The Decade of Inflection: reaching boiling point

We enter the next decade with interest rates at 5,000-year lows, the largest asset bubble in history, a planet that is heating up, and a deflationary profile of debt, disruption and demographics. We will end it with nearly 1bn people added to the world, a rapidly ageing population, up to 800mn people facing the threat of job automation and the environment on the brink of catastrophic change. At the same time, 3bn more people will be connected online and global data knowledge will be 32x greater than today. The social, political and economic responses to these challenges, all heading to a boiling point this decade, will overhaul traditional paradigms. We outline BofAML Transforming World’s top 10 themes to help investors navigate this decade ahead.

10 Themes for the Next 10 Years

1) **Peak Globalization**: the end of unrestricted free movement of labor, goods, and capital around the world. **Winners**: local markets, real assets; **Losers**: global markets.

2) **Recession**: record numbers of FMS investors think the global economy is late-cycle, the bond market bubble is set to unwind and populism is likely to be inflationary. **Winners**: inflation, real assets, infrastructure; **Losers**: growth, credit, deflation.

3) **Quantitative Failure**: monetary policy measures are proving less and less effective at boosting corporate and household “animal spirits”. **Winners**: Keynesianism, gold; **Losers**: financial assets, Monetarism.

4) **Demographics**: the number of grandparents will outnumber the world’s children; every second 5 people enter the EM middle class and Gen Z overtakes Millennials. **Winners**: eCommerce, new consumer; **Losers**: bricks & mortar, legacy consumer.

5) **Climate Change**: investors are more focused than ever on global warming’s impact on the economy, society, unemployment and migration. **Winners**: clean energy, electric vehicles; **Losers**: fossil fuels, diesel cars, single-use plastics.

6) **Robots & Automation**: up to 50% of jobs at risk of automation by 2035. **Winners**: automation, local production, big data & AI; **Losers**: humans, global supply chains.

7) **Splinternet**: China to overtake the US and become the world leader in AI by 2030. ‘Sovereign internets’ expand. **Winners**: emerging markets/the East; **Losers**: developed markets/the West.

8) **Moral Capitalism**: US$20tn of AuM is going into ESG strategies over the next 20 years = nearly market cap of S&P500. **Winners**: ESG, impact investing, stakeholders; **Losers**: business-as-usual investing, solely profit-maximizing firms.

9) **Smart Everything**: 500bn connectable devices by 2030 to combat deflationary demographics but at the risk of the death of privacy. **Winners**: IoT, connectivity, smart cities, ‘big brother tech’; **Losers**: privacy, offline.

10) **Space**: tourism and nanosatellites are the next frontier for an industry that could be worth cUS$1tn by 2030. **Winners**: aerospace & defence; **Losers**: legacy satellites.

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New paradigms of the 2020s

Exhibit 1: BofAML Transforming World: 2010s vs. 2020s

Source: BofAML Global Research
Did you know in the next decade...

- By 2020, for the first time in human history, the number of persons aged 65+ will outnumber children under 51
- By 2020, humans will generate 40x more bytes of data than there are stars in the observable universe2
- By 2021, the number of virtual/voice digital assistants will exceed the world population3
- By 2021, the economic cost of cybercrime is set to reach $6tn or approximately 7% of global GDP – bigger than the cost of climate change4
- By 2021, central bank balance sheets globally could reach $18tn, or approximately 1/5 of global GDP5
- By 2022, only 59% of tasks will be completed by humans and 42% by machines across 12 industries6
- The 2024 Paris Olympics could see eSports as an official sports for the first time7
- By 2025, the ICT industry will use 1/5 of the world’s electricity, generating more emissions than the entire airline industry8
- By 2025, people will interact with connected devices once every 18 seconds – that is 4,800 times a day9
- By 2025, 1 in 3 people on the planet are likely to be overweight or obese10
- By 2027, oil demand and production could reach its peak11
- By 2029, 5G mobile networks could reach their full capacity, 6G may be needed12
- By 2029, AI could be as intelligent as humans13
- By 2030, by 2030, global temperatures rise could breach the 1.5°C target, as humans potentially exhaust the remaining carbon budget14
- By 2030, the number of ICE/diesel cars on the road could plateau15
- By 2030, climate change could push more than 100 million people in developing countries below the poverty line16
- By 2030, 80% of the middle class will be living outside the EU and US17

The next decade: unlike any before it

The world’s social, environmental, political and economic systems are facing escalating challenges, fuelled by megatrends, which are all likely to reach their boiling point in the next decade. We expect the 2020s will overhaul old paradigms, disrupt business models, and produce new trends that will shape our future. In the next 10 years, we should see increased automation, a global recession, unprecedented innovation, serious environmental challenges, the death of quantitative easing, tectonic shifts in demographics and the end of globalization. These are just some of the economic and thematic megatrends likely to shape the investment world to come.

A decade of social and environmental megatrends…

Governments, companies and markets will face new social and environmental challenges unlike anything we have seen in the past. By the end of the decade, the world’s population will have increased by nearly 1 billion compared with today, putting a huge strain on the planet’s resources. A rapidly ageing population will challenge pension and healthcare systems and, by 2035 robotic automation could displace up to 50% of jobs. Without firm action, the world could reach an irreversible tipping point by the end of this decade as global temperatures increase and the planet exhausts its carbon budget. All these trends will impact social issues like inequality and immigration, as well as health and environmental problems like pandemics, pollution etc.

…new economic paradigm approaches…

We believe new paradigms will disrupt the status quo this decade. We are in the lowest interest rate environment in 5,000 years with monetary policy becoming less effective. The global economy is late cycle and fears of a recession are rising. We believe stakeholder value will be created in ways other than just profit maximization. These trends, among others, may lead to new economic theories like Modern Money Theory (MMT) and the death of globalization, and accelerate the geopolitical race for technological supremacy.

…and “techceleration”

At the same time, we expect unprecedented strides in innovation and “techceleration”. By 2030, global data knowledge will likely be 32x greater than today’s level. By the mid-2020s, we will interact with an online device every 18 seconds, vs. 6.5 minutes today; and there will likely be 500bn connectable devices globally by 2030. Techceleration will unlock economic value, but will challenge governments, privacy and society like never before (source: IBM).

Exhibit 2: 2020 vs. 2030

The 2020s is the decade of “peak”
Most strikingly, we see the 2020s as a ground-breaking “peak decade” that will see many themes reach their inflection points, and business-as-usual investing will be disrupted. Examples include:

- **Peak Globalization**: the first time in decades that the unrestricted global flow of people, goods, and capital is no longer guaranteed.

- **Peak Inequality**: the first time that profit maximization is no longer the sole objective for Wall St and shareholders, with the rise of ‘moral capitalism’ and the wider importance of stakeholders.

- **Peak Youth**: the first time that there are more seniors than children in the global population.

- **Peak Oil**: the first time that global oil demand plateaus as we transition away from fossil fuels towards renewable energy and electric vehicles (EV).

- **Peak Cars**: the first time that the total fleet number of diesel internal combustion engine (ICE) vehicles on the road declines.

- **Peak Stuff**: the first time that conspicuous consumption ends in developed markets as we shift away from ownership to the sharing/circular economy.

**Exhibit 3: Peak Globalization**

Source: BofA Merrill Lynch Global Investment Strategy, Global Financial Data, Bloomberg, USDA, Savills Shiller, ONS, Sparenivers, Historic Auto Group. Note: Real Assets (Commodities, Real Estate, Collectibles), vs. Financials Assets (Large cap stocks, long-term Govt bonds).

**Exhibit 4: Peak Youth**

Source: BofA Merrill Lynch Research, UN

**Exhibit 5: Peak Oil**

Source: BofA Merrill Lynch Research, IEA

**Chart 1: Peak Cars**

Source: BofA Merrill Lynch Research, BNEF // ICE = internal combustion engine; BEV = electric vehicle
10 themes for the next 10 years

In this report, we highlight BofAML Global Research’s top 10 themes over the next 10 years to help investors navigate the decade ahead in a Transforming World.

Exhibit 6: What is next for the decade ahead?

- Recession
- Peak Globalisation
- Quantitative Failure
- Climate Change
- Demographics
- Robots & Automation
- Splinternet
- Smart Everything
- Moral Capitalism
- Space

Source: BofAML Global Research
1. Peak Globalization: the world is not flat

Summary: Unrestricted global flows of people, goods, and capital are no longer guaranteed, creating opportunities for smaller firms, local markets, and unloved real assets.

Exhibit 7: Real assets at all-time lows vs. financial assets

Exhibit 8: World Trade Uncertainty

Exhibit 9: Themes, Trends and Strategy for Peak Globalization

PEAK GLOBALISATION TRENDS
- Trade Wars & Tariffs
- Nationalist Policies
- Reshoring & Local Production
- Inflation
- Populism
- Macro Volatility

PEAK GLOBALISATION STRATEGY & THEMES
- Bonds -> Equities
- Globalization -> Protectionism
- Large Cap -> Small Cap
- Supply Chains -> Localization
- Consumer -> Producer
- Credit -> Commodities

Source: BoFA Merrill Lynch Global Investment Strategy, Global Financial Data, Bloomberg, USDA, Savills, Shiller, ONS, Spaeniers, Historic Auto Group. Note: Real Assets (Commodities, Real Estate, Collectibles), vs. Financials Assets (Large cap stocks, long-term Govt bonds).

Source: International Monetary Fund, Knoema. *Higher index score denotes higher trade uncertainty based on country reports.

