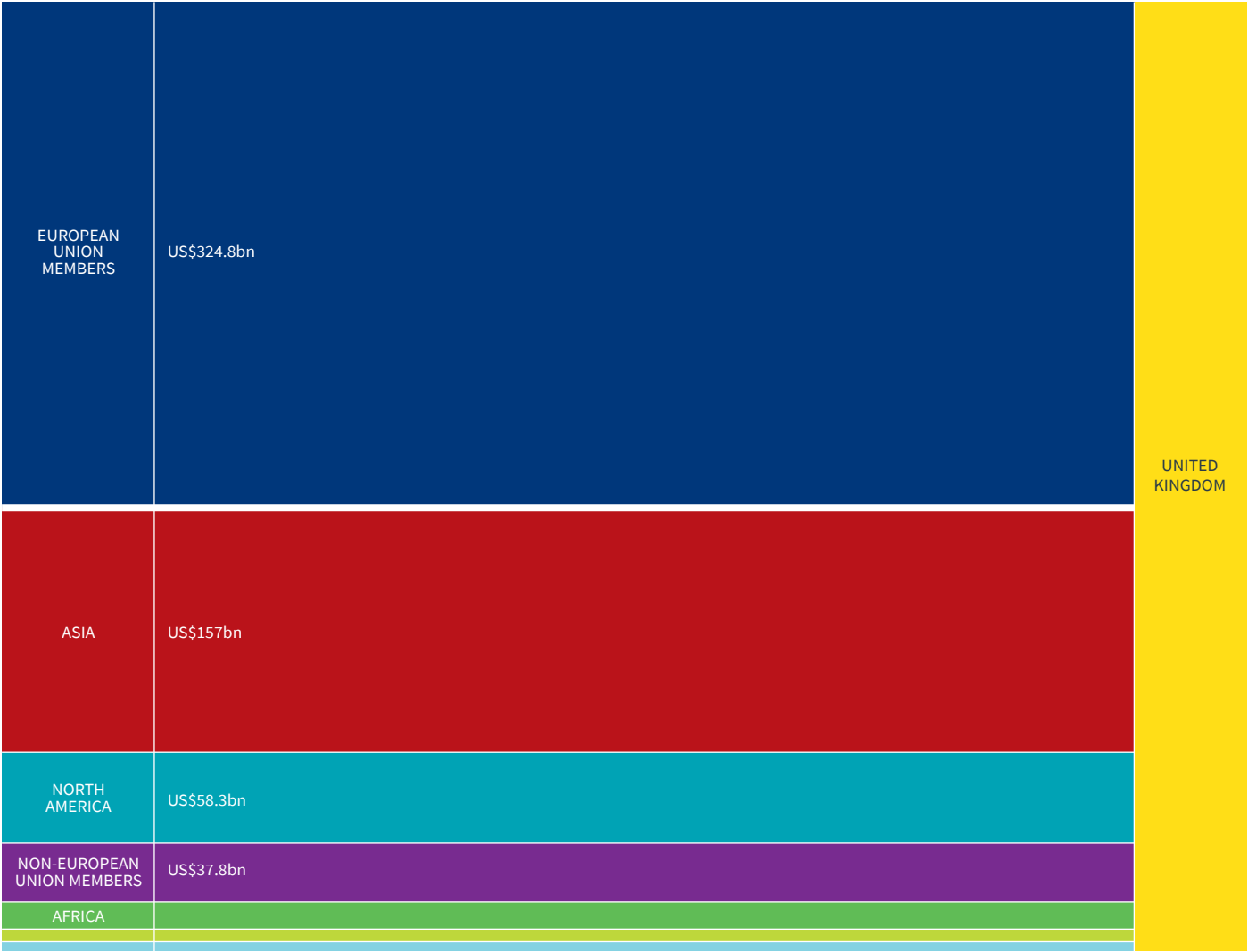
Scenario 5: This scenario is similar to Scenario 4, except it is assumed there will be no two-year transition period from 2019 onwards.



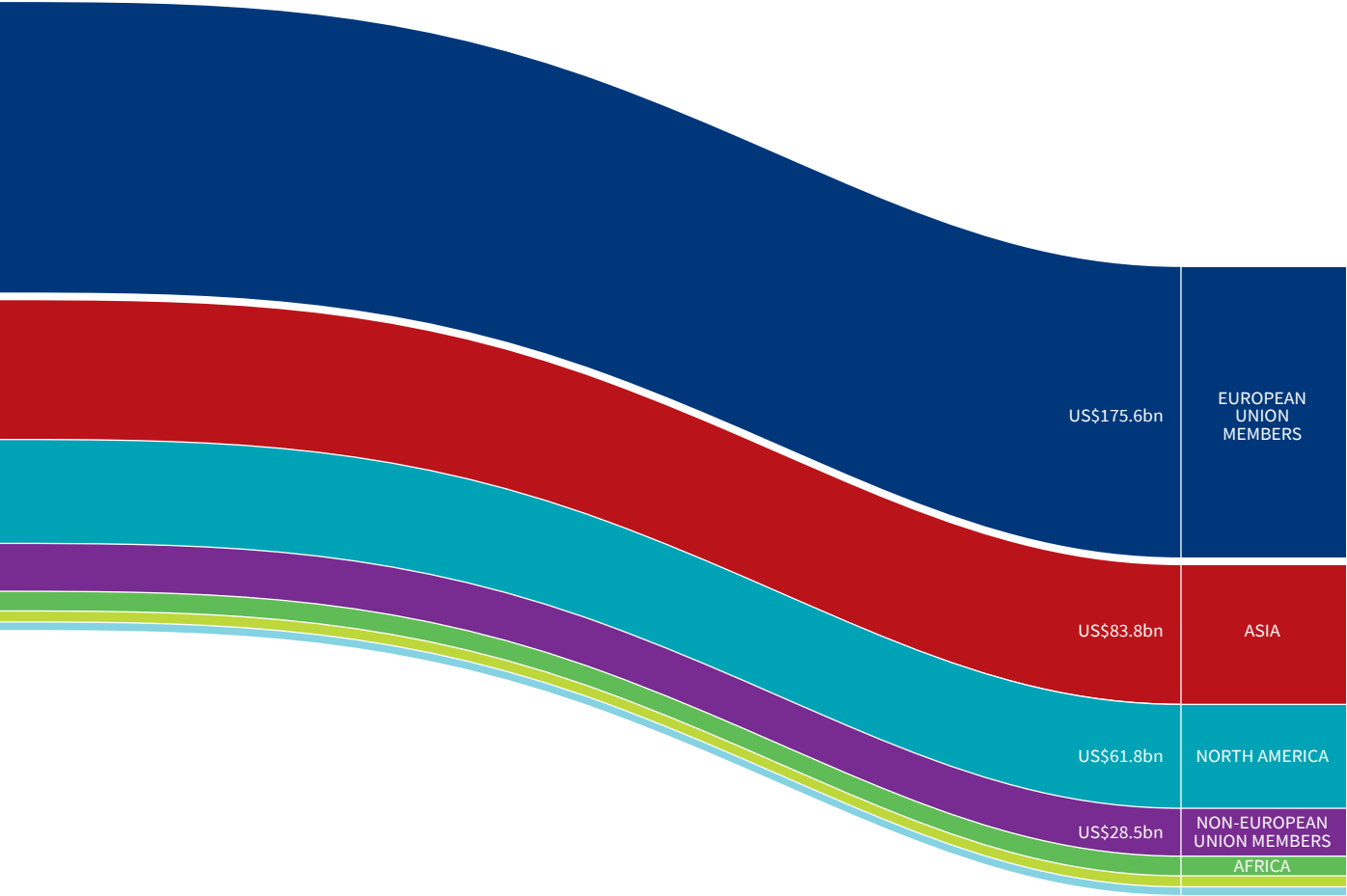
Brexit

UK Trade Flow based on OEC Data (2016)

IMPORT



EXPORT

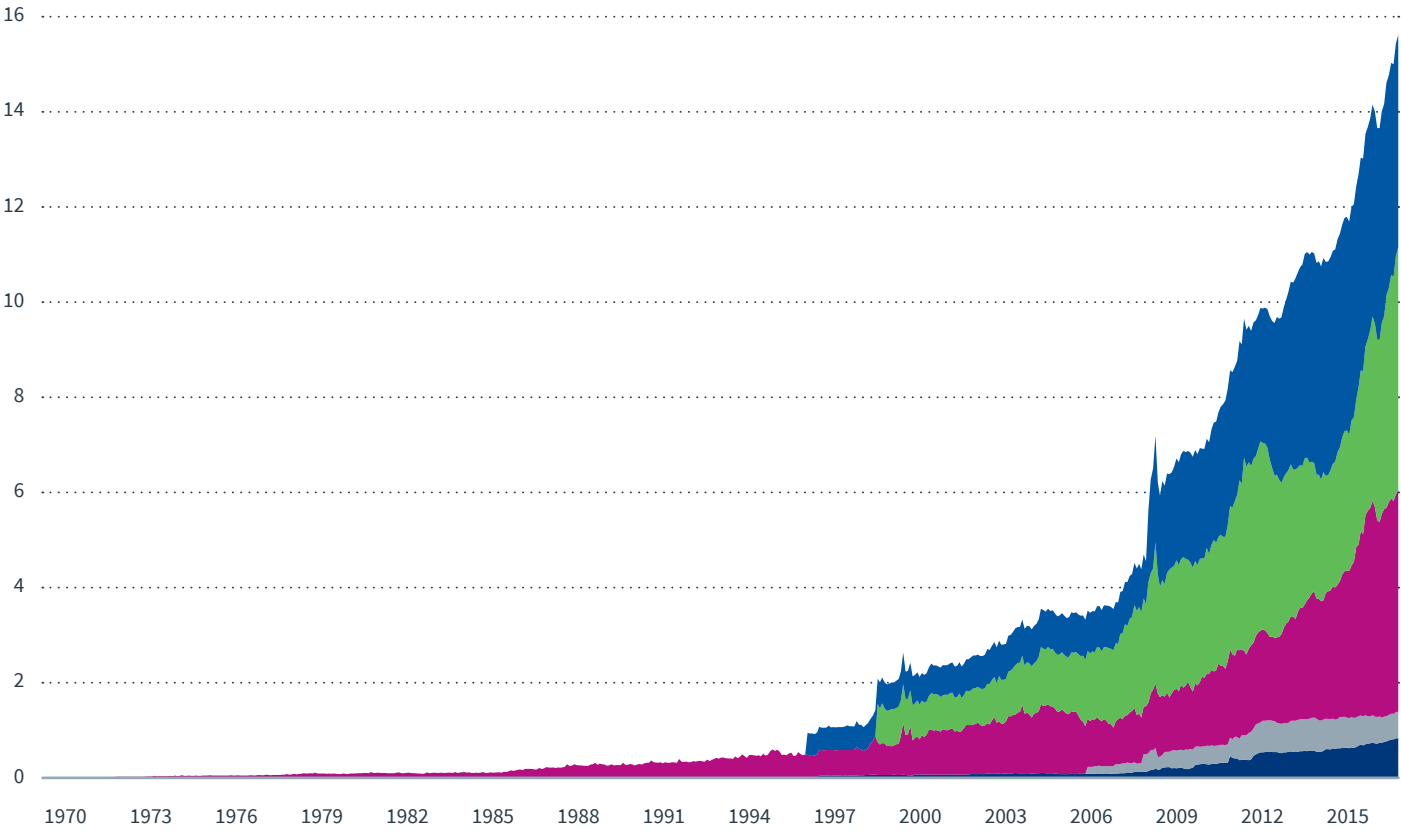


Quantitative easing and the central bank white knights

Cumulative value of central bank purchases

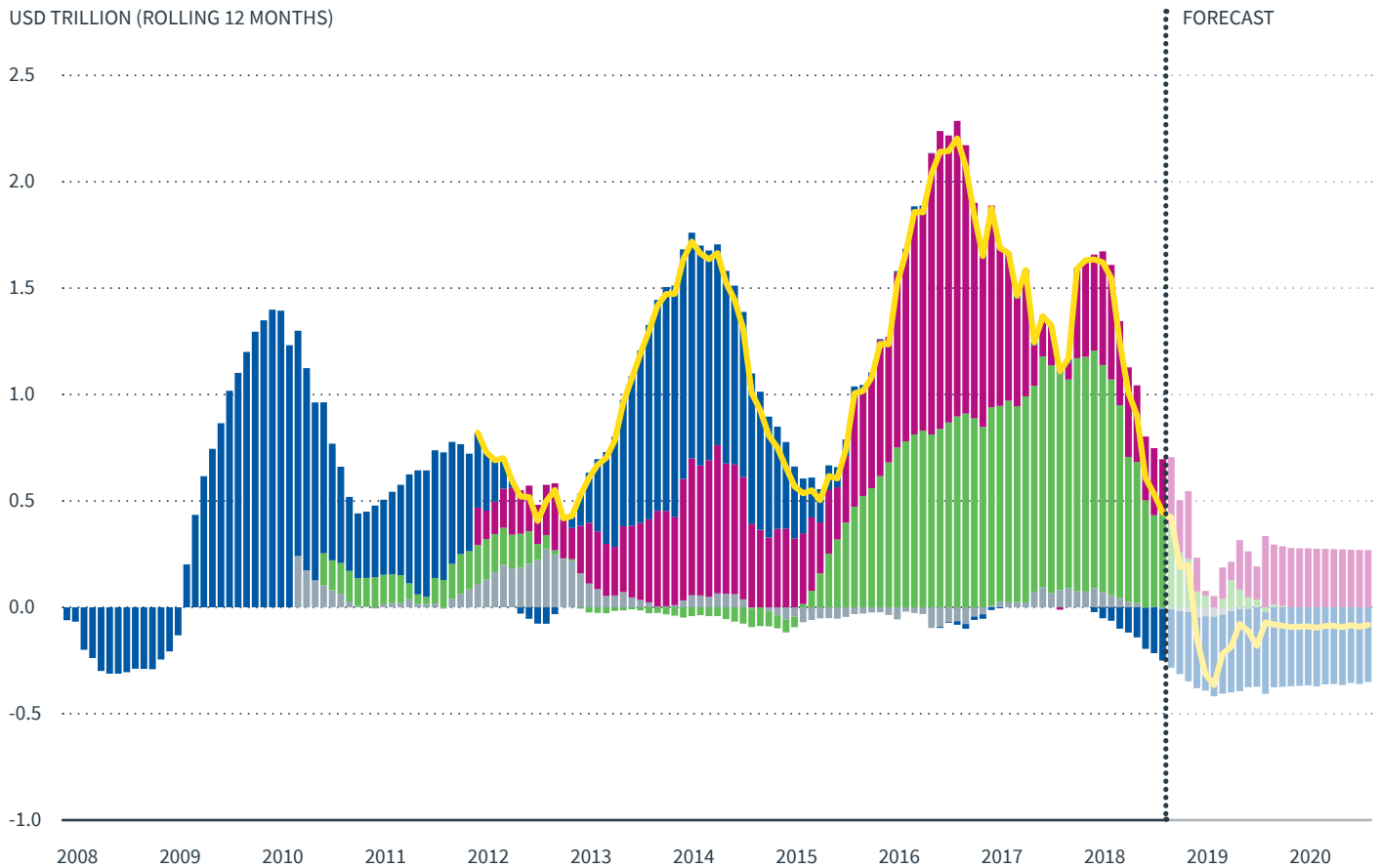
- FEDERAL RESERVE
- EUROPEAN CENTRAL BANK
- BANK OF JAPAN
- BANK OF ENGLAND
- SWISS NATIONAL BANK