Source: BoFA Merrill Lynch Global Research
The world is not flat

Proponents of globalization argue that high inflation in the 1970s was corrected by removing barriers to capital (deregulation, open capital accounts, fall of the Berlin Wall...). Those same changes are now under threat as societies grapple with inequality and the heavy burden of social security, pensions and disinflation. The moment of “peak globalization” is likely behind us. The 1981-2016 era of unchecked flow of goods, people and capital is coming to an end, catalyzed by the widespread recognition that while globalization has meant lower consumer prices, it has also meant slower growth, precarious employment and social disruption. Signs the transition is already underway:

- **People**: after the fall of the Berlin Wall in 1989, there were 15 physical barriers delineating international borders...now there are 77. Today the US is the only large economy to grant unconditional birth right citizenship; other developed countries have skilled or points-based immigration systems.

- **Goods**: the US/China trade war is only the first among many signs that the global flow of goods is being renegotiated. Global trade growth in 2019 (+2.5%) is falling below global GDP growth (2.7%) for the second time since the financial crisis, a rare event outside of a recession (Exhibit 10). Bilateral trade battles (US/China, Japan/Korea, US/UK) are replacing multilateral frameworks (NAFTA, TPP), and some corporates are planning relocations of supply chains to regional allies. These tectonic shifts will likely lead to greater macroeconomic volatility.

- **Capital**: from 1960-80 the US averaged a small trade surplus (0.3% GDP), since then the average current account deficit has fallen to -2.5% of GDP. The obverse of any trade deficit is a capital account surplus, which means countries running large trade & budget surpluses (e.g. China, Germany, South Korea) continue to export deflation to the US and other deficit economies. These persistent imbalances generate stronger political will to weaken the US dollar and limit capital inflows, in our view.

The transition to stronger local and regional economic ties is likely to accelerate as recent elections (Trump, Brexit, Bolsonaro, Salvini, Orban) proved it is possible to succeed politically while rejecting one or more aspects of globalization.
The start of history

The disruption of the flow of goods, people and capital will have profound implications for global supply chains, labor markets, interest rates, and corporate earnings over the next decade. Initially, it will mean rising costs of business as big regional powers attempt to dominate local geography and natural resources, and exercise tighter controls over currency and financial markets. Subsequently, we expect this rebalancing will raise productivity and set the global economy on a path to higher, sustainable growth. In the deflationary 2010s average global GDP growth fell from 3.9% to 3.6%, CPI in advanced economies dropped from 4.4% to 3.4%, and ex-US equities the best-performing assets globally were JGBs and European corporate and government bonds. The 2020s will likely mean higher growth, higher inflation, higher interest rates, and outperformance by global equities and commodities vs bonds. Key catalysts for this shift:

Geopolitical infrastructure spending will accelerate as countries expand their influence. Trade wars in the early 2020s may quickly give way to competitive investment cycles. The US/China conflict over trade and security will continue, whatever the outcome of any short-term negotiations: military spending is forecast to rise substantially in the coming decades to US$4.2tn in China and US$2.9tn in the US. By 2027 China’s US$1.3tn One Belt, One Road initiative will span 65 countries, accounting for almost one-third of global GDP and two-thirds of the world population. Russia is spending a tenth of its investment budget on the Arctic “Polar Silk Road”, and the ongoing 5G rollout will accelerate (US$77bn revenue opportunity).

Countries will develop explicit national industrial policies and boost spending on R&D to foster local innovation, protect nascent industries, and shield national champions from hostile foreign takeovers, e.g. the 2019 German proposals to increase its European manufacturing share by 1.8%, and the Japanese plan to limit foreign ownership in security-sensitive companies from 10% to just 1%.

Ageing demographics will force states either to pursue aggressive pro-nationalist policies or to compete for highly trained labor in the context of tight immigration policy, e.g. bipartisan US support now for family leave policies, Japan now offering visas to attract 250k foreign workers.

Open capital accounts will likely be the last domino to fall. Every trade deficit has an equal and offsetting capital surplus and we expect developed countries will learn that: (1) “capital controls are good and easy to use” (easier than tariffs, anyway); and (2) blocking the inflow of risk-averse savings is necessary for economic sustainability and trade stability. The financial “opening-up” of China and other EMs may prove too late as the risks from “hot money” flows prove greater than the benefits of access to foreign capital, while awareness rises in developed countries of problems caused by the global
savings glut; e.g. US Senate bills to tax capital inflows and to prohibit public pensions from buying Chinese equities, Canadian plan to tax foreign housing speculation.

**Exhibit 12: US vs China trade balance and Treasury Holdings**

Source: BofAML Global Research Investment Strategy

**Investment: think locally, act globally**

Globalization has rewarded financial assets at the expense of real assets, and has pushed companies toward domestic services vs exported goods and profit maximization vs economic productivity. Our top investment ideas focus on the reversal of these trends:

- **Long real assets vs financial assets**: own assets that benefit from higher growth and inflation, e.g. commodities, farmland, real estate, collectibles, and precious metals.

- **Long infrastructure and defense**: as national security and economic sovereignty dominate policy, own aerospace and defense, energy and water, plus infrastructure.

- **Long small cap vs large, value vs growth**: asset-light growth stocks will likely underperform as national industrial policies and import substitution incentivize higher operating leverage, investment in fixed assets, and higher returns to labor...all features of small-cap and cyclical value sectors e.g. industrials, resources and financials rather than tech and healthcare.

- **Long FX and rates volatility**: bond volatility has already started to rise (MOVE jumped from 40 to 90 in 2019) and is expected to increase to 150 in coming years with a rising risk of competitive FX devaluations, aggressive fiscal expansion, and more restrictions to capital flows.
2. Recession: late cycle, bond bubble, inflation

Summary: Yield curve inversion, global manufacturing recession, trade wars and rising debt defaults have raised the spectre of an imminent global economic recession; we believe the biggest vulnerability for markets in the 2020s comes from today’s bond market bubble and responses to the next slowdown will be inflationary.

Exhibit 13: 90% Global Fund Manager Survey investors think global economy is “late cycle”

Source: BofA Merrill Lynch Global Fund Manager Survey

Exhibit 14: The probability of a US recession is increasing


Exhibit 15: Themes, Trends and Strategy for Recession

<table>
<thead>
<tr>
<th>RECESSION TRENDS</th>
<th>RECESSION STRATEGY &amp; THEMES</th>
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<tbody>
<tr>
<td>Late Cycle</td>
<td>Credit -&gt; Comodities</td>
</tr>
<tr>
<td>Modern Monetary Theory (MMT)</td>
<td>Occupy Wall Street -&gt; Occupy Silicon Valley</td>
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<tr>
<td>Infrastructure</td>
<td>Inequality -&gt; Redistribution</td>
</tr>
<tr>
<td>Bond Bubble</td>
<td>Growth -&gt; Value</td>
</tr>
<tr>
<td>Inequality</td>
<td>Rich -&gt; Poor</td>
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<tr>
<td>Reflation</td>
<td>Deflation -&gt; Inflation</td>
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Source: BofAML Global Research
The longest, weakest economic cycle since the Civil War

We enter the 2020s with a record 90% of Global Fund Manager Survey investors saying the global economy is late cycle. Growth “bears” are bullish on policy impotence, yield curve inversion, trade wars and Brexit, and point to the global recession in manufacturing (global PMI at 49.7) and EPS (-3.7% 12m fwd YoY) as evidence of an imminent slowdown.

We leave the 2010s stuck in an economic regime characterized by low growth and low inflation. Real GDP has averaged just 2% in the US, 1% in the EU and Japan, and halved from 12% to 6% in China as it rebalances towards a consumer rather than export-led economy. This is despite historic levels of monetary accommodation since 2009: 768 central bank cuts, US$12.4tn of financial asset purchases and interest rates at 5,000-year lows.

What could trigger a recession (bond bubble)?

The combination of globalization, lower interest rates and a policy and macro backdrop of maximum liquidity and minimal growth have served to exacerbate wealth inequality, and create a surplus of global savings relative to investment, i.e. extremely low “animal spirits”. Higher debt has also failed to deliver higher growth (note corporations and governments global debt up from US$105tn in 2008 and US$247tn in 2019).

Instead, the monetary policy largesse of the 2010s induced significant upside (and polarization) in asset prices, but the economic spoils went to holders of capital not workers. A portfolio of bonds and stocks rose from US$100 to US$223, while US$100 of wages rose to US$125. Reliance on monetarism has also meant modern economic expansions are now driven by booms and busts in financial cycles.

Exhibit 16: US asset prices & the US labor force participation rate since 1978


We believe the biggest vulnerability for markets in the 2020s will come from today’s bond market bubble: >US$13tn negative yielding debt (of which c.US$1tn corporate), negative German/Swiss curves, Austria 100-year bond yields <1%, global bond yields just off record lows of only 19bp.

In the coming years a policy mistake (inflation targeting/MMT) and/or the start of policy impotence (central banks pushing on a string) will likely cause a jump in interest rate volatility, end the decade-long bullish combo of minimum rates-maximum profits, and signal the big top in asset prices.