USD TRILLION



Flow of central bank asset purchases

- FEDERAL RESERVE
- EUROPEAN CENTRAL BANK
- BANK OF JAPAN
- BANK OF ENGLAND
- NET



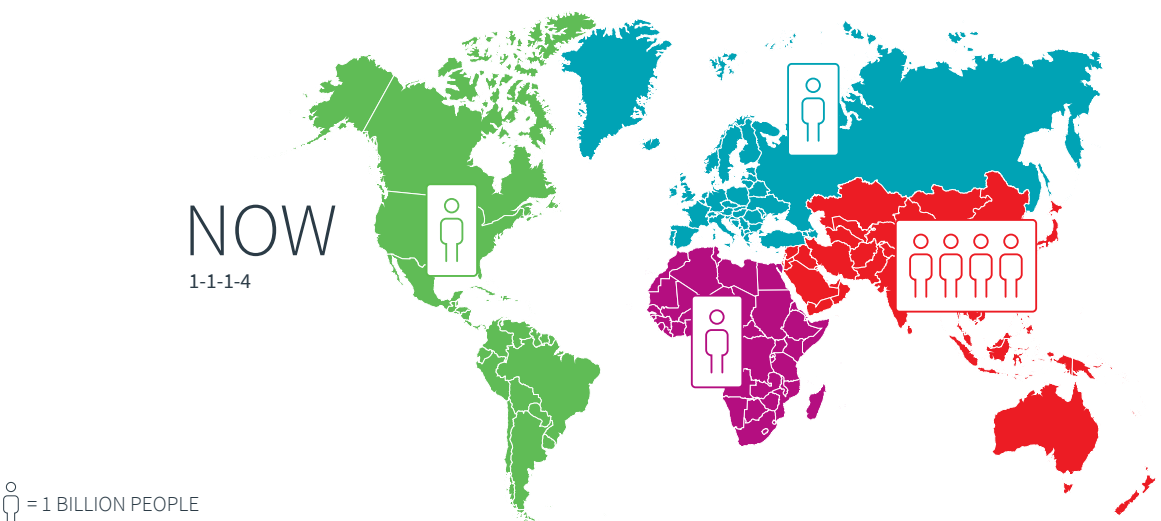
Demographics

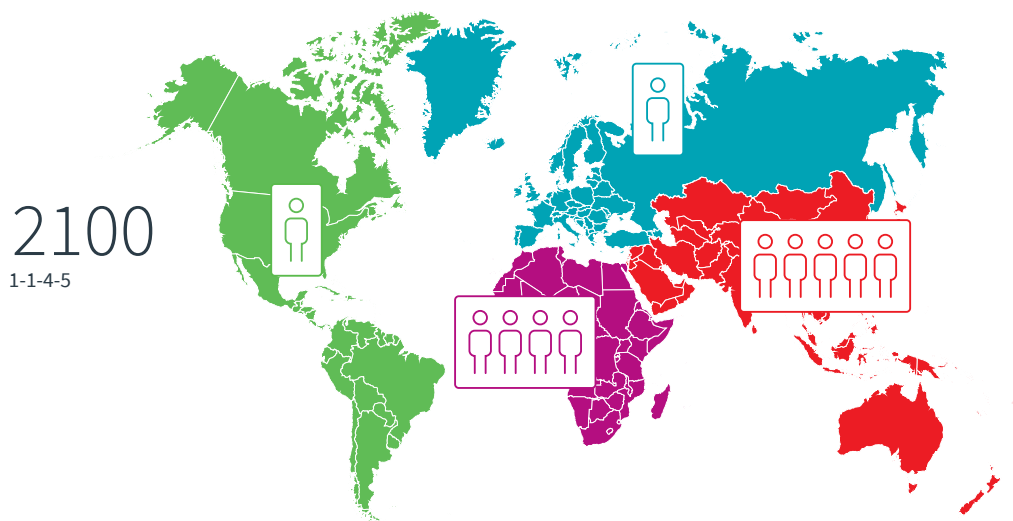
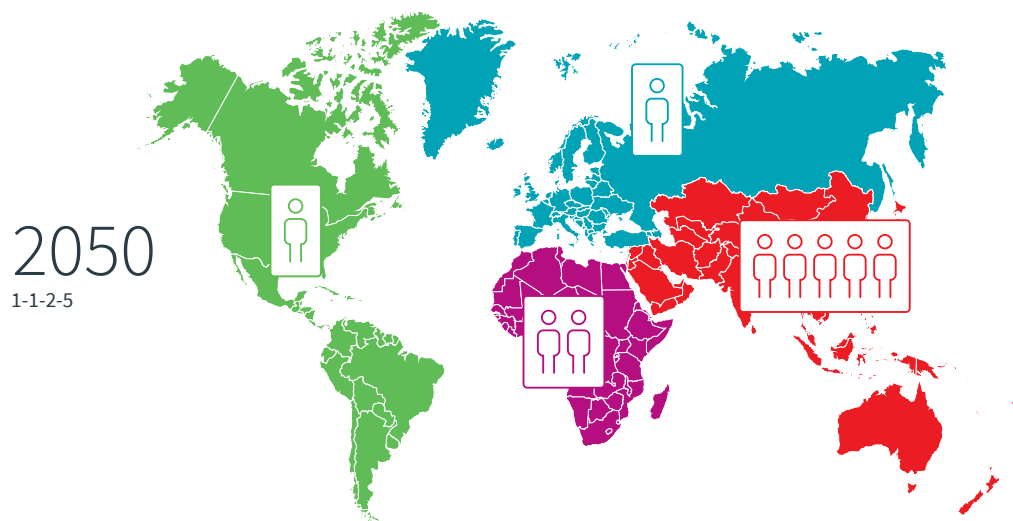
If demographics are destiny, as some assert, this section will help provide clarity on the shifting glacial trends taking place under our respective noses.

Global population

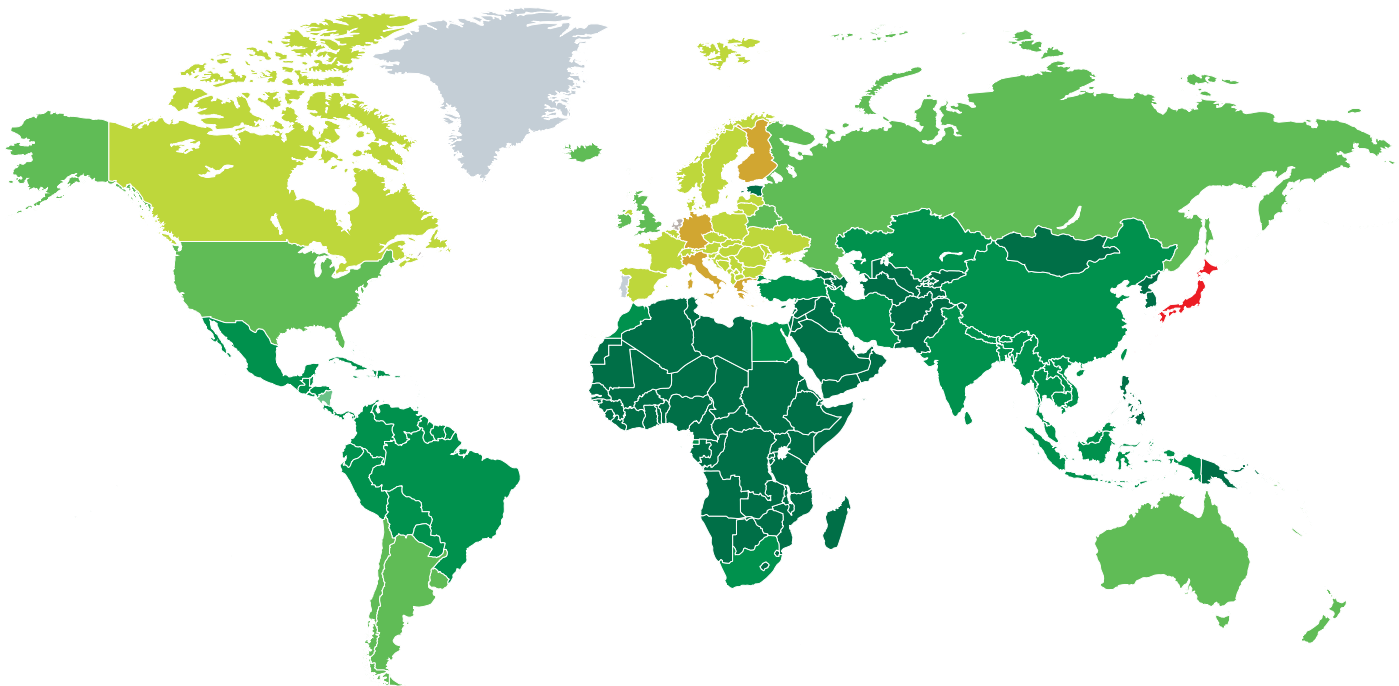
The growth of the global population over recent decades has prompted much hand-wringing over unsustainable resource use and other environmental costs. But as these maps show, the pace of growth is far from uniform.

The proportion of people who live in Africa and Southeast Asia will continue to rise sharply over this century, while the population share of Europe and the Americas will fall. Ageing populations in these regions are likely to cause big economic challenges, an issue we explore over the following pages.