A disorderly rise in bond yields would likely cause extreme pain as Wall St deleverages, inevitably leading to pain quickly thereafter for the real economy. This is why the Fed policy pivot on weak credit markets was so aggressive in December 2018/January 2019.
What is the policy reaction? Fed, MMT, inflation targeting

We believe the policy response to next recession will seek to correct the excesses of the 2010s that led to widespread wealth inequality and financial engineering:

- **Corporate sector leverage**: global corporate debt has risen by 62% 2008-18.
- **Wall St too big to fail**: US private sector financial assets at record 5.6x GDP
- **Private equity**: private equity and venture capital AUM to reach US$4.2tn with 2019 on track to be a new record for fundraising (US$624bn) and AUM a record 5.3% of global equity market cap.
- **Share buybacks**: since 2009, US corporates have spent US$5.4tn on stock buybacks (US corporates have spent US$114 on buybacks since 2018 for every US$100 invested in the real economy vs US$60 from 1998-2017) and issued US$15.0tn debt.
- **Shadow banking assets**: US$28.1tn (in 2010) to US$45.2tn (61%), not including US$2.8tn of private equity assets; shadow banking assets = 73% of global GDP.
- **Zombie companies**: the number of OECD zombie companies (those with an interest coverage ratio below 1) is at new post-GFC highs (548).

Electorates are already voting for War on Inequality policies and the 2020 US election is likely to be framed as Protectionist (Trump) vs Keynesian (Biden) vs Redistributionist (Sanders/Warren).

Policy actions will almost certainly involve higher US taxes in the 2020s; Occupy Silicon Valley policies to target tech profits, regulation of stock buybacks and a combination of rental price controls, living wages, and student debt forgiveness financed by wealth taxation. If necessary, governments are likely to issue debt (MMT) until inflation rises with infrastructure spending the big beneficiary.

![Exhibit 17: Global wealth has become far more concentrated](image)

Investment: real assets, currency debasement & inflation

Efforts to tackle the coming recession are likely to mean higher rates, lower earnings, or both as fiscal policy excesses (a large amount of borrowing and spending by governments to induce equality and inflation) stymies upside for asset prices. The secular contrarian would in coming quarters build a portfolio that anticipates less deflation and more inflation. We recommend:
**Hedging US monetary policy impotence** (as happened in Japan/Europe) via long gold and gold miners (US$ collapses and MMT discounted), monopolies such as utilities (pricing power), and the 30-year Treasury; accumulate upside optionality in small cap value stocks as monetary impotence leads to fiscal desperation.

**Hedging bond bubble popping** via gold (stores of value), T-bills, real assets (vs financial assets), high-quality banks (savings rise); note four recent bond crashes led to wider credit spreads, weaker stocks and strong currency in the region of the crash.

**Hedging equity deleveraging** via high-quality companies with oligopolistic pricing power in industries with low political risk should prosper in the next 18 months e.g. national defense, waste management, industrial gas, data processing and payments, global beverages; BofAML Best of Breed is a good source of stock ideas.
3. Quantitative Failure: post QE decade

Summary: Investors are increasingly concerned that more monetary policy alone will not bolster “animal spirits” or deliver meaningful reflation despite 768 interest rate cuts and >US$12tn in quantitative easing since 2009; banks are particularly at risk from negative interest rate policy (NIRP).

Exhibit 19: The 2020s will begin with the lowest interest rates in 5,000 years


Exhibit 20: Central Bank balance sheets and negative-yielding global bonds, $tn

Source: BofA Merrill Lynch Global Investment Strategy, Bloomberg

Exhibit 21: Themes, Trends and Strategy for Quantitative Failure

QUANTITATIVE FAILURE TRENDS
Fiscal Stimulus  Financial Repression
QE Infinity  Central Bank Impotence
Negative Bond Yields  Redistribution

QUANTITATIVE FAILURE STRATEGY & THEMES
Monetary -> Fiscal  Low Taxes -> High Taxes
Bank Deleverage -> Corporate Deleverage  Monetarism -> Keynesian
Deflation -> Inflation  Financial Assets -> Real Assets

Source: BofAML Global Research
**What is Quantitative Failure?**

Quantitative Failure, or monetary policy impotence, refers to diminishing returns from increasingly activist central banks & their use of monetary policies to reflate the economy. As our European Credit Strategist shows, a net 33% of credit investors say that central banks’ bare monetary cupboards is their biggest fear.

Since the Global Financial Crisis, central banks have pursued a series of extraordinary monetary policies to bolster inflation & growth: quantitative easing, yield curve controls, zero interest rate policies, negative interest rate policies and excess liquidity. The startling combination of 768 interest rate cuts (1 for every 4 trading days since Mar’09) and $12.4tn purchases has taken interest rates to 5,000 lows (Chart 2).

However, real GDP has averaged a meagre 2% in US, 1% in EU & Japan over past 10 years with inflation equally subdued. The excess supply of money has been outweighed by the 4 deflationary “Ds” of aging Demographics, excess Debt, bank Deleveraging, technological Disruption. Tempered “animal spirits” have also been compounded by a surplus of global savings glut relative to investment. Rather than stimulating reflation, monetary policy gains have been locked within the financial system driving inequality on Wall St. & Main St. This, in turn, is leading to concerns about recession, a bubble in bonds and the rise of populism – as addressed in prior sections.

**Chart 2: Interest rates since 3000BC**

![Chart 2](source: Bank of England, Global Financial Data, Homer and Sylla “A History of Interest Rates” (2005))

**Chart 3: Weak labor force growth has subdued inflation**

![Chart 3](source: BoA Merrill Lynch Global Investment Strategy, Bloomberg, EPFR Global, Haver)

**Pushing on a string**

We enter the 2020s with central banks already close to or below the zero bound; Fed Funds 175bp, ECB -50bp, BoJ -10bp. The risk is that, in trying to fight an economic slowdown, central banks either run up against their own political constraints and red lines, or start pursuing increasingly extreme measures that provoke counter-intuitive and counter-productive responses.

If central banks are “pushing on a string” monetary policy alone will not starve off recession risks or populism. Instead of easing financial conditions, central bank interest rate cuts will only compound issues. The Quantitative failure “tells” are interest rate cuts leading to higher bond yields, wider credit spreads, stronger domestic currencies and weaker equity markets. Likewise, extreme policies simply drive precautionary saving and defensive behaviour by economic agents.

**Banks and the perils of NIRP**

We already see evidence of Quantitative Failure in Europe and Japan. Households and corporates are saving more not less, debt is being repaid not utilised, and banks are tightening rather than easing lending standards.

Eurozone Banks, in particular, have suffered from the unintended consequences of negative interest rate policies (NIRP – Chart 4). NIRPs prevent banks from making
revenues on deposits and deposit income. Political and reputational risks also prevent banks from passing on these costs to retail customers. As a result, the more negative rates go, for longer, the less profitable and lower the ROE on Eurozone banks get. Note Eurozone banks are down 55% relative the MSCI ACWI since the ECB launched quantitative easing in the Eurozone.

**Chart 4: NIRP in Europe & Japan are hurting banks**

![Graph showing BoJ overnight call rate (starts Jul'85) and ECB deposit rate (RHS, starts Dec'01)](chart.png)

Source: BofA Merrill Lynch Global Investment Strategy, Bloomberg

NIRPs are a material risk to both Europe and Japan in the 2020s. If their banking sectors remain unprofitable then their financials-heavy equity indices will also stay stuck in bear markets. US banks are even more vulnerable if the Fed joins the ECB & BoJ. Erika Najarian’s US Banks team estimate more downside risk to EPS (64%) and stock prices (45%) in a negative rate scenario (with positive GDP growth) than even in a recessionary scenario.

**Trading Quantitative Failure**

Japan’s lost decades (1990s & 2000s) offer important guides for how financial assets behave if central banks are unable to reflate the economy...equities go up and down with bond yields in a fat trading range, FX becomes correlated with financials, inventory cycles drive rotations, quality & monopolies outperform & rate sensitives lose their sensitivity – see Chart 5.

Investors should also rotate into gold & real assets if the dollar leadership cracks. Meanwhile the more the debt universe becomes negative yielding (currently c. $13 trillion) the more likely it is we see another leg higher for bond “proxies” in the equity world (Chart 6).
Chart 6: Bond proxies moving in step with global negative yielding bonds

4. Demographics: the new consumer

**Summary:** The global population will increase by c.1bn people and the demographic mix will have changed tremendously by 2030. We are reaching “peak youth” with a rapidly ageing population globally, seeing Gen Z overtake Millennials as the largest generational cohort, and witnessing the emergence of the EM middle-class consumer in Asia. Furthermore, the new consumer’s preferences are shifting away from the old economy towards tech-compatibility, sustainability and experiences.

**Exhibit 22:** World population projections based on fertility rate variants

![World population projections chart](source: UN, Our World in Data)

**Exhibit 23:** Enter the Age Wave of the Silver Generation

![Age wave of the silver generation chart](source: UN DESA, Mapping World)

**Exhibit 24:** Themes, Trends and Strategy for Demographics

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<tr>
<th>DEMOGRAPHICS TRENDS</th>
<th>DEMOGRAPHICS STRATEGY &amp; THEMES</th>
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<tbody>
<tr>
<td>New Consumer</td>
<td>Old Media -&gt; New Media</td>
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<tr>
<td>She-conomy</td>
<td>Men -&gt; Women</td>
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<tr>
<td>Ageing Population</td>
<td>Goods -&gt; Experience</td>
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<td>EM Consumer</td>
<td>Real Sports -&gt; eSports</td>
</tr>
<tr>
<td>Millennials &amp; Gen Z</td>
<td>Single Use -&gt; Sustainability</td>
</tr>
<tr>
<td>Future Human</td>
<td>Retail Banking -&gt; Fintech</td>
</tr>
</tbody>
</table>

Source: BofAML Global Research
World population: 1 billion in 1800 vs 8.5 billion by 2030

In the year 1000 AD, the world population was 256 million people. In 1999, 1,000 years later, it was 6 billion. Today, the world population is 7.6 billion and is expected to grow to 8.5 billion by 2030, and to almost 10 billion by 2050. However, the two most important demographic trends for investors in the coming decade are: (1) a slowdown in the growth of the working population; and (2) rapid ageing of the global population.