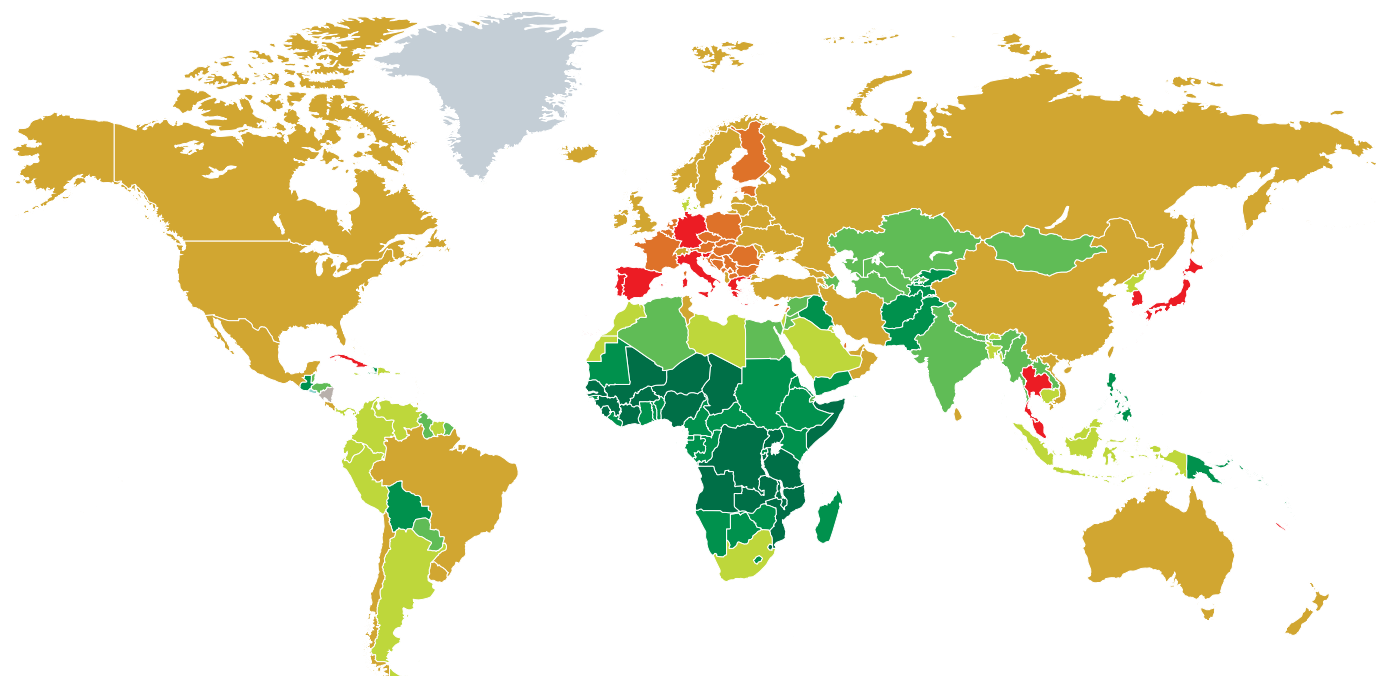
Ageing populations



% OF POPULATION 65+

- > 30%
- 25-30%
- 20-25%
- 15-20%
- 10-15%
- 5-10%
- 0-5%

2015



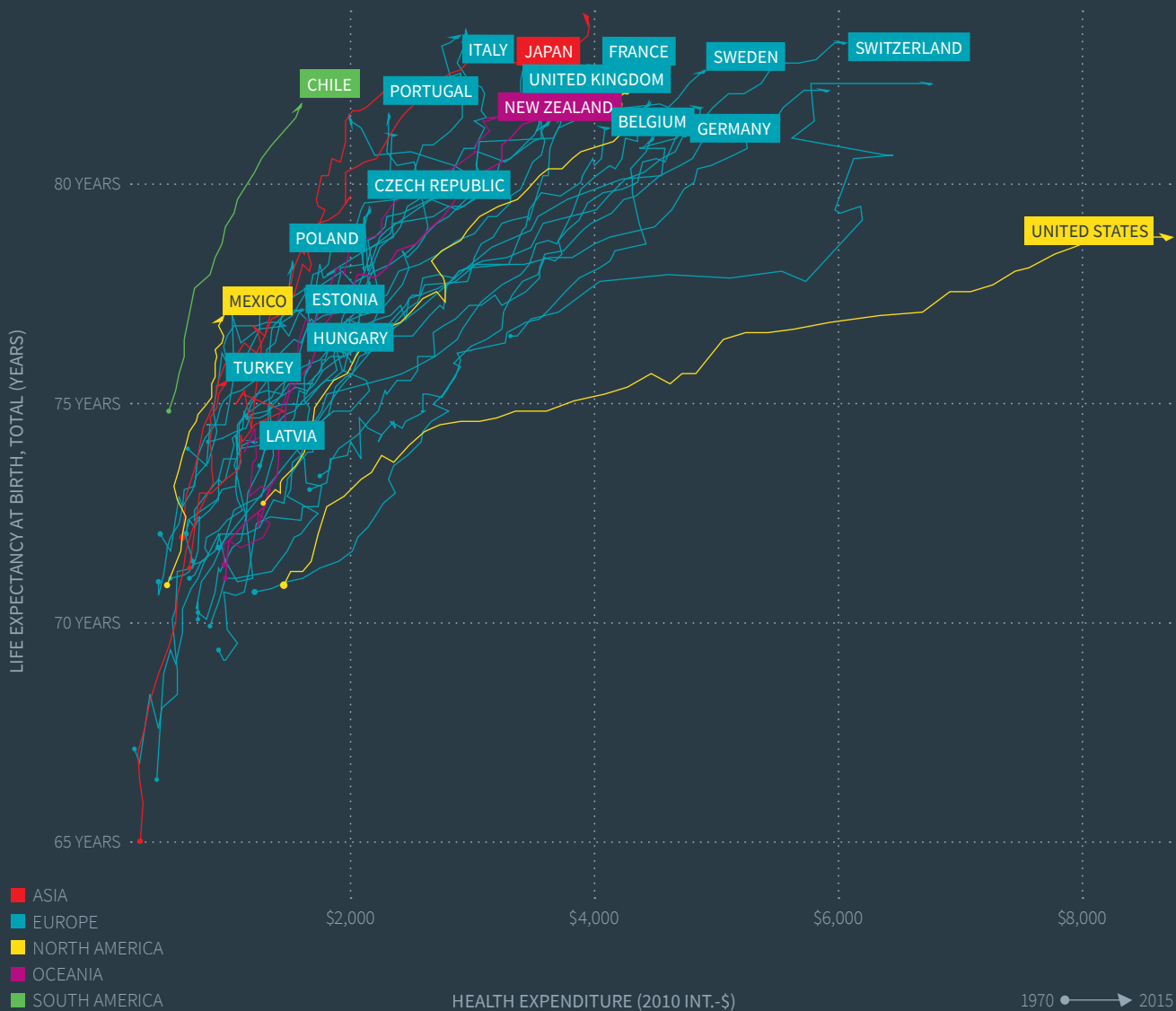
% OF POPULATION 65+

- > 30% ■
- 25-30% ■
- 20-25% ■
- 15-20% ■
- 10-15% ■
- 5-10% ■
- 0-5% ■

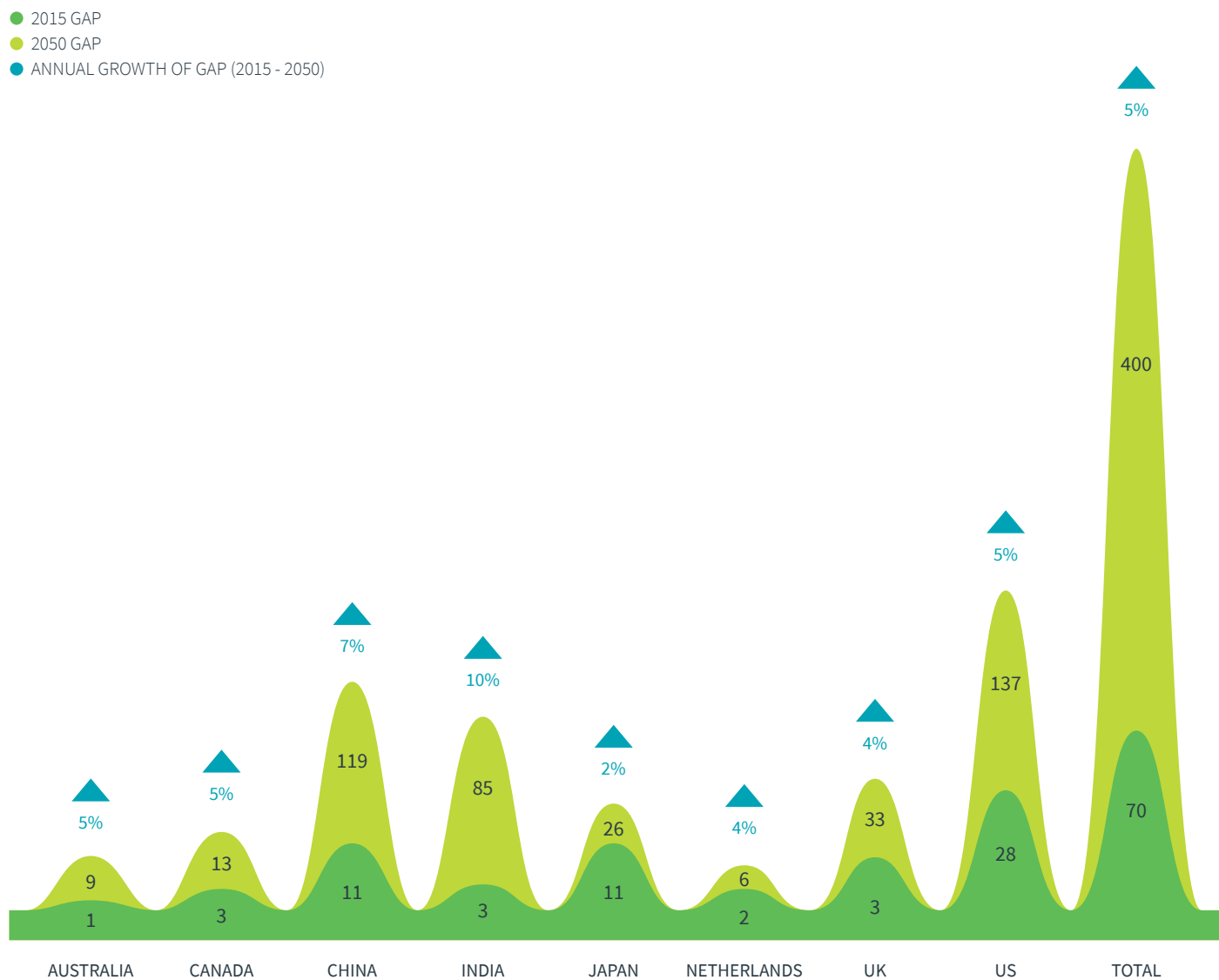
2050

Financing health and pensions

Life expectancy vs health expenditure



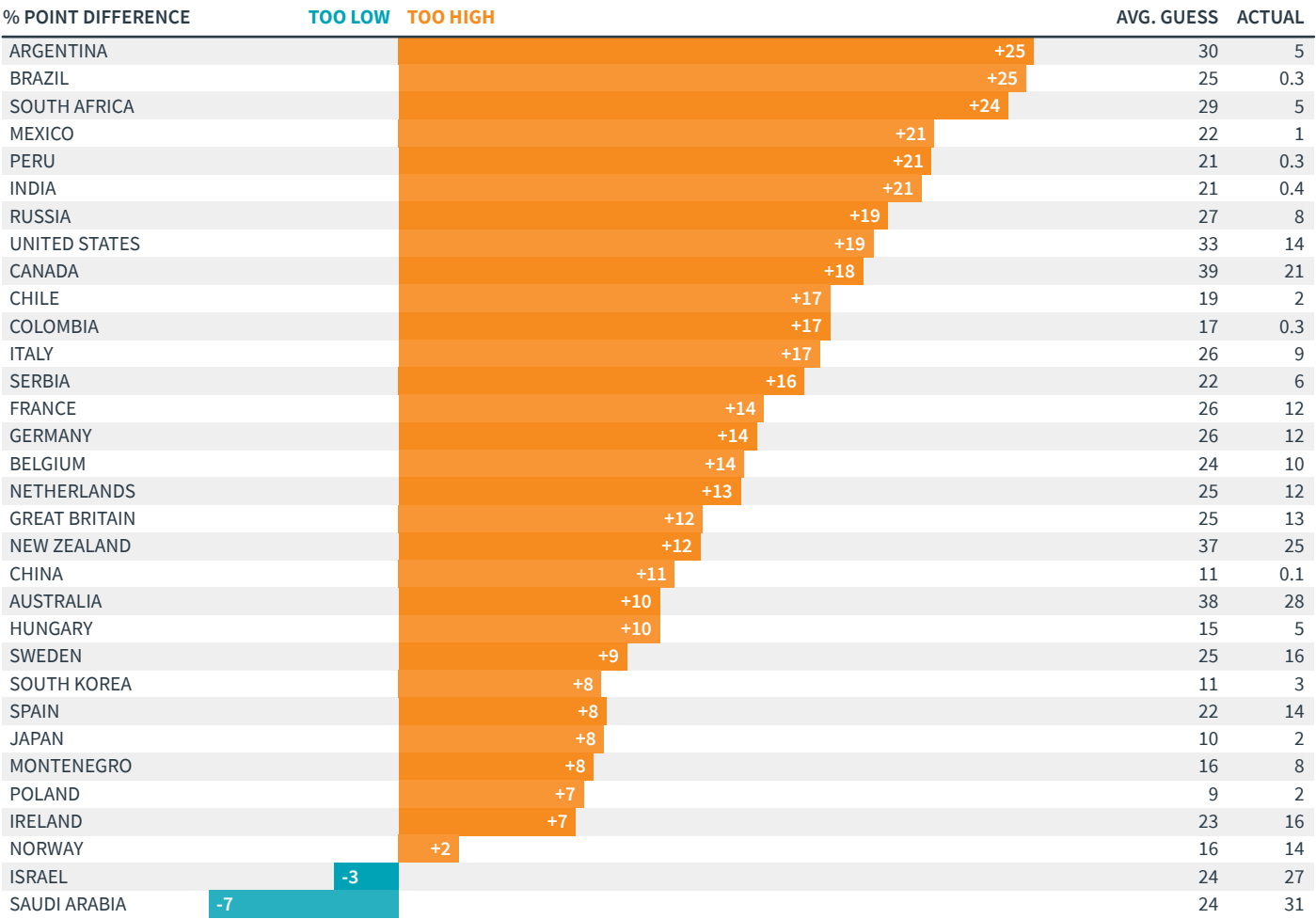
The pension gap will soon dwarf global GDP



Migration

Perceptions are *not* reality

WHAT PERCENTAGE OF THE POPULATION DO YOU THINK ARE IMMIGRANTS (I.E. NOT BORN IN THE COUNTRY)?



N.B. THE RESULTS HAVE BEEN ROUNDED UP TO THE NEAREST WHOLE NUMBER

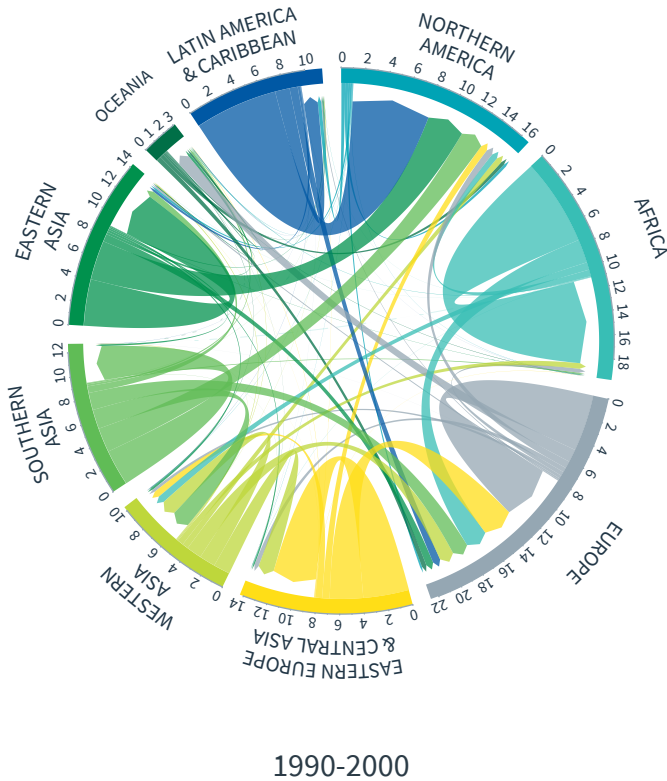
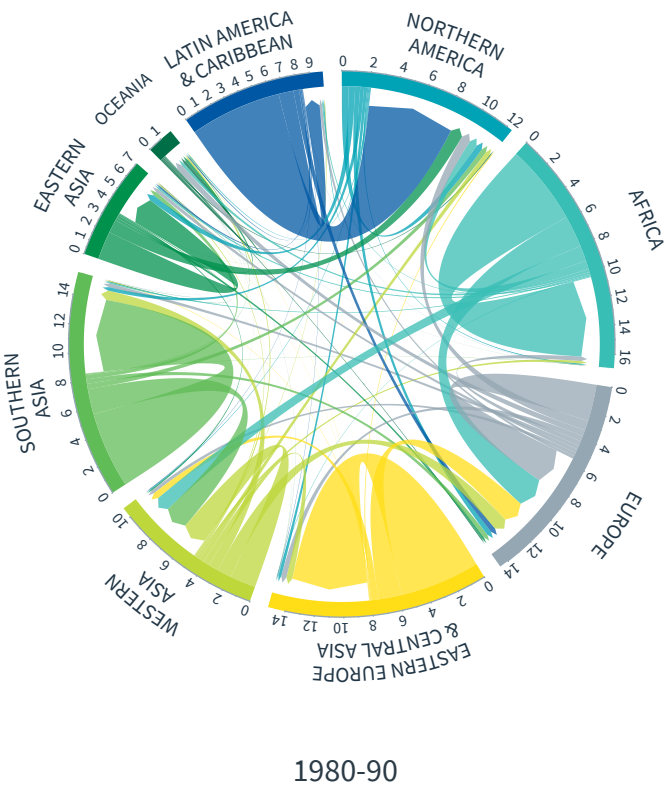


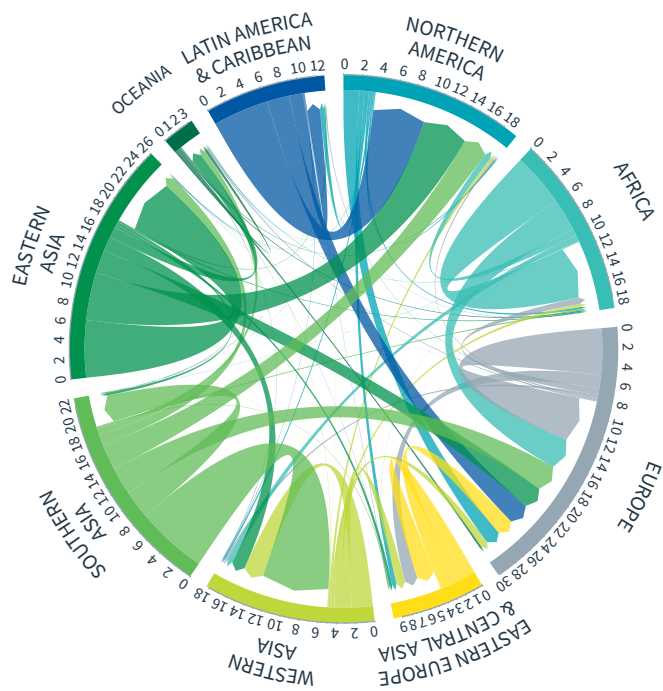
The Ipsos Perils of Perception survey highlights how wrong the online public across 32 countries are about key global issues and features of the population in their country. On many subjects – murder rates, immigration, teenage pregnancy, etc. – things are not as they seem.

We focus here on the issue of immigration. Results show the majority of online respondents hugely overestimate the immigration percentage, with 22 of the 32 countries missing the actual number by a difference of more than 10 percentage points. Apart from Israel and Saudi Arabia, where the online public underestimated the percentage of immigrants, all countries inflated this number, highlighting the trend that migration issues are being overly exaggerated around the world. This is especially true in Latin America.

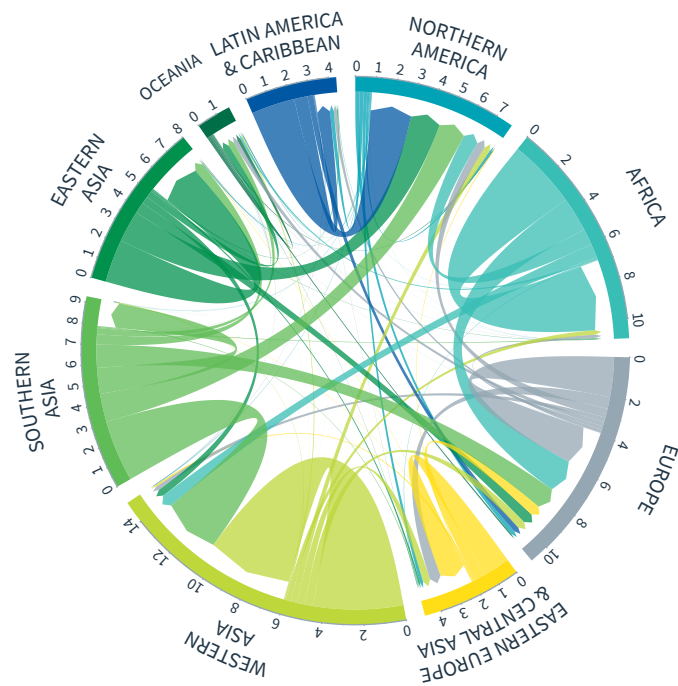
Migration

Migration flow evolution 1980 - 2015 (millions)





2000-10



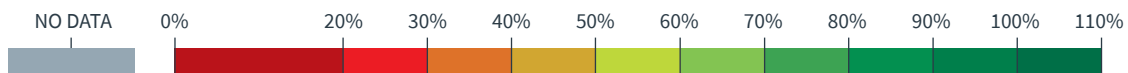
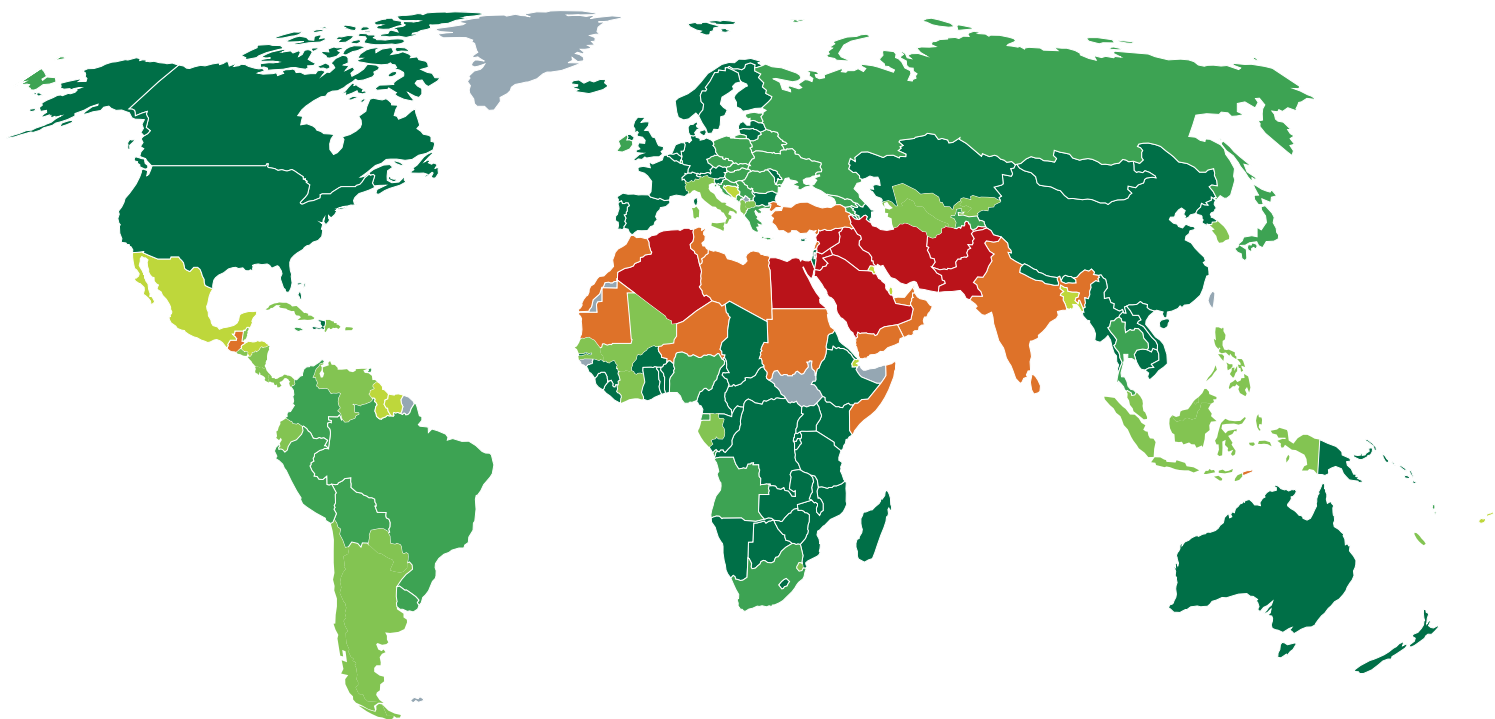
2010-2015

Women in the labour market

Ratio of female to male labour force participation rates, 2015

With the benefits of diversity all but indisputable now, the focus on gender equality is rightly taking centre stage. After all, why would you ignore 50 per cent of the potential working population?

Although crude and not representative of any gender pay gaps that exist, the map adjacent clearly highlights how much progress has been made to overall labour force participation and where the laggard countries reside. Books like Saadia Zahidi's *Fifty Million Rising* are timely critiques of areas for improvement.



Innovation and technology

Highlighting the implications of the recent bilateral innovation race, as well as the impact online interactions, dematerialised businesses and increasing amounts of data have in shaping global markets.

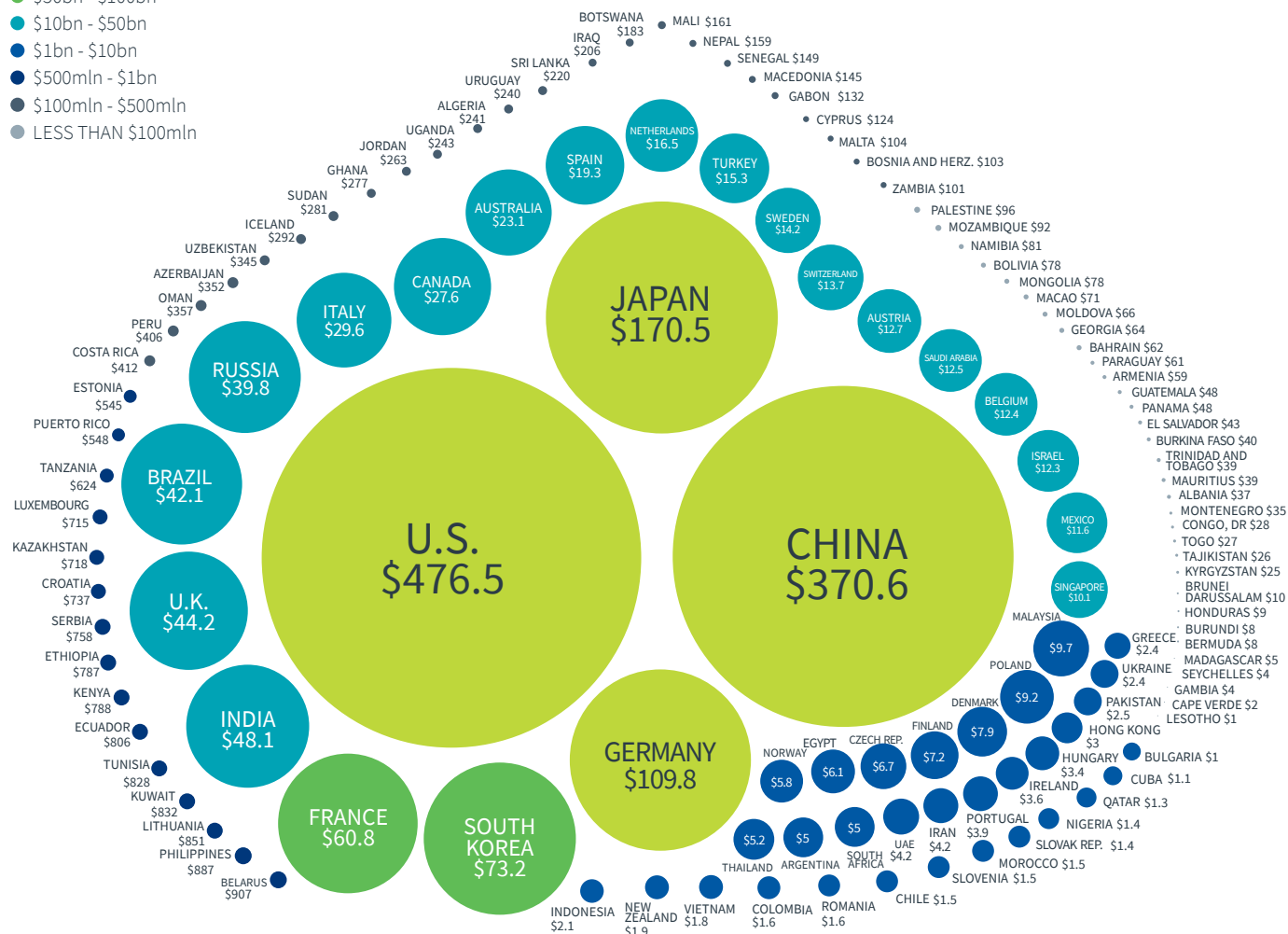
Research and development spending by country

Investing in innovation can be risky; with no crystal ball it is hard to tell what is going to be a success, and sometimes the results aren't seen for decades. Yet economic experts tend to agree on the importance of R&D investment to long-term economic growth.

The numbers comprised in this visualisation include government, private, academic and non-profit investments, painting a complete picture of R&D across the world.

The standout point here is how top-heavy R&D investment is; ten countries account for about 80 per cent of the entire world's outlay. Judging by this visualisation, it is clear the US and China will continue to be locked in an ongoing race for innovation and economic control over the rest of the world.

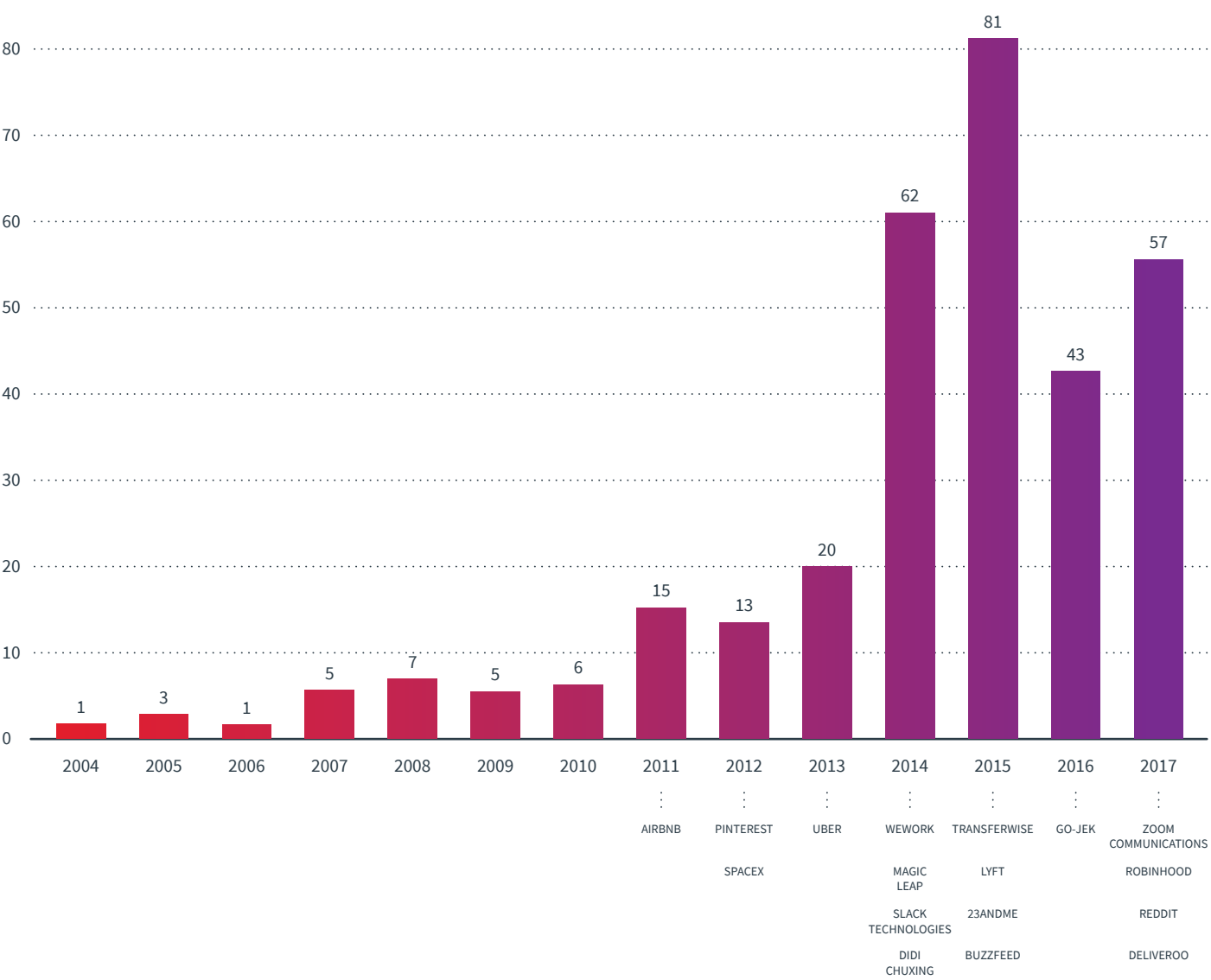
- MORE THAN \$100bn
- \$50bn - \$100bn
- \$10bn - \$50bn
- \$1bn - \$10bn
- \$500mln - \$1bn
- \$100mln - \$500mln
- LESS THAN \$100mln



R&D SPENDING BY COUNTRY (IN PPP\$)

Trend in unicorn creation

Number of new startups with \$1bn+ valuations





The term unicorn was first used by investor Aileen Lee of Cowboy Ventures in 2013 to define a private company with a valuation of US\$1 billion or more. The first unicorn appeared in 2003 and, since then, their number have steadily grown due to the proliferation of increasingly bigger rounds of funding. In fact, close to 50 per cent of total deal value in 2017-2018 were transactions worth US\$50 million or more.

Today, we count 282 unicorns around the world, whose combined valuation is approaching US\$900 billion. The US is clearly leading the charge with 121 unicorns, including Uber, the most valuable private company (US\$68 billion), followed by China with 76, home to the second most valuable unicorn, Didi Chuxing (US\$56 billion). In contrast, Europe only counts 31 unicorns.

In terms of industries, e-commerce/marketplaces and fintech are the most represented, mainly due to their usually low capital requirements, which make them an attractive investment for major venture capital firms.

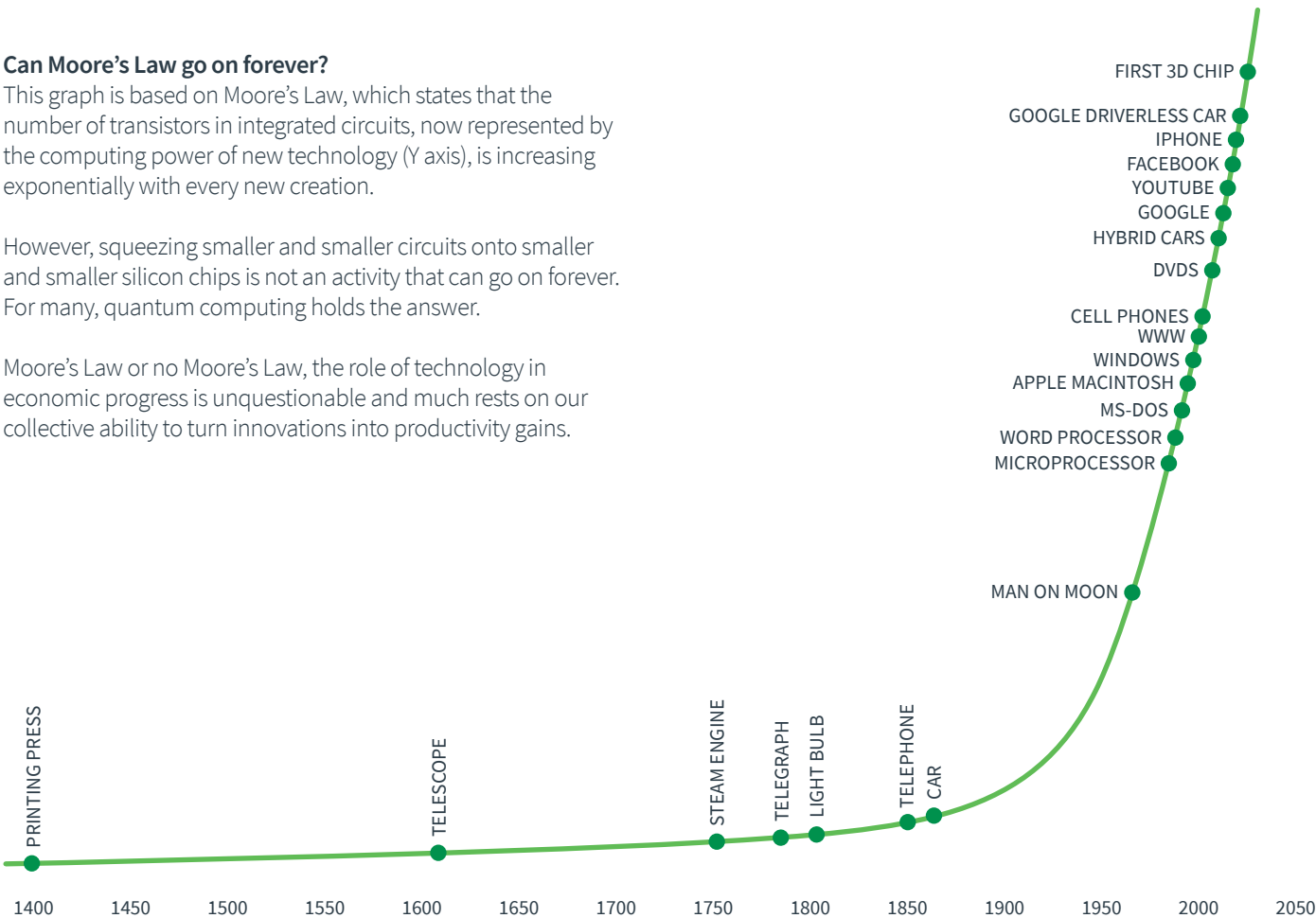
Accelerating growth in technology

Can Moore's Law go on forever?