Peak youth: more grandparents than children

In the 2020s, the world will experience “peak youth” for the first time in human history, with the number of persons aged 65+ expected to outnumber children under-5. From 1950 to 2015 under-5s have risen from 340 million to 670 million; those aged 65+ from 130 million to 610 million. By 2100, the UN expects the number of under-5s to remain flat at 650 million, but those aged 65+ to reach 2.5 billion.

Life expectancy increases: the “miracle” of our lifetime

Life expectancy is rising rapidly thanks to technology and better lifestyles, and has been one of the most remarkable demographic stories of the past century. The global average life expectancy has increased from 31Y in 1900 to 72Y today and is projected to reach 83Y by 2100E. The period between 2000 and 2016 saw the fastest increase in life expectancy since the 1960s (source: UN, WHO).

Ageing: enter the silver generation

In the next 10 days, 128,000 people will reach retirement age in the US, Europe and Japan. By 2050 there will be 2.1 billion people over 65, and just four workers for every retiree versus eight today. A key implication of an ageing population is that an economy’s savings rate tends to rise, while increases in investment levels tend to decline. The global pension savings gap is set to soar at 5% pa, from US$70tn in 2015 to US$400tn by 2050, driven by India, China, and the US. Japan’s ageing portends high savings and very low interest rates in the 2020s (according to OECD). ‘Unlike Japan,
Americans save via equities, making wealth management for "The Silver Generation" (600mn to 2.1bn from 2020-50) a key financial markets trend. Overall, the ageing of the population is encouraging saving rather than spending, which is deflationary rather than inflationary.

Exhibit 25: Deflationary Demographics

Future Human: immortal combat

"Immortality" may prove the most interesting secular theme in the 2020s. Life expectancy is rising rapidly thanks to technology and better. What’s more, it is not just about living longer, but also about living healthier with a better quality of life. We are entering an era of “healthceleration” where advances in technology could bring about a quantum leap in the quality and length of human lives. Innovations in genomics, big data & AI and “amortality” mean that living healthily past 100Y could become more common in the coming decades.

The next frontier in precision medicine will further extend life expectancy and quality. For instance, ageing has not traditionally been viewed as a disease that can be treated, but this trend is changing with more scientific breakthroughs. Hence, longer term, moonshot medicine could result in more radical life extension that “disrupts death” by tackling the hallmark pathways of ageing such as genomic instability, telomere attrition, cellular senescence among others.
Exhibit 26: Genomic-related data is growing more rapidly than other areas of ‘Techceleration’

Source: BofA Merrill Lynch Global Research

Chart 9: Increasing life expectancy but also making your extra years happier and healthier

Source: Life Biosciences

EM Consumer: rise of the middle class

For the first time since agriculture-based civilization began 10,000 years ago, the majority of humankind is no longer ‘poor’ – with the ‘middle class’ becoming the largest consumer group. Furthermore, roughly every second one person escapes extreme poverty, but more importantly five people enter the middle class (source: Homi Kharas, Brookings Institution).

The global middle class is the fastest-growing consumer group with 3.6bn people in 2018, rising to 5.3bn by 2030E. This implies 150mn new people are entering this cohort per year, of which almost 90% are expected to be found in Asia. This emerging middle class is set to expand faster in the next decade than at any other time in history. And by 2030, the spending power of the American middle class will remain the greatest in the world — at about US$16tn on a 2011 PPP basis — with China (US$14.1tn) and India (US$12.3tn) not far behind.

Households entering the middle class will seek to purchase consumer durables, e.g. refrigerators, washing machines, motorcycles, air-conditioning, as well as services including tourism, entertainment, health, education, and transport (source: World Data Lab, Homi Kharas, Brookings Institution).
Investment: Gen Z and the New Consumer (tech, sharing, experiences)

We believe our Demographics theme is the ultimate demand driver in a Transforming World and will profoundly impact the Consumer sectors over the next 10 years. However, consumers in each demographic cohort are as diverse as ever, meaning there is no silver bullet strategy to fulfil demand. Companies will need to adapt or face disruption from the emerging spending power not just of Millennials but also of new Gen Z consumers (e-commerce, same-day delivery). But there are also ‘untapped’ opportunities (Ageing Consumer – #1 cohort by spending power, but less than 5% of targeted ad dollars) as well as ‘structural’ opportunities (Bottom Billions Consumer – 3.6bn middle-class consumers today in 2018 growing to 5.3bn by 2030).

Exhibit 27: Demographic pyramids by generation around the world

Source: Euromonitor
**Technology Driven:** Regardless of their generation, consumers are leveraging new advances in shopping technology, e.g., online, voice assistants, same-day delivery, like never before. Millennials and Gen Z are well known for being tech savvy but 7/10 US Baby Boomers (aged 50+ now own a smartphone, using it to stay in touch with relatives and to shop (source: AARP). Furthermore, connecting the c.4bn people who are still offline is a structural opportunity (source: AARP, ITU).

**Exhibit 28:** The New Consumer: from technology to sustainability to experiences

[Diagram showing the new consumer with interconnected themes like Technology, Sustainability, Authenticity, Community, Lightweight, Thrift, and Experiences]

**Sustainability/Circular Economy:** In the latest BofAML proprietary sustainability survey (2,000 respondents; Staphos Survey), over 60% and over 50% of UK and US respondents, respectively, said that the environmental impact of a product’s packaging affected their purchasing decisions. Of those that were willing to pay more, the top choice in terms of how much more they were willing to pay for sustainably packaged goods was 5-10% for both the UK and US at over 30% of respondents. Further, in the UK, 40% of respondents backed the banning of products that could not be easily repurposed or recycled.

**Chart 12:** For those who would pay more, the maximum appears to be in the 5-10% range

[Bar chart showing the percentage of respondents willing to pay more for sustainably packaged goods, with US-July, US-Sept, and UK-Sept data points]

**Experience/Sharing Economy:** We have reached ‘peak stuff/ownership/consumption’ with £3.5/US$4.5tn worth of assets lying idle globally and 80% of belongings used just once a month (source: PeopleWhoShare). As a result, we believe this could be disruptive to traditional incumbents which benefit from “conspicuous consumption”. Furthermore, we believe Experiences is the key differentiator between the youth shoppers of today vs older consumers: 75% of Millennials prefer to spend money on an experience rather than a material possession (source: The People Who Share, Peerby, Eventbrite).
Chart 13: 'Peak stuff' - The dematerialization of consumption

US Personal Consumer Spending, 1959-2016

Source: US Bureau of Economic Analysis

Exhibit 29: Times are changing – China, once the bellwether of “making stuff”, has now shifted towards a service economy

Share of China’s nominal GDP

Source: China National Bureau of Statistics
5. Climate Change: make earth green again

Summary: We are reaching the inflection point in climate change, i.e., by the end of the decade humans could exhaust the remaining carbon budget for a two-thirds chance of remaining below 1.5°C warming. Global sea levels could increase further, economic damage from extreme weather will rise and the economic/political damage could result in climate-induced immigration, inequality and unemployment. At the same time the 2020s will be the decade of clean energy solutions and bold action could boost the global economy in a “make earth green again” (MEGA) strategy.

Exhibit 30: Historical Trends of Climate Change

Exhibit 31: Fossil Fuels vs Renewables

Exhibit 32: Themes, Trends and Strategy for Climate Change

Source: BofAML Global Research

Source: Perez & Perez, IEA 2015

Source: BofAML Global Research
No longer business as usual
Climate change is disrupting the way we live. Accelerating global warming means the past four years have been the hottest ever recorded and the 20 warmest years occurred over the past 22 years. More extreme weather episodes are leading to large-scale displacements; from 2008-15 more than 25mn people on average were internally displaced each year. Meanwhile, the global reliance on non-recyclable plastics is contributing to more than 8mn tons of plastic waste hitting our oceans each year, affecting fisheries and marine ecosystems (source: Ellen MacArthur).

Exhibit 33: Even with extreme net zero emissions by 2040, there is a positive likelihood of surpassing 1.5°C warming
IPCC modelled global warming scenarios
Global warming relative to 1850-1900 (°C)

Source: IPCC 2018 (Intergovernmental Panel on Climate Change)

The two biggest emitters are China (29%) and the US (14%), where the cost to the US economy is already estimated to be US$250bn per annum. Inequality of use and access to resources carry developmental implications too; Luxembourg’s ecological footprint is a startling 31x that of Eritrea’s (Source: Global Carbon Atlas).

Climate Action could be one of the biggest transformations to the global economic landscape, impacting current practices in multiple areas, such as energy, farming, transport and even globalization (local production can be much more environmentally friendly, for example). Bold climate action could yield a direct economic gain of US$26tn through to 2030E compared with business as usual (source: New Climate Economy). Regulations around emissions and waste are likely to become tougher – there are many signs of this, such as 100% renewable targets, carbon pricing laws, proposed ICE bans, higher city charges for polluting vehicles, airline emission taxes, etc.
**Exhibit 34: The World’s Carbon Footprint**

**Countries sized by their carbon emissions**

The decade for action

The UN predicts that the 2020s will be critical to limiting global warming to the 1.5°C pre-industrial level by 2030 — the temperature above which academics believe climate change will cause lasting environmental damage. A rise of just 4°C would be enough to submerge 600mn homes due to rising sea levels.