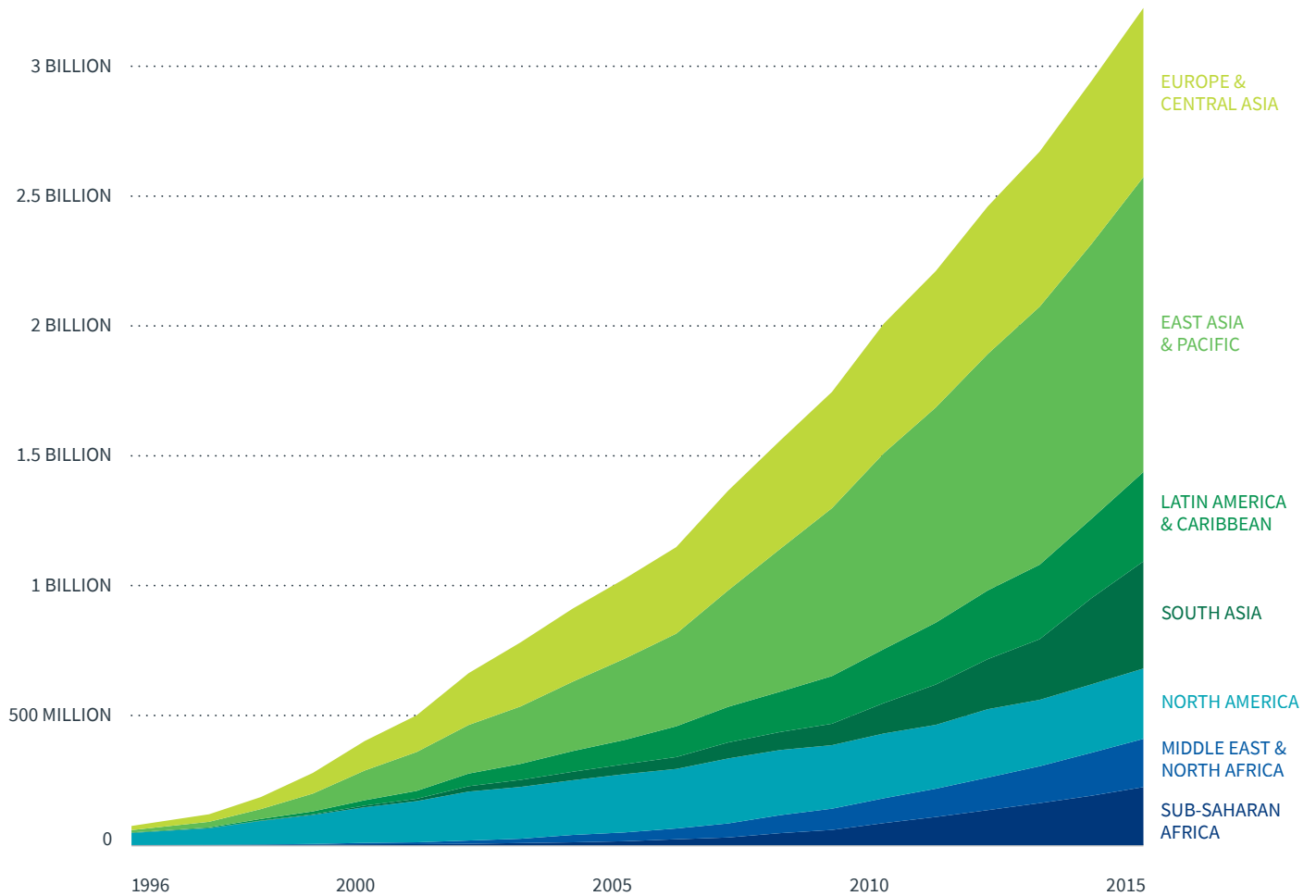
This graph is based on Moore's Law, which states that the number of transistors in integrated circuits, now represented by the computing power of new technology (Y axis), is increasing exponentially with every new creation.

However, squeezing smaller and smaller circuits onto smaller and smaller silicon chips is not an activity that can go on forever. For many, quantum computing holds the answer.

Moore's Law or no Moore's Law, the role of technology in economic progress is unquestionable and much rests on our collective ability to turn innovations into productivity gains.

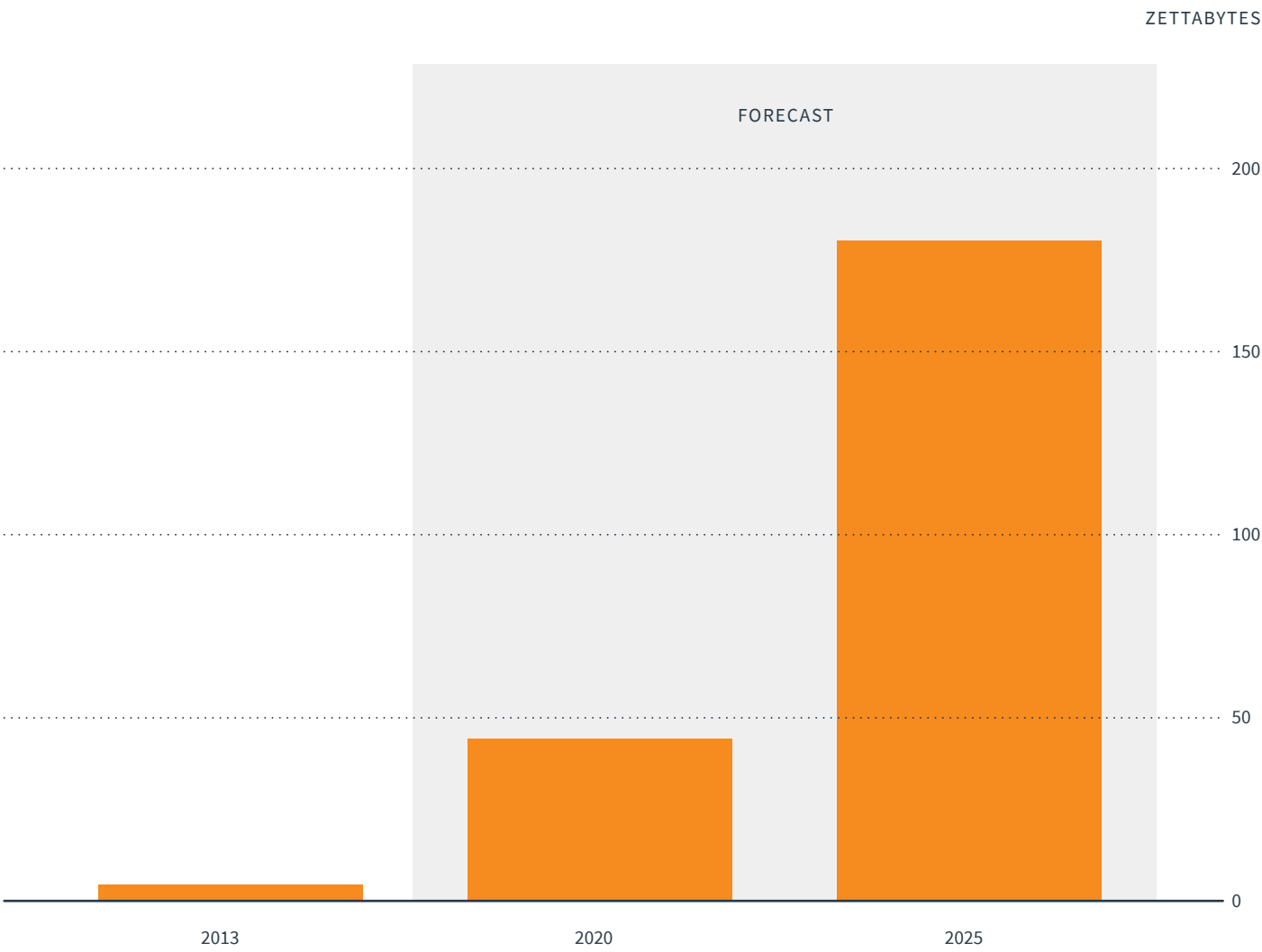


Internet users by region



Data deluge

Projected data produced by digital universe





= 1 TERABYTE

1,000,000 TERABYTES

=

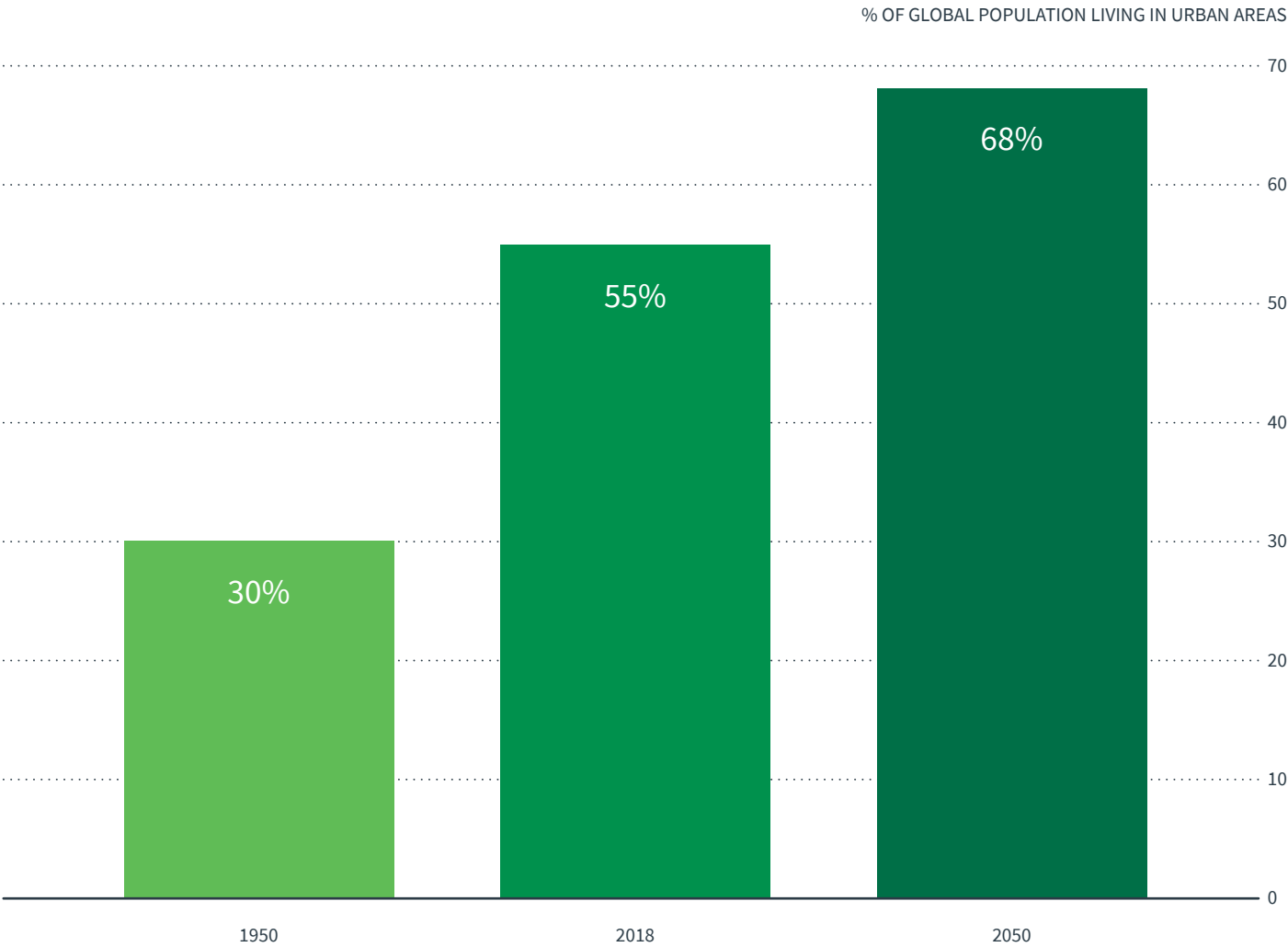
1 ZETTABYTE

Urbanisation

Understanding that 70 per cent of the global population are set to reside in urban areas, as well as the nuances that lurk below the surface, will be key to effective policy and overall decision-making.

Urbanisation

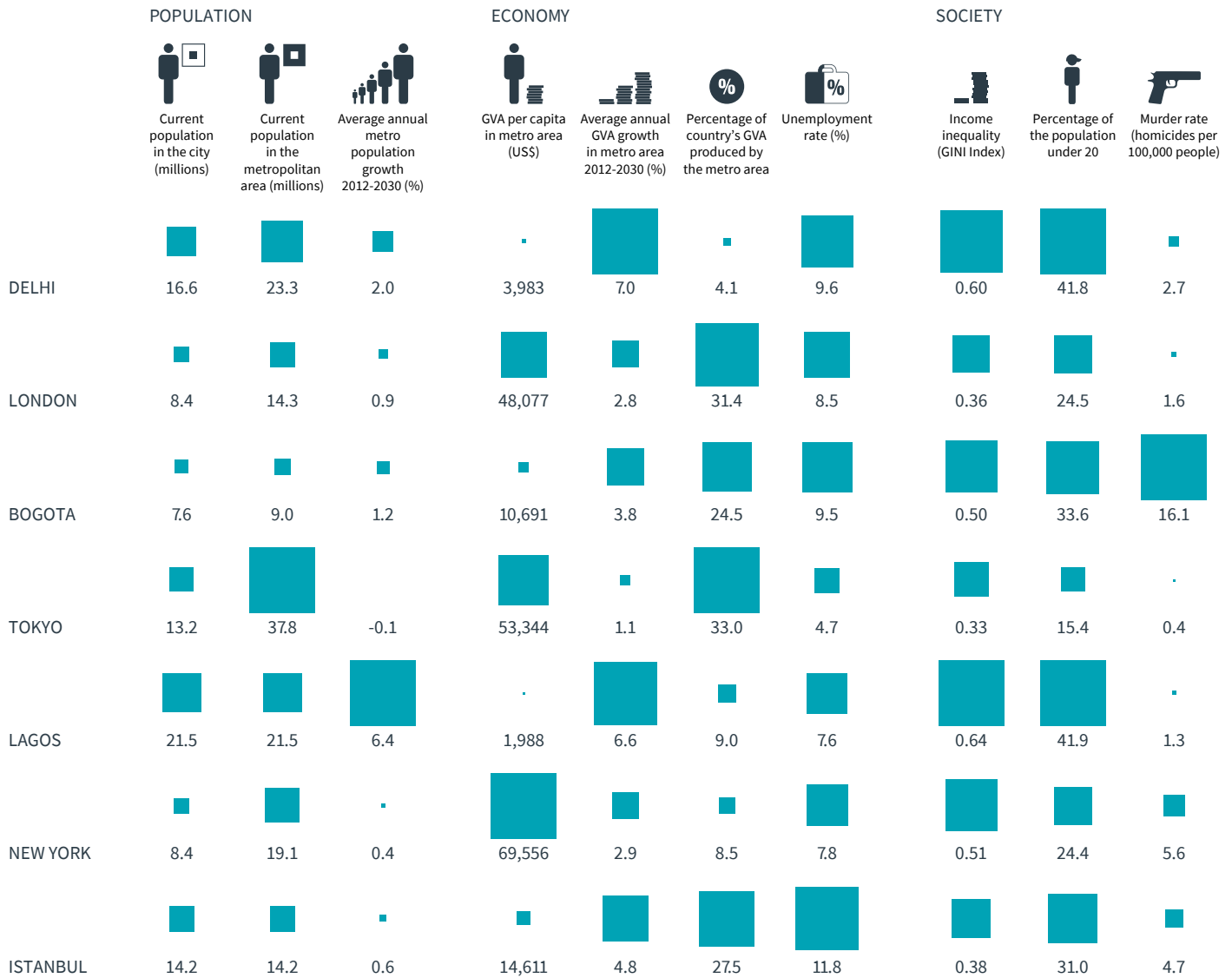
The world’s urban population will have grown by 2.5 billion people in just 100 years