One market-based mechanism for reducing emissions is carbon pricing. More than 40 governments worldwide either directly tax fossil fuels or use cap-and-trade programmes with the value of carbon trading surpassing US$40bn in 2017. Such changes, e.g., new EU legislation tripling CO2 prices, incentivize energy intensive industries to embrace more sustainable long-term energy sources as renewables become more price competitive.
Efforts to curb global warming require behavioural and systemic changes that will provide substantial opportunities for investors. For example, New Climate Economy predicts bold climate action could yield a direct economic gain of US$26tn through to 2030 compared with business as usual. Tougher regulations around emissions and waste management as well as carbon targets will also change the way in which investment decisions are made.

BofAML estimates that the clean energy market is already worth US$300bn, while the global waste industry presents a US$2tn opportunity. Likewise, water infrastructure will need a minimum cumulative investment of US$7.5tn to 2030E to keep up with projected growth.

New technologies are also driving change within industries and investors. Big data and the rollout of 5G are likely to mean the communications industry is responsible for c.20% electricity use by 2025. A shift in corporate focus among these firms is helping to drive the pivot towards renewables.

This issue is being embraced by the new cohort of investors. Climate change is the #1 ESG issue for ESG asset managers, according to US SIF (The Forum for Sustainable and Responsible Investment), with US$3tn of ESG assets considering climate change as part of their investment decisions.

Exhibit 36: Top Specific ESG Criteria for Money Managers 2018

<table>
<thead>
<tr>
<th>Climate Change/Carbon</th>
<th>Tobacco</th>
<th>Conflict Risk (Terrorist or Repressive Regime)</th>
<th>Human Rights</th>
<th>Transparency and Anti-Corruption</th>
</tr>
</thead>
<tbody>
<tr>
<td>$3.00 Trillion</td>
<td>$2.89 Trillion</td>
<td>$2.26 Trillion</td>
<td>$2.22 Trillion</td>
<td>$2.22 Trillion</td>
</tr>
</tbody>
</table>

Source: US SIF Foundation
6. Splinternet: the race for technological supremacy and sovereign internets

Summary: We enter the 2020s with the technological rivalry between the US and China heating up i.e. “Splinternet”. There could potentially be a bifurcation in tech standards by the end of the decade driven by a divergence in the rules and standards of the superpowers (‘sovereign internets’). In the next decade, we continue to see the US and China competing in nextgen technologies like quantum computing, semiconductors, AI, 5G communication networks, cybersecurity and space that go well beyond manufacturing and trade issues. By 2030, China is expected to overtake the US and become the world leader in AI. Furthermore, China’s One Belt One Road project already spans 60+ countries with a total of 4.4bn people, covering 63% of the world’s population.

Exhibit 37: The largest trading partners for the US vs. China

Exhibit 38: Quantum Computing patent filings by country

Exhibit 39: Themes, Trends and Strategy for The Splinternet

SPLINTERNET TRENDS
Tech War
Defense/Cybersecurity
One Belt One Road

US Infrastructure
Trade War
Restoring

SPLINTERNET STRATEGY & THEMES
Global -> Local
US -> China
Defensive -> Cyclicals
AI -> Quantum Computing

DM -> EM
Privacy -> Surveillance
**US vs China: from trade war to tech war?**

We believe the current trade war will transition towards a tech war in the 2020s, which will see a new “arms race” between the US and China to reach national superiority in technology over the long term vis-a-vis Quantum Computing, Big Data, 5G, Artificial Intelligence, Electric Vehicles, Robotics, and Cybersecurity etc.

China’s strategy is to ensure that 40% of its mobile phone chips, 70% of its industrial robots and 80% of its renewable energy equipment is “Made in China” by 2025. This China First strategy will be met head-on by an America First strategy. The IMF forecasts military spending by the US and China to rise substantially in the coming decades to US$3tn and US$4tn, respectively. Global defense, tech & cybersecurity as “national security champions” should benefit over the next 10 years.

Moreover, the US tech sector could be inhibited by increasing “Occupy Silicon Valley” sentiment and regulation policies to address inequality. Revenue-rich tech is the most lightly regulated sector: just 27K US federal regulations, compared with 215K for manufacturing and 128K for the financial sector. And tech and e-commerce companies currently account for almost a quarter of all US corporate profits, a level rarely exceeded, and often associated with bubble peaks.

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**Exhibit 40: Innovation = China/US tech arms race**

**Exhibit 41: Tech has been among the least-regulated sectors**

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**Data Privacy: from big data to big brother**

**Table 1: Data & Privacy in China, the US and Europe**

<table>
<thead>
<tr>
<th></th>
<th>China</th>
<th>US</th>
<th>Europe</th>
</tr>
</thead>
<tbody>
<tr>
<td>Annual Mobile Data (Exabytes 2016)</td>
<td>11.8</td>
<td>16.1</td>
<td>8.8*</td>
</tr>
<tr>
<td>Annual Mobile Data CAGR to 2021</td>
<td>56%</td>
<td>35%</td>
<td>42%*</td>
</tr>
<tr>
<td>Connected people</td>
<td>772mn</td>
<td>292mn</td>
<td>705mn</td>
</tr>
<tr>
<td>Unconnected %</td>
<td>45%</td>
<td>11%</td>
<td>15%</td>
</tr>
<tr>
<td>Data policy</td>
<td>Data control</td>
<td>Data commercialisation</td>
<td>Data protection</td>
</tr>
<tr>
<td>Privacy concerns</td>
<td>Limited</td>
<td>Heightened</td>
<td>Heightened</td>
</tr>
</tbody>
</table>

Source: Internet World Stats, Cisco, Control Risks, World Bank, *Western Europe only
Diverging data trends mean that BAT (Baidu, Alibaba, and Tencent) may be better placed than FAANG (Facebook, Amazon, Apple, Netflix, and Google) to take advantage of AI and big data developments as key megatrends drive further potential growth in China. Just over half the population is connected in China but that is already nearly triple the number of internet users in the US, suggesting China’s annual mobile data traffic could grow 56% compared with 35% in the US (source: Internet World Stats, Cisco, World Bank). With favorable policies and government backing, China’s technology companies are likely to be better placed to take advantage of these data trends.

**Exhibit 42: China’s larger pie**

*Source: Abacus News 2018*

- **China has over 2.6x the internet users of the US and only 56% penetration.** With 772mn internet users, China has already overtaken the US and Europe with 287mn and 705mn, respectively, and has a significantly lower penetration rate of 56% (the US and Europe have 89% and 85%, respectively) (source: South China Morning Post, Internet World Stats). Consequently, the country has the opportunity to grow data through bringing half its population online.

- **China’s data volumes are also expanding above average** with 21.21bn GB of data traffic generated in just 11 months in 2017 and mobile internet access traffic increasing 158.2% yoy (source: CNNIC 2018). In comparison, Cisco estimates a 46% CAGR in global mobile data traffic to 2022 (source: Cisco 2018).

- **China’s first formal Cybersecurity Law** came into effect on 1 June 2017, banning the collection and sale of users’ personal information without permission. Companies will also need to store data on servers inside China with restrictions on the transfers of certain data of Chinese citizens out of the country by “key information infrastructure operators”, including banks, power companies, and others. Major multinationals believe this will give Chinese companies an unfair advantage as it prevents them from pooling client data in cloud storage centres across the world.

- **Seemingly less privacy-conscious in China** – Surveys in the US and Europe have reported higher privacy concerns – of 2,000 surveyed in the US in November 2017, 82% were concerned to some degree (source: GDMA 2018). China seems less affected by this issue. When questioned about the social credit system to collect data on all Chinese citizens, in an online survey of 2,200 citizens, 49% claimed to strongly approve of the system in 2018 (source: Genia Kostka, Freie Universitat Berlin 2018).

- **Favorable policies for all things technology** (big data, AI, internet of things, industry 4.0) have become priorities for the Chinese government. The country aims to
be at parity with the US in AI dominance by 2020, and the leader by 2030. Supportive governmental policies include the 13th Five Year Plan, Made in China 25, the Robotics Industry Development Plan, and the latest AI development plan to 2030E. In 2017, China surpassed the US in AI funding at the start-up level, taking in c.50% of all dollars invested globally, up from only 11% in 2016 (source: CBInsights 2018).

Exhibit 43: Share of Top 50% AI Papers published by country

Source: Medium, Semantic Scholar

Chart 14: Number of internet Users

Source: CNNIC, Eurostat, ITU, World Bank

Social Credit Score system case study
The Chinese government is implementing a “social credit” system, which would assign every citizen and company a score based on how they behave at work and in public venues, and their financial standing. This will go beyond the traditional financial credit scoring systems to enable extensive monitoring of the Chinese population and corporate world. This would help to determine which services individuals are entitled to, or what blacklists they might land on, or potentially affect companies’ ability to get subsidies and credit. The system will combine traditional sources of data, such as criminal history and engagement with government initiatives, with social inputs, such as jaywalking, as well as online activities, such as online contacts and buying too many video games. This could give China-focused companies a data advantage and propel them to the front of the Big Data and AI revolution, but it also has serious privacy implications.

Exhibit 44: The enterprise impact of China’s Social Credit System

Source: Mercator Institute for China Studies (MERICS)
Splinternet: decoupling the world into a dual tech system

Our Global Technology team believes that the Huawei incident has solidified China’s resolve and accelerated the process of reducing the reliance on US vendors. This seismic shift in the global supply chain seems structural, and we see a likely formation of a dual tech eco-system, one for China and one for rest of the world. As of 2018, China imported US$300bn+ of semiconductor products while producing US$24bn domestically. The 85% deficit poses significant risks to China.