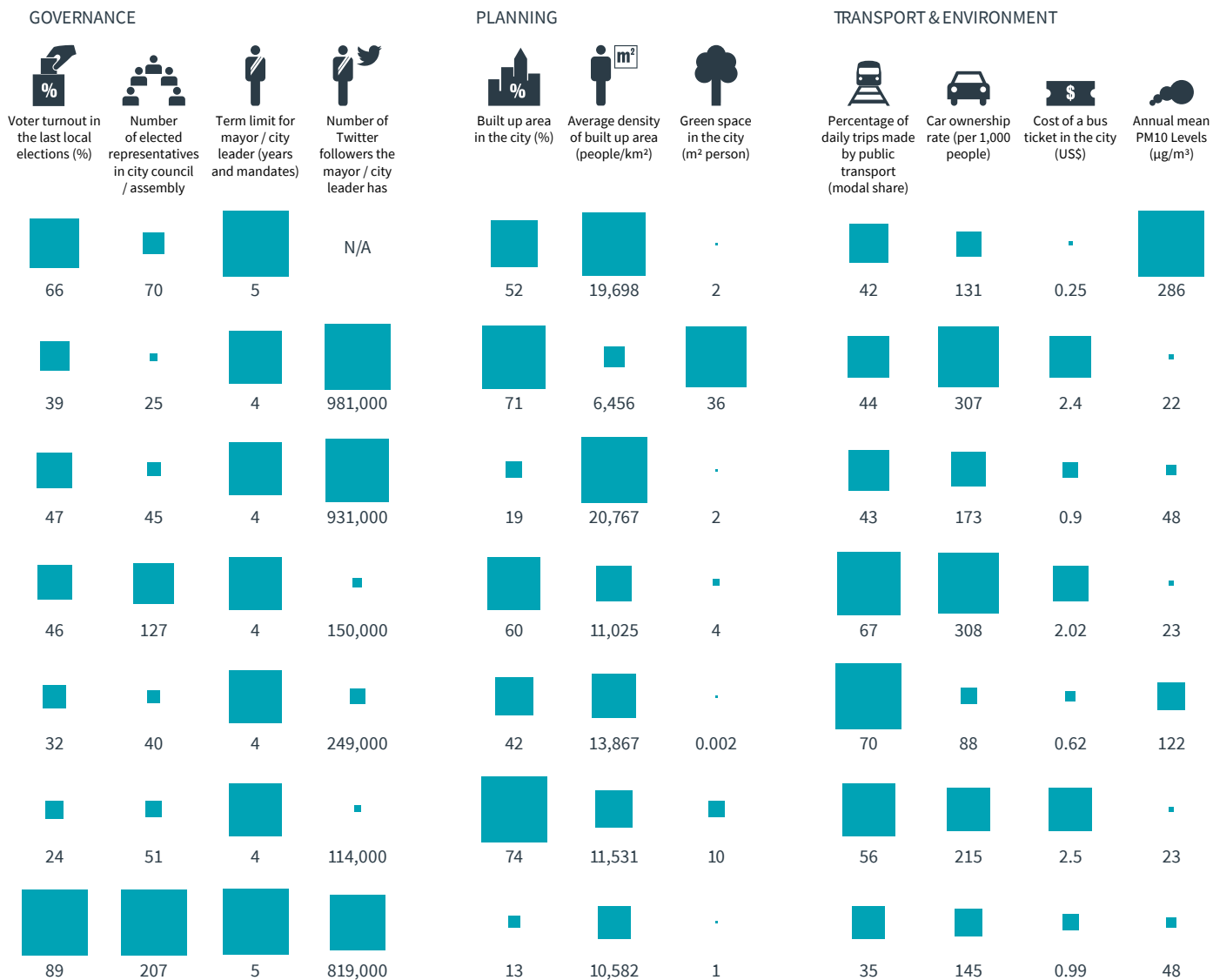


90% of the increase is taking place in Asia and Africa



How cities perform

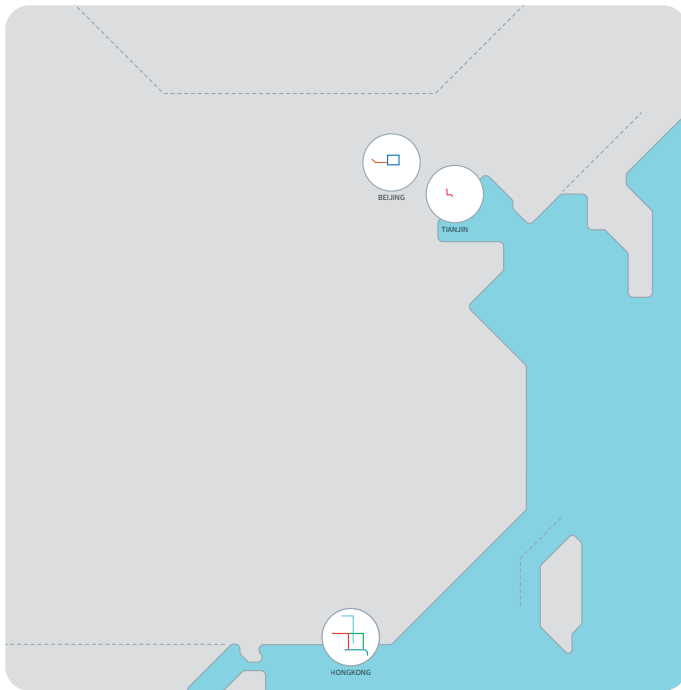




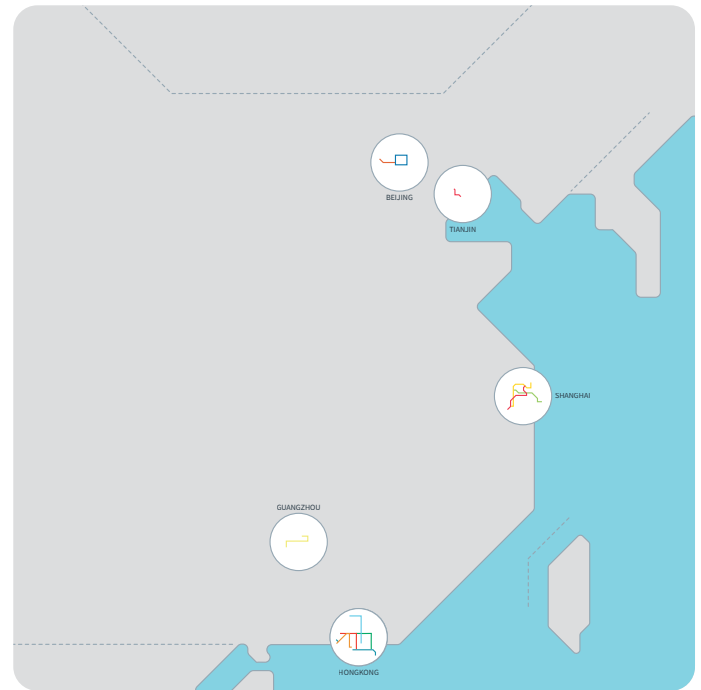
Chinese metro growth

Inspired by the work of the late US graphic designer and transit expert Peter Dovak, these maps show the rapid development of Chinese city metro systems since 1990.

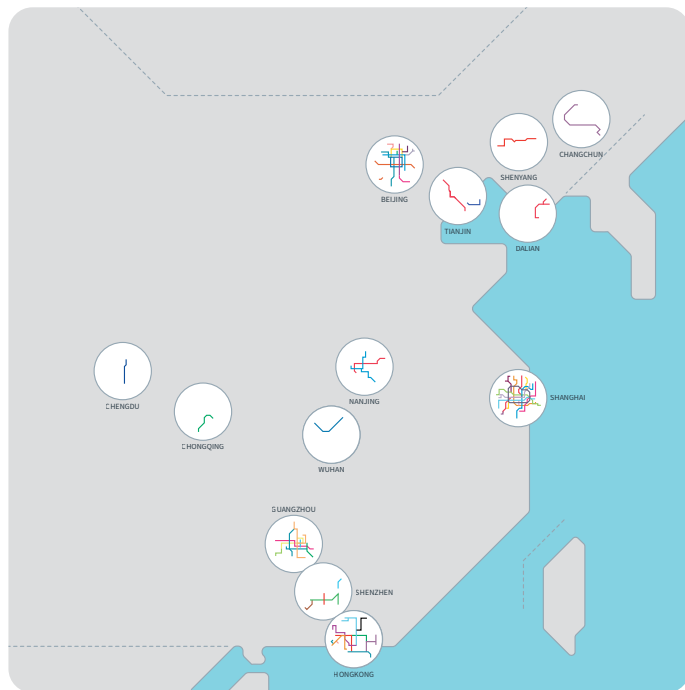
1990



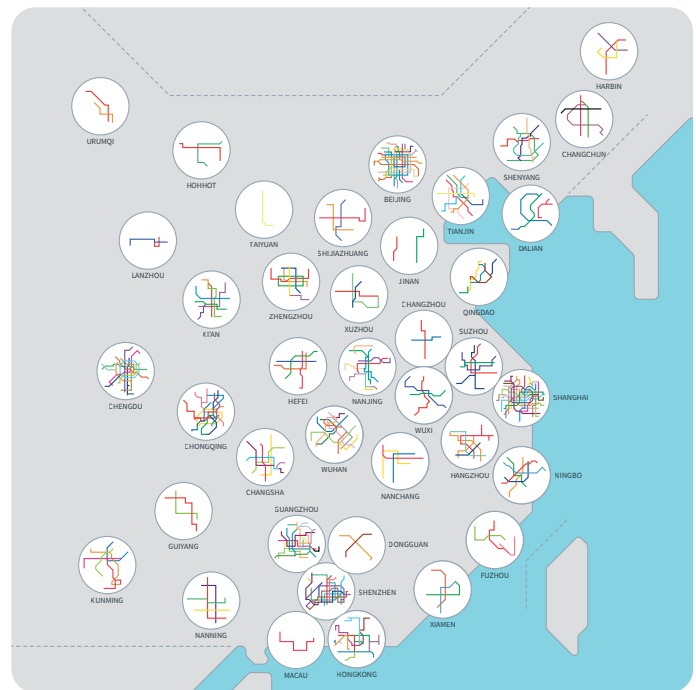
2000



2010



2020



Sustainability

There is no doubt climate change is happening, and the consequences of temperature rise are not only limited to environmental decay, but also economic. Corporates and financial institutions have a major role to play in mitigating these impacts.

Sustainable energy

Do we suffer from a lack of imagination?



1 MILLION
TRILLION

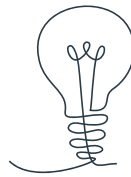
KILOWATT-HOURS A YEAR



TOTAL GLOBAL ENERGY USAGE =

150 TRILLION

KILOWATT-HOURS PER YEAR



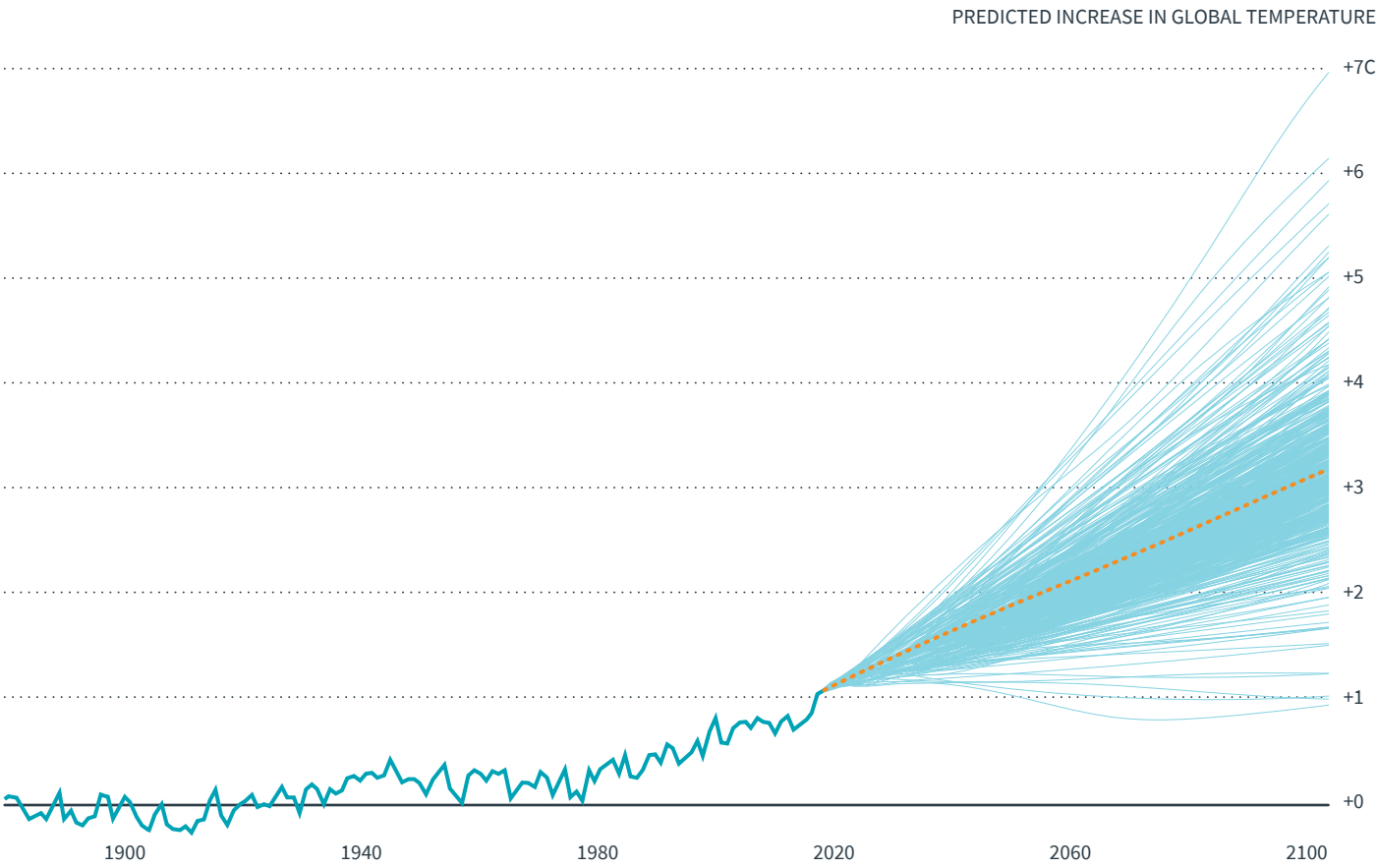
In 1931, not long before his death, inventor and father of electricity Thomas Edison told his friend Henry Ford: “I’d put my money on the sun and solar energy. What a source of power! I hope we don’t have to wait until oil and coal run out before we tackle that.”

This visual challenges our collective imagination. It shows clearly the disparity between the total amount of energy delivered to the earth by the sun and the amount of energy we use each year.

Climate change

Global temperature change

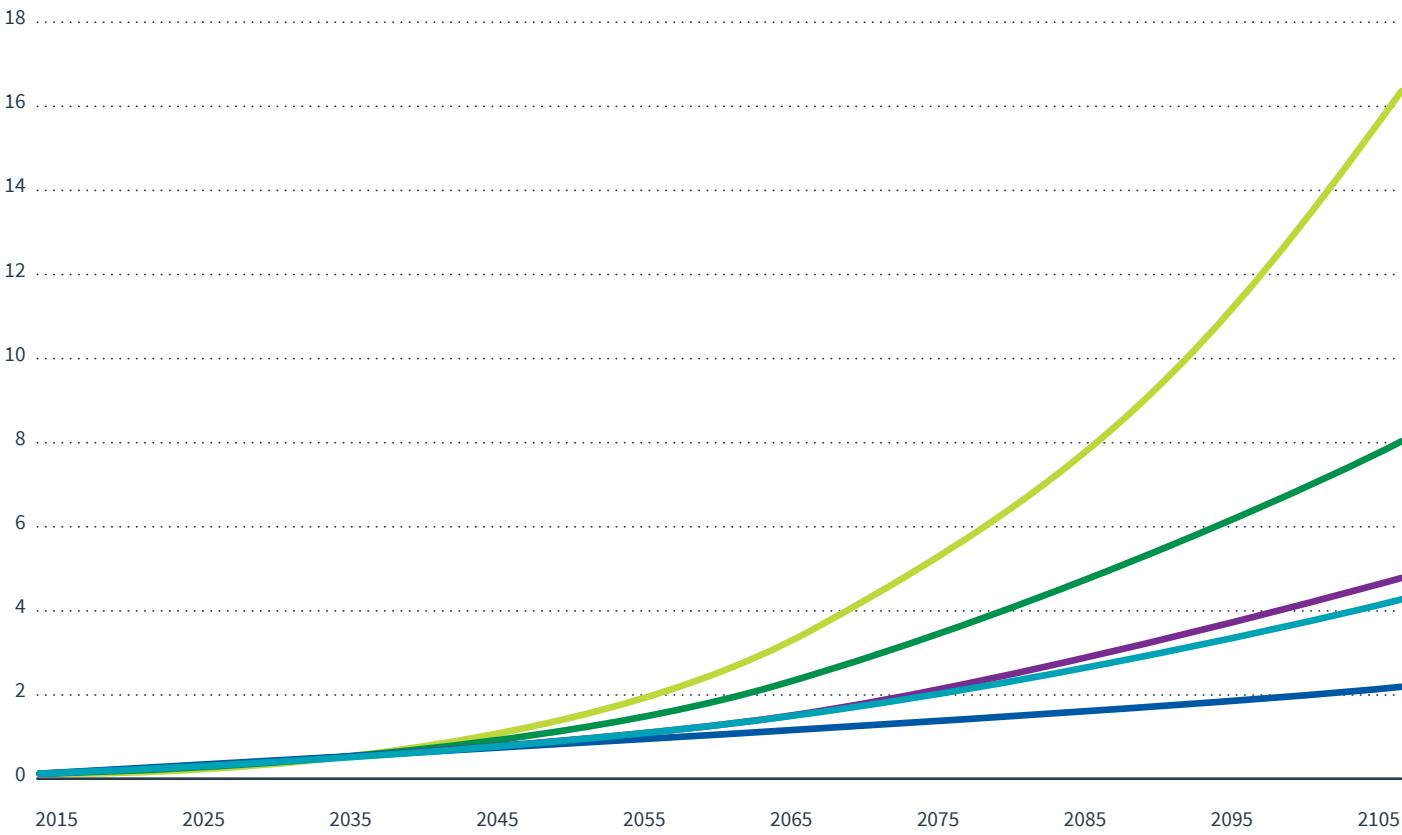
----- AVERAGE PREDICTION



Losses will primarily occur in the latter half of the century

- 6° SCENARIO
- 5° SCENARIO
- 4° SCENARIO
- 3° SCENARIO
- AVERAGE ESTIMATED GLOBAL TEMPERATURE INCREASE

ECONOMIC LOSS (\$ TRILLIONS)

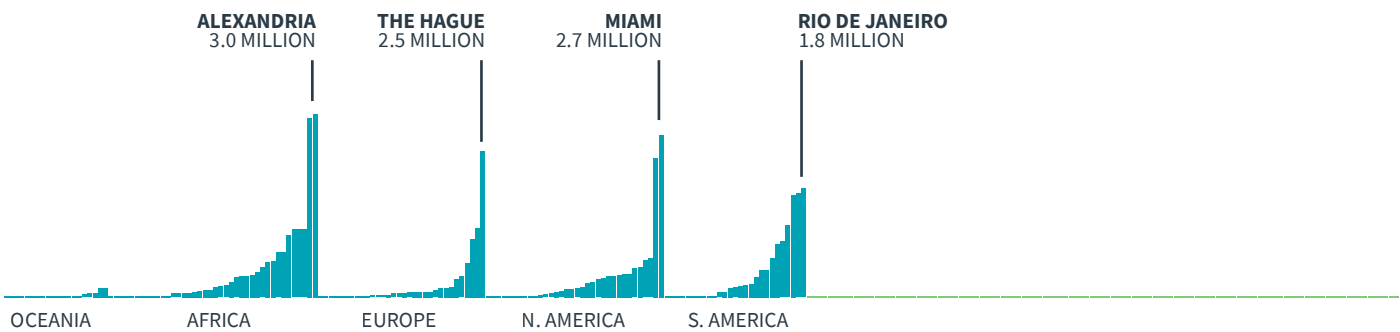


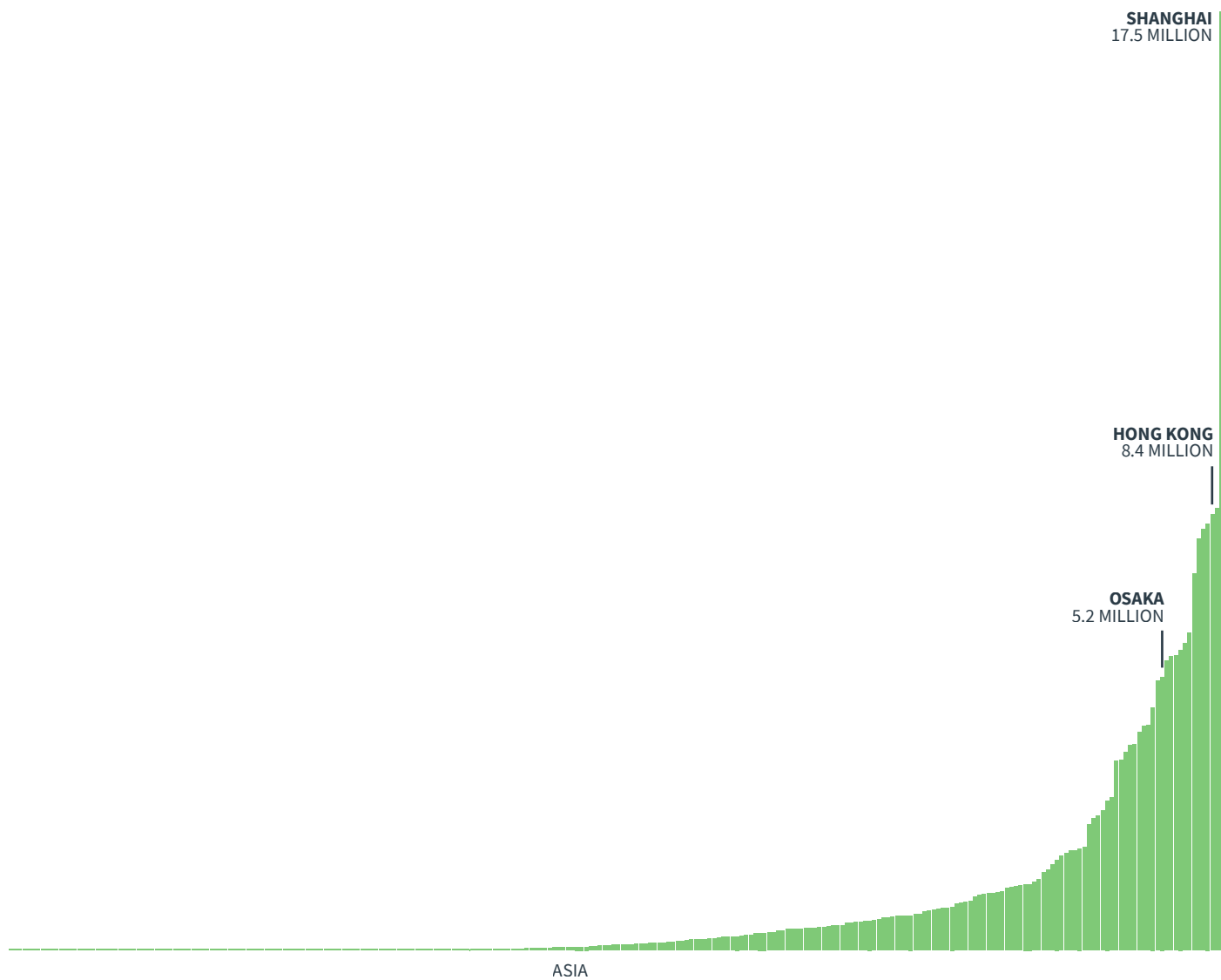
Sea level rise

People in Asian cities will be worst affected

Climate change is transforming the environment in numerous ways. But the most dramatic consequence of a warmer planet will be the rise in global sea levels. Thermal expansion of seawater is one contributing factor; melting ice sheets and glaciers another.

If temperatures reach the higher end of current projections, the implications for coastal cities would be severe. The graphic below shows the cities most at risk on each continent. East Asia is especially vulnerable: at three degrees Celsius above pre-industrial temperatures, large swathes of Shanghai and Osaka would be deluged.





Markets

Visualisations of data designed to highlight both the opportunities and risks associated with equities, bonds and alternative assets.

Where has all the diversification gone?

Pre-2008 (Jan 1998 - Dec 2007)

	US IG	EUR IG	US HY	EMD USD	ABS/SEC	CMBS	US EQ	EURO EQ	JAPAN EQ	EM EQ
US IG		0.81	0.76	0.50	-0.29	-0.20	0.53	0.45	0.40	0.52
EUR IG	0.81		0.63	0.31	-0.35	-0.29	0.45	0.42	0.34	0.47
US HY	0.76	0.63		0.49	-0.10	0.05	0.49	0.41	0.38	0.52
EMD USD	0.50	0.31	0.49		0.03	0.10	0.54	0.40	0.36	0.67
ABS/SEC	-0.29	-0.35	-0.10	0.03		0.89	-0.34	-0.45	-0.21	-0.30
CMBS	-0.20	-0.29	0.05	0.10	0.89		-0.24	-0.35	-0.17	-0.25
US EQ	0.53	0.45	0.49	0.54	-0.34	-0.24		0.79	0.48	0.72
EURO EQ	0.45	0.42	0.41	0.04	-0.45	-0.35	0.79		0.48	0.61
JAPAN EQ	0.40	0.34	0.38	0.36	-0.21	-0.17	0.48	0.48		0.56
EM EQ	0.52	0.47	0.52	0.67	-0.30	-0.25	0.72	0.61	0.56	

CORRELATIONS SPECTRUM



(1 = PERFECTLY CORRELATED)
(-1 = PERFECTLY NEGATIVELY CORRELATED)

Post-2008 (Jan 2008 - Nov 2016)

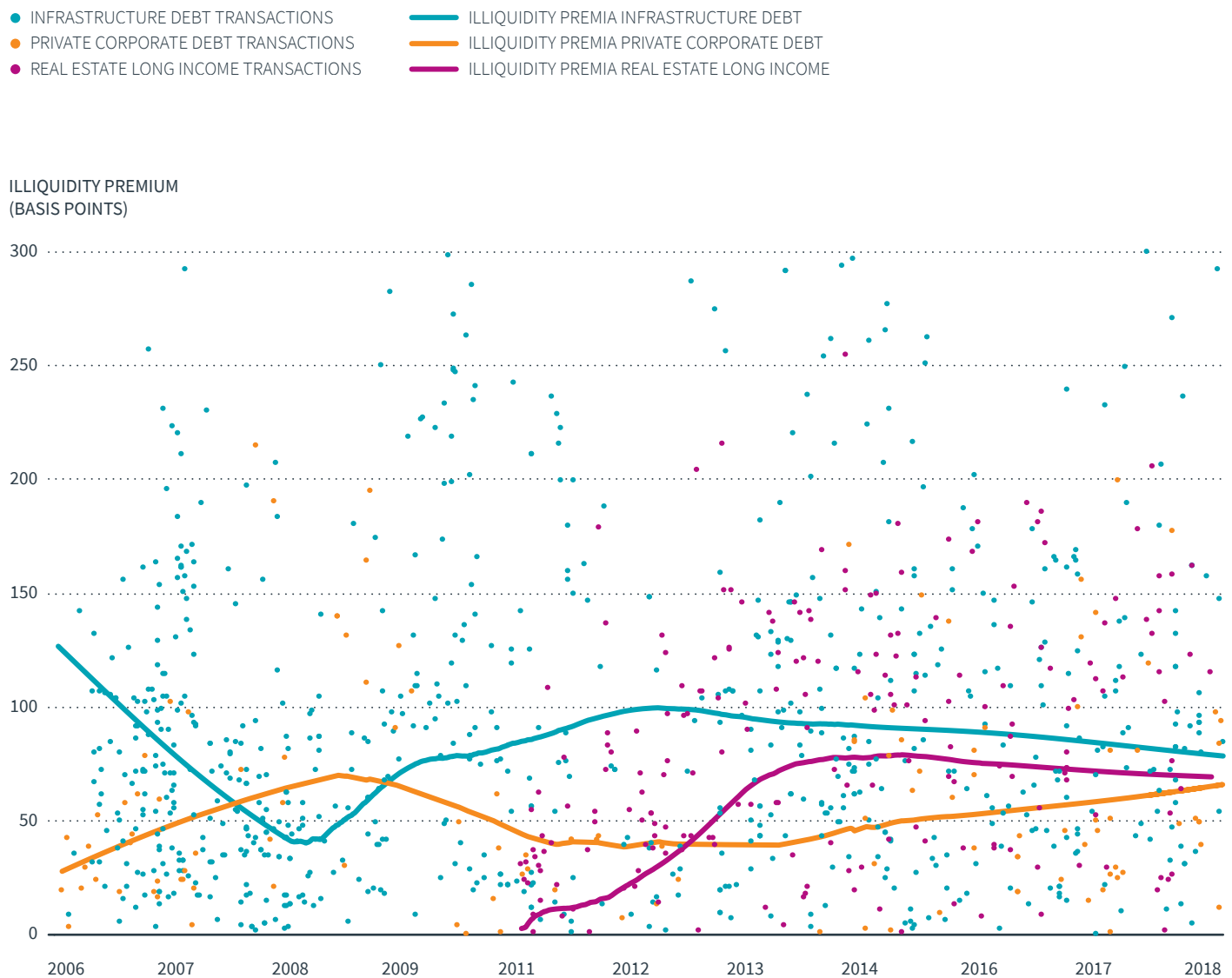
	US IG	EUR IG	US HY	EMD USD	ABS/SEC	CMBS	US EQ	EURO EQ	JAPAN EQ	EM EQ
US IG		0.89	0.86	0.60	0.50	0.52	0.63	0.61	0.60	0.73
EUR IG	0.89		0.79	0.57	0.46	0.51	0.69	0.70	0.61	0.73
US HY	0.86	0.79		0.76	0.57	0.78	0.73	0.66	0.55	0.81
EMD USD	0.60	0.57	0.76		0.54	0.56	0.55	0.49	0.38	0.72
ABS/SEC	0.50	0.46	0.57	0.54		0.50	0.26	0.19	0.13	0.40
CMBS	0.52	0.51	0.78	0.56	0.50		0.57	0.50	0.34	0.60
US EQ	0.63	0.69	0.73	0.55	0.26	0.57		0.84	0.70	0.81
EURO EQ	0.61	0.70	0.66	0.49	0.19	0.50	0.84		0.71	0.72
JAPAN EQ	0.60	0.61	0.55	0.38	0.13	0.34	0.70	0.71		0.62
EM EQ	0.73	0.73	0.81	0.72	0.40	0.60	0.81	0.72	0.62	

US IG US INVESTMENT GRADE
EUR IG EUROPEAN INVESTMENT GRADE
US HY US HIGH YIELD
EMD USD EMERGING MARKET DEBT (USD)
ABS/SEC ASSET-BACKED SECURITIES/SECURITISED

CMBS COMMERCIAL MORTGAGE-BACKED SECURITIES
US EQ US EQUITIES
EURO EQ EUROPEAN EQUITIES
JAPAN EQ JAPANESE EQUITIES
EM EQ EMERGING MARKET EQUITIES

Illiquidity premium

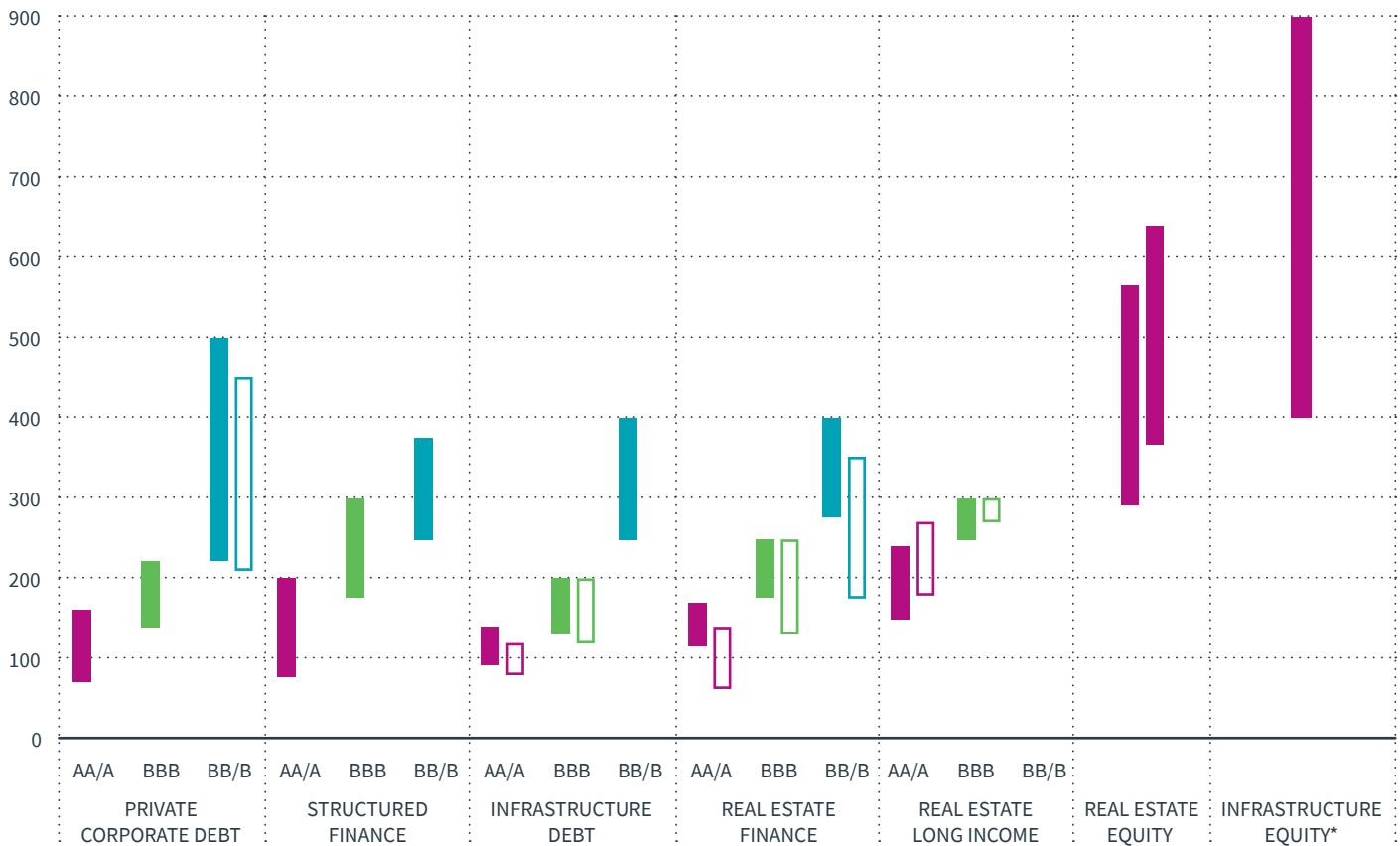
Revealing premia in select private markets transactions