Against this policy tailwind and advanced mobile internet/e-commerce backdrop, we expect Chinese chipmakers to focus on: (1) 5G, led by earlier adoption of the network; (2) artificial intelligence (AI) in both public and consumer markets; and (3) Internet-of-Things (IoT) given the favorable environment. High-performance computing chips from US vendors are still difficult to source domestically, but Chinese start-ups and internet platforms are pouring in resources aggressively.

Infrastructure – One Belt, One Road (OBOR)

- The 64+ countries are mostly EMs with a total population of 4.4bn or 63% of the global population, and accounting for 40% of the global economy (source: SCM)
- OBOR has also been dubbed the “21st Century Silk Road” and could be 12x larger than the US’s original Marshall Plan in absolute dollar terms
- China has initially committed c.US$1tn to financing the project but funding estimates range from US$4-8tn on a cumulative basis

The most important benefit of OBOR is not economic but political, i.e. closer ties with many countries important to China’s long-term security. China’s OBOR plan encompasses a variety of projects, including transport infrastructure projects in railway, highway, port, airport, as well as cooperation schemes in energy, power transmission and telecoms. China will encourage direct investment in OBOR regions, and incentivize Chinese companies to bid for overseas projects by providing political and financial support. The below are likely to be key beneficiaries of the OBOR strategy:

- Construction-related including contractors and building materials should benefit especially if investment surprises to the upside.
- Key equipment makers, including those for rail, power and telecom projects, but on a relatively more marginal level.
• **Port operators and shipping companies:** the seaborne route will likely progress more smoothly than the ground route, because the former is easier to arrange politically.

• **Defence** will likely be a big beneficiary as China needs to project power, especially Navy power, to protect its overseas interests.

• **Major banks:** if the Chinese government opts for the private sector to fund a significant portion of OBOR investment overseas, major banks may benefit from additional loan demand on the margin.

OBOR is not without risks and challenges, though. For example, the IMF has flagged the potential for unsustainable projects in countries that already have heavy debt burdens, e.g., Pakistan, where China was the largest lender in 2018, financing about a fifth of the country’s debt (source: CADTM). This could have a knock-on effect on the Chinese banking and financials sector, which helps fund these foreign projects, bearing the default risk, and is already struggling with issues pertaining to shadow banking.

**Exhibit 45: China’s One Belt, One Road**
Involves 60+ countries mostly EMs covering 63% of the global population. Countries combined generate total GDP of US$2.1tn equivalent to 29% of the global economy.
7. Moral Capitalism: stakeholders take over from shareholders

**Summary**: We enter the 2020s with capitalism focused purely on profit maximization on the cusp of reform – as it shifts away from shareholder supremacy towards greater involvement of stakeholders, i.e., moral capitalism. The 2020s will mark the key decade to meet the UN Sustainable Development Goals (SDGs) set for 2030, where we see ESG/impact investing, quantification of values and intangible assets disrupting the traditional investing approach.

**Chart 17**: ESG is important to Millennials and Women in their investment decisions
Percentage who agree on the importance of ESG in their investment process

<table>
<thead>
<tr>
<th></th>
<th>Millennials</th>
<th>Gen X</th>
<th>Boomers</th>
<th>Silent</th>
<th>Women</th>
<th>Men</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Percentage</strong></td>
<td>87%</td>
<td>65%</td>
<td>48%</td>
<td>39%</td>
<td>64%</td>
<td>46%</td>
</tr>
</tbody>
</table>

Source: BofA US Trust Survey 2018

**Exhibit 46**: United Nations’ Sustainable Development Goals (SDGs) for 2030

**Exhibit 47**: Themes, Trends and Strategy for Moral Capitalism

**MORAL CAPITALISM STRATEGY & THEMES**

<table>
<thead>
<tr>
<th>Profit Maximization</th>
<th>ESG Investing</th>
<th>Linear Economy</th>
<th>Circular Economy</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fossil Fuels</td>
<td>Clean Energy</td>
<td>Oil &amp; Gas</td>
<td>Stranded Assets</td>
</tr>
<tr>
<td>Shareholders</td>
<td>Stakeholders</td>
<td>Financial</td>
<td>Climate Accounting</td>
</tr>
</tbody>
</table>

Source: BofAML Global Research
Impact Investing

Millennials are more likely than older generations to believe that better performance is possible through impact investing (source: US Trust Wealth and Worth Survey 2018). For asset and wealth managers this suggests a growing need for ESG, thematic, socially responsible and ‘impact first’ solutions. We believe the trend towards thematic and ESG investing will intensify, once Generation Z comes of age and is embedded in the productive economy. Our US Equity and Quant Strategy team led by Savita Subramanian estimates that US$20tn of AuM will go into ESG strategies over the next 20 years – the size of the S&P.

The asset owner mix is changing – there is strong demand for investment decisions that consider thematic issues. This is especially true among Gen X and Gen Y (Millennials), who are increasingly becoming the swing factors in terms of new asset formation. Currently 4.4bn people in Generation Y and Z account for 59% of the world’s population and US$21tn of income, and they are focusing more on thematic investing. By 2020, Millennials will account for 16% of global private wealth.

87% of Millennials believe ESG factors/impact investing is important in their investment process (source: BofA US Trust Survey 2018). The majority of Millennials are driven by the belief that businesses should have ambitions beyond profit, with almost nine out of 10 (87%) believing that “the success of a business should be measured in terms of more than just its financial performance” (source: Deloitte 2016).

Exhibit 48: AuM of UN PRI signatories continue to rise in 2019

Task Force on Climate Financial Disclosures (TCFD)

In the 2020s, climate risk related ESG reporting will start to take shape. Signatories to the UN Principles for Responsible Investment (UN PRI) (over 2,450 investors) are required to comply with the Task Force on Climate-related Financial Disclosures (TCFD) from 2020. In addition, financial regulators across 34 markets met in April 2019 to push for prudential reporting on risk scenarios by member firms. We see TCFD as a catalyst for: (1) increased ESG disclosure on climate strategy, metrics, targets and risk scenarios; (2) debt and equity stakeholders working through potential exposures and mitigation (scope for de/re-rating); (3) growth in low carbon indices; and (4) abatement opportunities in green finance, renewables, storage and EVs.

Who bears the burden? +US$1tn of losses over five years: The CDP estimates US$970bn in losses from 215 Global500 companies within five years. The IEA estimates
US$850bn of stranded assets in Power and Energy sectors by 2030. Nearly a third of REIT property assets have exposure to flood, typhoons and rising sea levels. Plus the cost of doing business will increase as CO2 pricing normalizes at US$30-60/Gt.

**Sectors most impacted? Financials, Resources, REITs, Transport and Utilities:**
TCFD’s status report shows +50% of Banks, Consumer and Materials companies now disclose climate metrics and targets in ESG reports. Highlights from initial analysis:

**Banks:** 68% of exposure is indirectly through clients. UNEP initial scenarios assess probability of default in Utilities increases 2.2-2.3x and in Metals & Mining by 1.4-2.0x. Banks, incl. DBS, HSBC and Westpac now disclose exposure to “climate risk” sectors.

**Insurers:** Risks including higher claims and reinsurance premiums. DNB estimates higher claims by 2085. Travellers provides probability ranges and losses for catastrophes.

**Oil & Mining:** Impact from lower demand (30% cut)/oil prices and carbon price.

**REITs:** Climate risk impacts REITs with coastal exposure including across Japan, Hong Kong and Singapore. Buildings will need to cut CO2 emissions 80% by 2050.

**Transport:** Aurizon says global coal trade could decline by 33%. China Airlines highlights that the abnormal climate leads to flight cancellations. Toyota notes cost and demand risks from fuel consumption regulation.

**Utilities:** Electricity share to grow from 20% to 50% but 90% cut in emissions.

**Exhibit 49: Core elements of recommended climate risk disclosure**

![Diagram of core elements of recommended climate risk disclosure]

Source: Recommendations of the Task Force on Climate-related Financial Disclosures (2017)

**She-conomy: equality for women could boost global GDP by up to 31%**
According to the World Economic Forum, the overall global gender gap could close in 108 years for the 106 countries the report has covered since initiation. The most challenging gender gaps, economic and political empowerment, could even take 202 and 107 years, respectively. If current rates were to be maintained, the overall global gender gap would close in 61 years in Western Europe, 70 years in South Asia, 74 years in Latin America and the Caribbean, 124 years in Eastern Europe and Central Asia, 135 years in Sub-Saharan Africa, 153 years in the Middle East and North Africa, 171 years in East Asia and the Pacific, and 165 years in North America.
It is estimated that advancing women’s equality could boost global GDP by 31% or US$28tn by 2025, the size of US and China GDP combined. We see women driving the labor market, as well as the wealth management sector. By 2020 they are expected to hold US$72tn of the world’s financial assets, double the 2010 level and accumulating assets 1.5x faster than men. But there is still much to do. The economic gender gap is reducing at a snail’s pace and, all being equal, will not close for centuries – 202 years.