Real assets indicative yield spreads above comparable government bonds (annual data, Q3 2018)

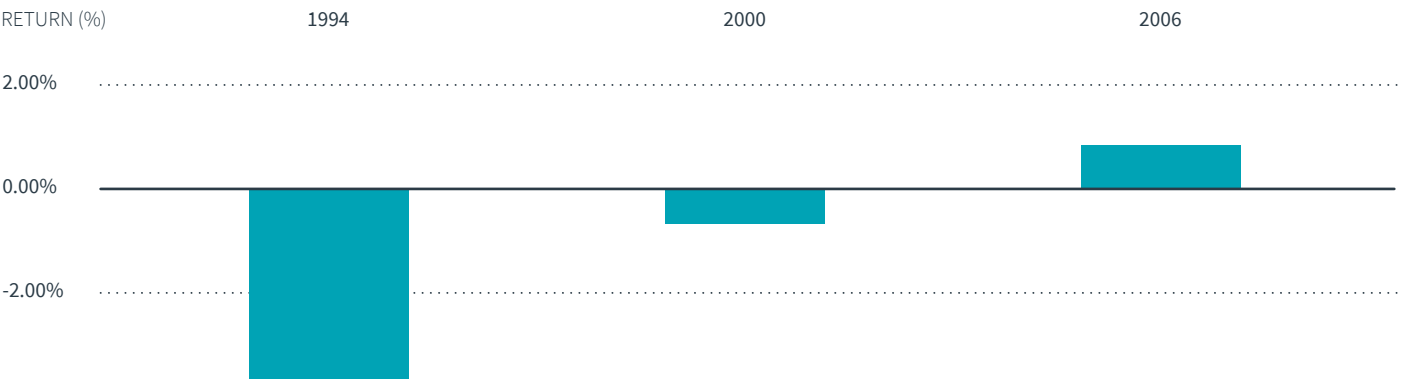
■ (SOLID) GBP
□ (OUTLINE) EUR

BASIS POINTS



Fixed income - beware duration risk

What actually happened

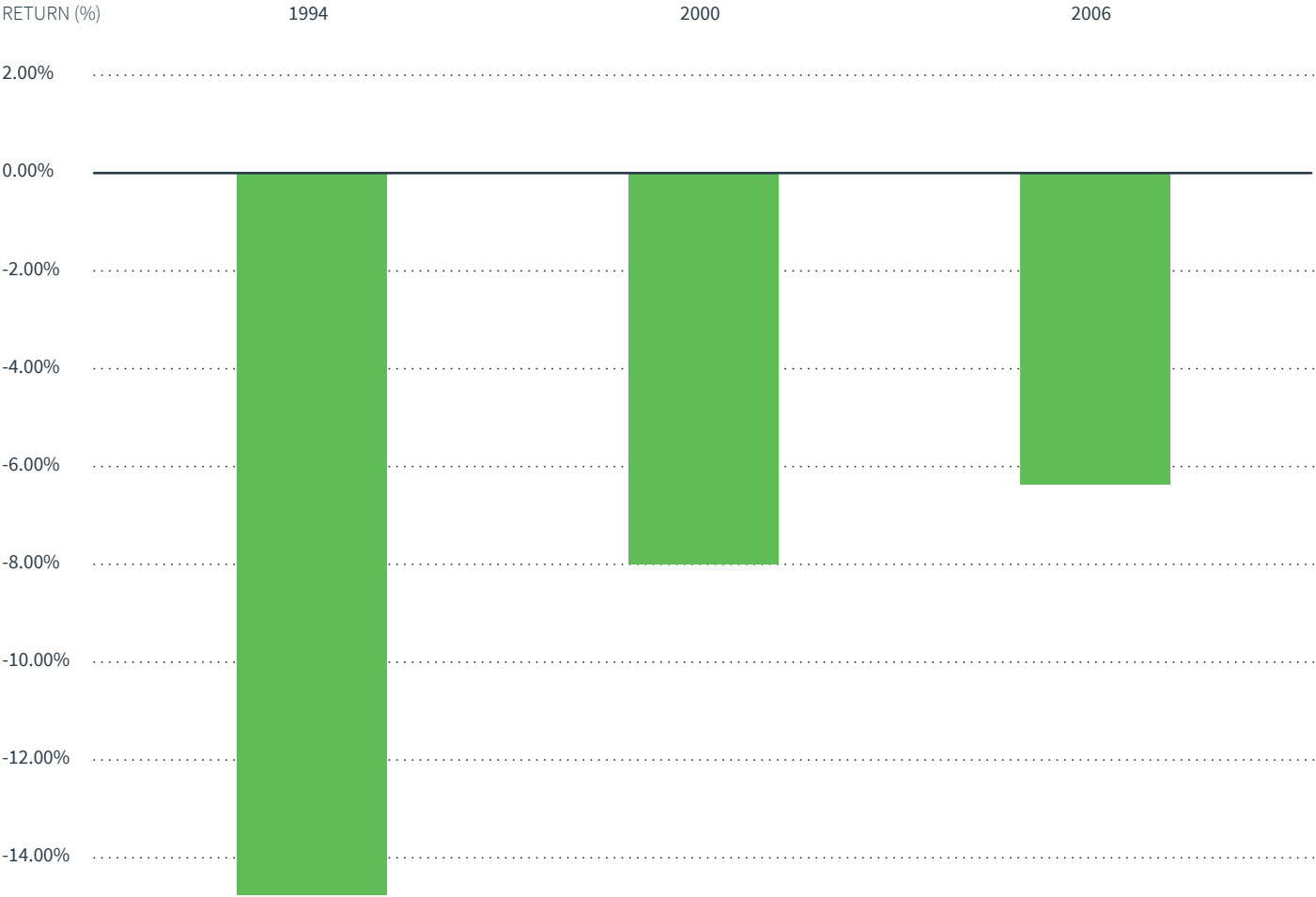


For those who remember it, the bond massacre of 1994 still sends shivers down the spines of investors.

Low government bond yields and inflation make comparisons between then and now obvious. However, there is one major, and worrying, difference: duration. Simply defined, duration is a bond's sensitivity to interest rates. And the persistently low yield environment means investors face significant risks as interest rates start to rise.

To help understand the true comparison, in the two charts provided here we show what actually happened to US Treasury yields in three significant market event periods (1994, 2000 and 2006) and what those events would have looked like given the level of duration risk currently embedded into fixed income markets.

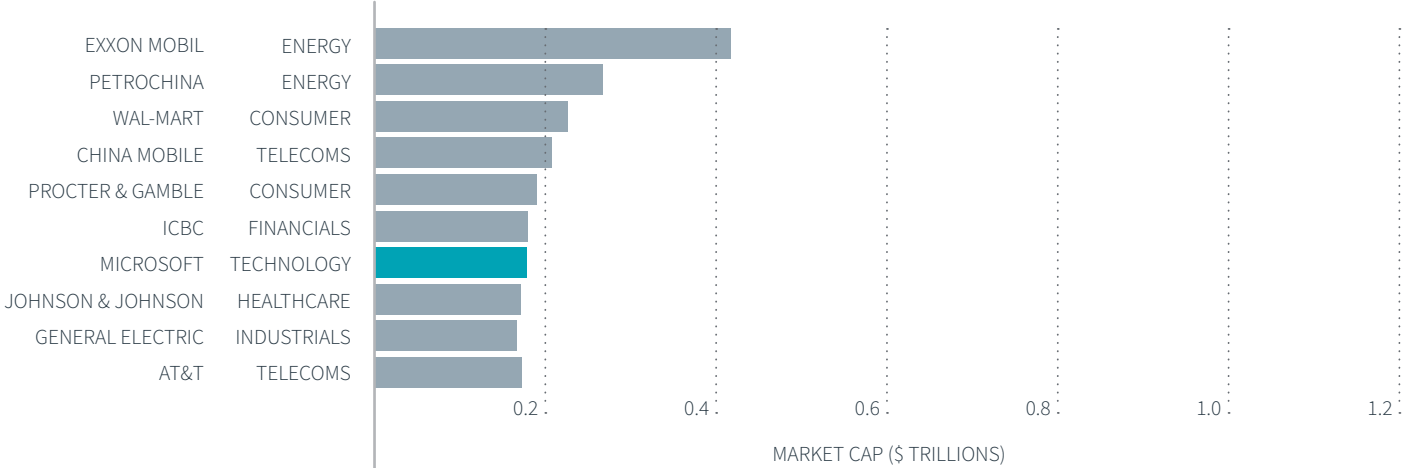
What would have happened based on today's market duration levels



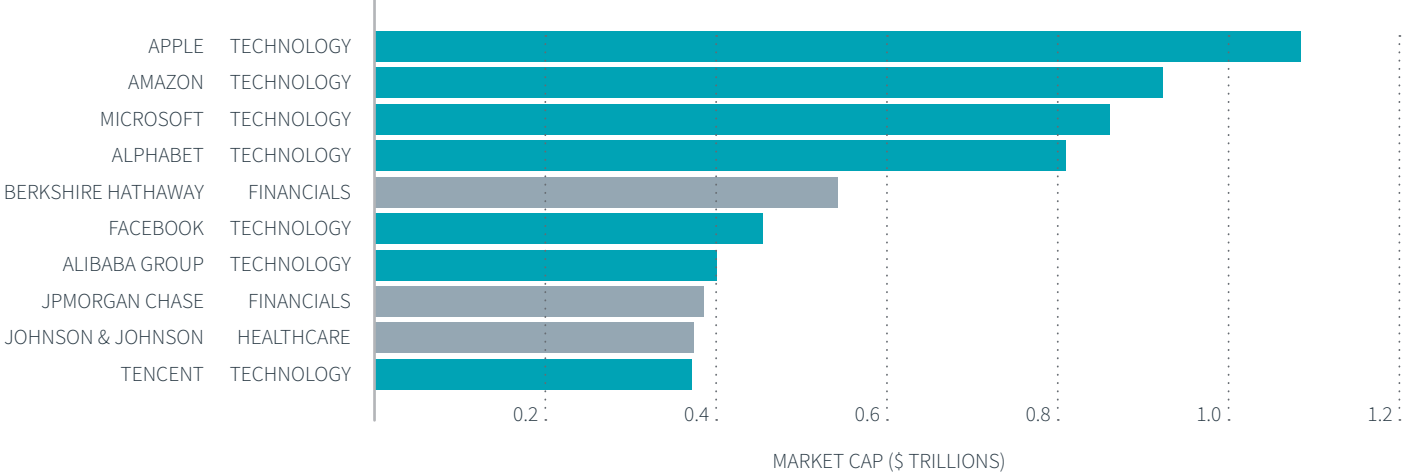
A virtually new world

The rise of tech

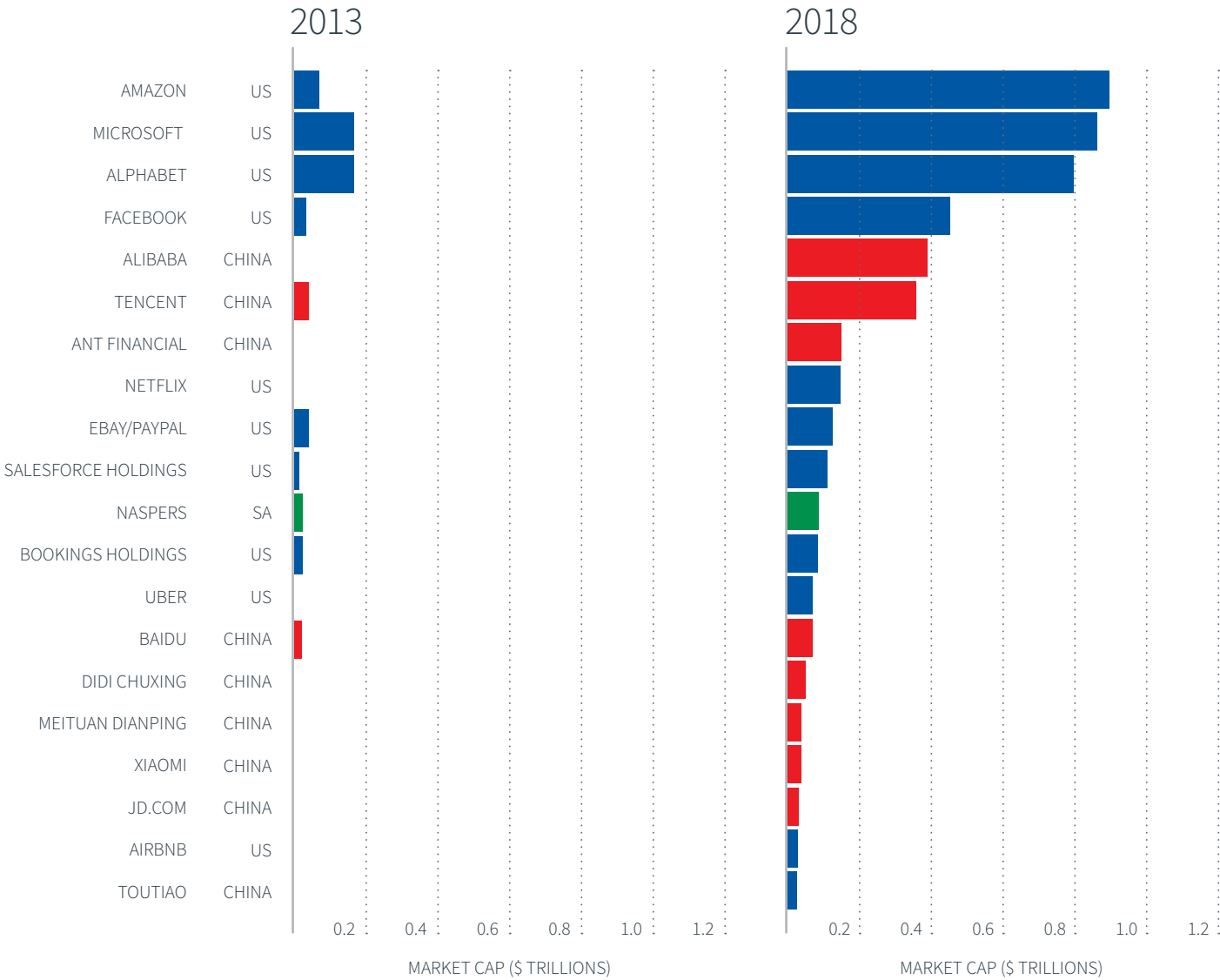
2008



2018



Internet companies: China on the rise



Risk is not ‘normal’

RISK
IS NORMAL UNTIL
IT ISN'T • MODELS BASED
ON GAUSSIAN BELL CURVES
NAVELY REDUCE RISK TO UNIFORM
RULES • UNFORTUNATELY LIFE IS
INHERENTLY SKEWED AND MESSY;
NOT NEARLY AS NEAT AS THE LOGICIANS
WOULD LIKE • AND WHILE 'RISK' CAN BE MEASURED
PROBABILISTICALLY, UNCERTAINTY CANNOT • AN ELUSIVE
GAP EXISTS BETWEEN KNOWN UNKNOWNNS AND UNKNOWN
UNKNOWNNS, LEAVING THE MATHS WANTING – UNABLE TO GRASP THE
FINER POINTS OF SURPRISE • BLACK SWANS, RANDOM WALKS AND FAT TAILS ALL
CONSPIRE TO DEVIATE IN THE MOST UN-STANDARD OF WAYS! SO BE HUMBLE ENOUGH TO
EMBRACE UNCERTAINTY FOR, ALAS, YOU CAN ONLY CONTROL WHAT YOU CAN AND MUST ACCEPT THAT **WILDNESS** LIES IN WAIT

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Asset Class	Ticker	Index full name
US IG	COA0	ICE BofAML US Corporate Master Index
EUR IG	ER00	ICE BofAML Euro Corporate Index
US HY	HOA0	ICE BofAML US High Yield Master II Total Return Index
EMD USD	DGOV	ICE BofAML US Emerging Markets External Sovereign Index
ABS/Sec	ROA0	ICE BofAML US Fixed Rate Asset Backed Securities Index
CMBS	CMBS	ICE BofAML US Fixed Rate CMBS Index
US Eq	SPX	S&P 500 Index
Euro Eq	SX5E	EURO STOXX 50 Index
Japan Eq	NKY	Nikkei 225 Index
EM Eq	MXEF	MSCI Emerging Markets Index

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