**Chart 19: Closing the global gender gap could deliver up to US$28tn of additional GDP in 2025**


Source: McKinsey

**Investment: UN Sustainable Development Goals (SDGs)**

The UN Sustainable Development Goals (SDGs) are a bold but achievable agenda towards the year 2030 with US$12tn per annum of benefits. The UN SDGs are a universal set of 17 goals, 169 targets and 304 indicators on how 193 member states’ governments, the private sector, and civil society can achieve the goals of ending poverty, protecting the planet, and ensuring prosperity for all as part of a new sustainable development agenda (source: UN). We – along with a growing body of investors – see the SDGs as a global roadmap for reducing inequality, opening up to US$12tn+ pa of market opportunities in four economic areas: food and agriculture, cities, energy and materials, and health and wellbeing, and creating 380mn new jobs by 2030E (source: BSDC 2017).
Exhibit 50: BoFAML themes by UN SDGs

Source: BofA Merrill Lynch Research, UN
8. Robots and Automation: rise of the AI machines

**Summary**: Up to 800 million, or 50%, of world jobs could be at risk of replacement through automation by 2030-35. The cost of industrial robots fell 27% from 2005-14 and is expected to decrease a further 22% by 2025E. On the flipside, the industrial robot market size is rising from US$38bn in 2016 to US$71bn by 2023E driven by robotic process automation (RPA), speed factories and other use-cases. We also enter the 2020s with underlying trends in Big Data & AI accelerating towards the exponential threshold of ‘technological singularity’.

**Exhibit 51: ‘Long Robots, Short Humans’**

[Graph showing the relationship between global industrial robots and civilian labor force growth]

Source: BoFAML Global Research, IFR, US BLS

**Exhibit 52: Moore’s Law/exponential growth in computing drives us towards AI singularity**

[Graph illustrating exponential growth of computing powers per 
\( \times 1000 \) dollars over time]

Source: Ray Kurzweil, The Singularity Is Near: When Humans Transcend Biology

**Exhibit 53: Themes, Trends and Strategy for Robots & Automation**

<table>
<thead>
<tr>
<th>ROBOTS &amp; AUTOMATION TRENDS</th>
<th>ROBOTS &amp; AUTOMATION STRATEGY &amp; THEMES</th>
</tr>
</thead>
<tbody>
<tr>
<td>Factory Automation</td>
<td>Global -&gt; Local</td>
</tr>
<tr>
<td>Demographics/Ageing Workforce</td>
<td>Slow -&gt; Nimble</td>
</tr>
<tr>
<td>Service Automation (AI)</td>
<td>Mass -&gt; Customised</td>
</tr>
<tr>
<td>Robotic Process Automation (RPA)</td>
<td>Humans -&gt; Robots</td>
</tr>
<tr>
<td>Speed Factories</td>
<td>Manual -&gt; Automated</td>
</tr>
<tr>
<td>Jobs/Immigration</td>
<td>Bricks &amp; Mortar -&gt; Digital</td>
</tr>
</tbody>
</table>

Source: BoFAML Global Research
Robots/Automation: from machines to cognitive thinkers

Robotics and automation are not new concepts and have been used in various applications for decades now, for example in manufacturing plants or in the office via software. But the next generation of robotics and automation could be even more transformative, putting up to 50% of jobs at risk by 2035 as well as transforming supply chains and economies. Better computing and artificial intelligence are driving improvements in many diverse areas such as optical sensing, machine vision, voice recognition, environmental sensors, motion actuators and touch/haptics that are set to take robots and automation to the next level, opening up new possibilities and job risks. Furthermore, demographic issues such as ageing and restrictions on immigration as well as trade tensions (trade wars, tariffs) also support a move towards more robots & automation.

- **Re-shoring**: possibility of re-shoring with automated factories would reshape trade
- **Autonomous vehicles (AV)**: could bring new business opportunity but also job risk
- **Artificial intelligence**: AI solutions could impact wide range of service jobs
- **Agricultural automation**: precision ag could impact chemical use and farm jobs

Industrial robots & speedfactories to change globalisation

Industrial robotics is advancing fast and, while fully automated factories are not always possible in every type of manufacturing, an increasing number of activities can be automated or products reconfigured for automated manufacturing. This trend diminishes the importance of manual labour and makes processes much more efficient. This shift could materially impact global supply chains, especially compared with the past few decades when cheap emerging market labor was the biggest driver of globalisation. Now, advanced industrial automation can enable local production, unintentionally playing into rising nationalism and trade protectionism themes but also helping to reduce environmental footprint.
A case study of Adidas’ speedfactory in Germany shows that it has managed to cut down the manufacturing time of its athletic footwear to days from months with automation, additive manufacturing (3D printing) and product redesign. Such speedfactories enable product customisation, local production, less inventory and faster product cycles adaptable to internet “trend shopping”. Speedfactories in local end-markets and in a single space are diametrically opposite to current production models (EM outsourcing, multiple global factories).

“We wanted to create the factory of the future. This should be representative of what all our factories are in five to 10 years from now.” – Gerd Manz, Head of Technology Innovation, Adidas Future Team.

**AI, Robotic Process Automation (RPA): Service jobs at risk**

While robotics and automation are typically associated with factories and industrial establishments, increasingly office and service sector tasks are being automated due to improvements in computing and software. From voice/text recognition to automated risk assessment, investing and medical imaging, many previously “human” tasks are being replaced by powerful software, some of which incorporates AI concepts like machine and deep learning, natural language processing, machine vision etc. Chatbots and voice assistants are well-known examples but, beyond these, new automation companies are deploying RPA or Robotic Process Automation, which aims to use software to replace a whole host of human activities in the office (e.g., automating the accounts payable process). RPA companies are growing fast from a low base and may not only put office jobs at risk but also change the dynamics of outsourcing vs reshoring. But, by freeing up time from routine tasks, RPA could also enhance the value of remaining jobs.
Exhibit 55: Robotic Process Automation (RPA) is the new automation drive that present risks (and opportunities) for service jobs

The number of industrial robots in use worldwide is set to grow from 2.25mn today to 20mn by 2030 – Oxford Economics

- The rise of Artificial Intelligence (AI): companies involved in AI and related process areas (RPA, NLP, enterprise software) could create significant value in the coming decade. The market size for AI analytics and technology could exceed US$110bn by 2024E (Source: BCG).

- Industrial robots helped by lower costs and better tech. As factories modernize in EM and wages rise (China 9x wage growth since 2000), the global industrial robot market is expected to rise from US$11bn in 2014 to US$24bn by 2025E (IFR, BCG).

- Autonomous vehicles opportunity with several auto companies, mobility providers and tech firms vying to develop this technology and new AV business models.

- Aerospace & Defence: Unmanned automated vehicles (UAVs, drones) expenditure rose 10x 2000-16 to US$3bn and military robots (10% CAGR, US$14bn market by 2020) are the opportunities due to safety, flexibility and cost benefits (Source: BCG).

- Financial services are deploying robots & AI, e.g. robo-advisors, analytics, automated trading, fraud detection and credit risk checking.

- Healthcare: deploying medical robots (accounting for 35% of professional services robots) and computer-assisted surgery. Telehealth and algorithms, care-bots, and bionics all offer significant robot & AI opportunities.

- Service Robots perform services useful to the wellbeing of humans, assisting with jobs or chores. Growth will be driven by convenience and an ageing population.

- Agriculture & Mining are also seeing automation due to labor shortages and large scale operations suitable for automation, e.g. driverless tractors/trucks, milkbots.

Exhibit 56: Investment Entry Points - Robots & Automation

<table>
<thead>
<tr>
<th>Industrial Robots (e.g. robots, optics, software, Industry 4.0)</th>
<th>Process Automation (e.g. RPA, enterprise software)</th>
<th>Artificial Intelligence (e.g. cloud, semiconductors, cybersecurity, analytics)</th>
<th>Autonomous (e.g. autonomous vehicle tech or machines, drones)</th>
<th>Other Automation (e.g medical imaging, precision ag)</th>
</tr>
</thead>
</table>

Source: BoFAML Global Research
9. Smart Everything: ubiquitous connectivity & death of privacy

**Summary:** We enter the 2020s with only 30bn devices connected to the internet, but this figure could grow to 500bn by 2030 driven by the growth of smart cities which includes future mobility, energy, 5G, IoT among others. Urban areas already generate 85% of global economic activity but this is set to rise further from US$62tn in 2015 to US$115tn by 2030E (Source: OECD World Bank). Rising urbanization in the 2020s (>1bn urban population added by 2030 vs 2015) means that problems inside cities will be magnified. However, new solutions such as smart mobility, smart buildings, big data solutions, infrastructure and communications will be key in improving urban life.

**Exhibit 57: Smart Cities**

![Smart Cities Diagram](source)

**Exhibit 58: Themes, Trends and Strategy for Smart Everything**

<table>
<thead>
<tr>
<th>SMART EVERYTHING TRENDS</th>
<th>SMART EVERYTHING STRATEGY &amp; THEMES</th>
</tr>
</thead>
<tbody>
<tr>
<td>Smart Cities</td>
<td>Dumb -&gt; Smart</td>
</tr>
<tr>
<td>Urbanization</td>
<td>Privacy -&gt; Big Brother</td>
</tr>
<tr>
<td>Nextgen Infrastructure</td>
<td>Analog -&gt; Connectivity</td>
</tr>
<tr>
<td></td>
<td>4G -&gt; 5G/6G</td>
</tr>
<tr>
<td></td>
<td>Data Silos -&gt; Big Data &amp; AI</td>
</tr>
<tr>
<td></td>
<td>Legacy Autos -&gt; Future Mobility</td>
</tr>
</tbody>
</table>

**Source:** BofAML Global Research

**Chart 22: Urbanization over the past 500 years**

![Urbanization Chart](Source: UN DESA)
The “Datafication” of Everything

By the end of the decade we will have 500bn connectable devices vs. “only” 30bn today (source: Cisco). By 2030, autonomous vehicles (AVs) could generate more data than the earth’s entire population does today. And one smart city will generate even more data than all the AVs combined. 3 billion more people will go online and we will interact with an online device every 18 seconds by the middle of the decade - compared to 6.5 mins today. New technologies are needed to meet demographic, economic, environmental, social, and infrastructure challenges. These include ubiquitous broadband (84% globally); nextgen infrastructure (5G up to 100x faster vs 4G); the Internet of Things (IoT) (500bn connected devices by 2030E); Big Data (175 zettabytes of data worldwide by 2025 per IDC); cloud (secure, accessible), autonomous vehicles (fewer accidents) and artificial intelligence (predictive insights, anticipatory actions). Smart Cities can achieve 30% lower energy use and crime, 20% lower traffic delays and water loss.

Cities will drive some of the major 2020 transformations

The shift from a 55% to a 70% urbanised world over 2016-50E will result in growing wealth creation, already at 84% of global GDP. However, >80% of global cities are showing fragility, or already at tipping point with several issues needing smart solutions: (1) poor governance and weak institutions; (2) inadequate infrastructure (US$78tn required in next 10 years); (3) rising inequality (75% of cities are worse off than 20Y ago); (4) housing (1bn new homes needed); (5) crime; (6) environmental challenges (cities use c.75% of natural resources and air quality is worsening); and (7) new and pervasive risks (e.g., cybersecurity, terrorism, security, disease, and pandemics).

Among the biggest ecosystems for investors

The smart city theme, by virtue of its broad definition and many sub-themes, represents one of the biggest investible universes. Zion Market Research sees the global smart city market at c.US$1.0tn in 2017 and expects it to reach US$2.7tn by 2024, growing at c.16% CAGR in 2018-24. Mordon Intelligence values the smart cities market at US$0.5tn in 2018 and expects it to grow to US$1.45tn by 2024 (c.18% 2019-24 CAGR).

But at the cost of “peak privacy”?

There are three key trends will that will determine whether innovation wins over privacy:
1) The Connected World which is expanding but more importantly is already in place and integrated into society making it difficult to retreat – 43% of the global population are already mobile internet users. 2) The Privacy Paradox means that consumers are unlikely to reduce their interactions with business services as they choose convenience over any privacy concerns (79% of 1,500 US consumers surveyed stated that they were willing to give up personal data for ‘clear personal benefits’). This is particularly prevalent in younger generations with 62% of millennials willing to give up third party data for
cheaper premiums (vs. 44% of the total population) (source: GSMA 2018, Deloitte 2016, Salesforce.com 2018). 3) Consequently, legislation is the only driver aiming to protect privacy and improve data governance. As a result, while we do expect privacy to impact companies in the short run, as regulation increases the risks from data misuse that impacts profitability.

Exhibit 61: Smart city digital ecosystem components

Smart Six: Infra, buildings, homes, safety, energy, mobility

- **Smart Infrastructure:** Smart infrastructure investments can transform traditional infrastructure. The global smart city ICT infrastructure market is projected to reach US$1.7tn by 2025E, 17.5% CAGR vs. 2017 (source: Verified Market Intelligence).

- **Buildings:** We spend 90% of our time in buildings which account for c.40% of energy, 25% of water, and 40% of resource use, and a third of GHG emissions. However, just 10% of US buildings have basic smart technologies (e.g. efficient lighting or monitoring). The global smart building market is to grow from US$61bn in 2019 to US$106bn by 2024E (source: MarketsandMarkets, 11.7% CAGR).

- **Smart homes:** Smart Home devices can control, automate and optimize household functions like lighting, heating, cooling, entertainment, safety and voice assistants. The global market for Smart Homes is projected to grow to US$405bn by 2030E, at a 25% CAGR from US$14bn in 2015 (source: AT Kearney).

- **Smart Safety & Security:** Smart Cities are integrating an increasing number of ICT-enabled devices and measures to improve safety and security. The Safe City market will see US$226bn in revenues in 2015-21E with opportunities in CCTV, incident detection, adaptive lighting, emergency alerts, environmental monitoring, disease surveillance, epidemic monitoring, and smart/assisted care.

- **Smart Energy:** Smart Grids – digitalized and connected electrical grid comprising cleantech – could grow to US$169bn by 2025E (Source: Allied Market Research, 12.4% 2018-25 CAGR). New global investments in zero carbon electricity generation capacity are expected to be US$3.8tn cumulative in 2021-30 vs.
US$656bn for fossil only (Source: BNEF NEO 2019). Solar/Wind power, smart meters, and electric vehicles could all be key catalysts for smart energy take-up.

- **Smart Mobility:** The US$7tn mobility market is inefficient, expensive, and highly polluting (>20% of global emissions). A shift towards Mobility as a Service is a viable option to city car usage while digital capabilities (sensor data, diagnostics, analytics) can help improve efficiency and reduce costs (accidents, repairs).

**Investments: Most impactful smart cities technologies**

- **5G networks to transform connectivity:** 5G networks offer much higher data speeds, bandwidth and reduced latency vs. current 4G networks. 5G mobile handsets are arriving despite networks not ready yet. Once 5G is properly deployed in 4-5 years, new services such as autonomous vehicles, IoT and delivery drones can become feasible. There could be major transitions in some services (e.g. broadband + TV on cable) due to other transformations such as streaming TV/gaming explosion.

- **Urban transport transformation - electric, shared, public:** The biggest shifts in urban transport and mobility will be in the next decade. Electric cars to gain share vs gasoline cars in the 2020s. Ride hailing to be much more disruptive due to electric vehicles (lower running costs) and regulation (city fossil bans, private car restrictions, emission taxes). Micro mobility (cycles, scooters) and multi-modal mobility (different transport modes for one journey) could mean redesign of cities (cycle lanes, pedestrian zones, traffic lights, sensors etc). Major transitions for sectors such as autos, oil & gas, construction, semiconductors and software.

- **Circular, efficient and clean economy:** Circular economy will be a key focus for cities – plastic regulation (e.g. charges, bans), biodegradable packaging and waste reduction. Corporates will have to consider circular economy – e.g. electric vehicle manufacturers will have to focus on battery recycling too. Sustainable packaging could be a big theme in the 2020s as will be local production (e.g. vertical farming, speed factories). Sensors & analytics to boost energy efficiency and many major cities want high renewable energy share, e.g. New York drove US offshore wind.

- **Internet of Things (IoT) boosts data economy:** Sensor and IoT deployment is mostly in cities, opening major opportunities for semiconductor, sensor and software suppliers. For example, the expansion of the London Ultra Low Emission Zone for polluting vehicles will require cameras/sensors and software services. The smart cities theme could become one the biggest drivers of Big Data & AI growth in the 2020s. These new services would increase demand for cloud computing & AI.

- **Public spending surge:** Stagnating growth (esp. in the western world) and concerns about climate change impacts could lead to major fiscal spending to upgrade city infrastructure around the world. While monetary policy has been very supportive in the past decade, there has not yet been a major upgrade in spend and now the rising focus is on fiscal spending, especially in infrastructure, which could be a secular trend in the 2020s. And it is likely such spend will be directed towards smarter technologies, which can transform the urban landscape, e.g. much more public transport, futuristic concepts like Hyperloop and net zero emissions buildings.

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**Exhibit 62: Investment Entry Points - Smart Cities**

<table>
<thead>
<tr>
<th>Communications</th>
<th>Infrastructure</th>
<th>Internet of Things</th>
<th>Environment</th>
<th>Smart Mobility</th>
</tr>
</thead>
<tbody>
<tr>
<td>(e.g. 5G, cell towers, fibre optics)</td>
<td>(e.g. grids, toll roads, construction)</td>
<td>(e.g. sensors, semis, software, cloud)</td>
<td>(e.g. circular economy, efficiency, clean energy)</td>
<td>(e.g ride hailing, electric vehicles, charging, trains)</td>
</tr>
</tbody>
</table>

Source: BofAML Global Research
10. Space: final frontier of exploration

**Summary:** We enter the 2020s on the cusp of a new space age as commercialization by private companies enables humanity’s lift-off from Earth. While only 560+ people have ever been to space vs. a 7bn+ global population, we believe the 2020s will be the decade of space democratization with new technologies. Government spending on space is expected to reach $79bn by 2025 vs $62bn in 2016 and the space market opportunity involving nanosatellites, space tourism etc. could reach nearly $1tn by 2030 (source: OECD, ULA).

**Exhibit 63: Sub-orbital space tourism illustrations**

Source: FAA, Tauri Group

**Exhibit 64: Themes, Trends and Strategy for Space**

**SPACE TRENDS**

Nanosatellites & Miniaturisation  
Reusable Rockets  
Megaconstellations  
Space Tourism  
Private Commercialisation  
Extra Terrestrial Objects

**SPACE STRATEGY & THEMES**

Geostationary Orbit -> Low Earth Orbit  
Singular Launch -> Reusable Launch  
Astronauts -> Space Tourists  
Big Satellites -> Small Satellites  
Government -> Private  
Earth -> Moon

Source: BofAML Global Research
A radical new space age in the 2020s

In the next decade, we enter a completely new and radical space age that could far exceed the 1960s missions to the Moon. New technology (reusable rockets), innovative speedy private companies, miniaturisation of electronics and new services (internet from space, space tourism) could revolutionize space like never before. In the 2020s, large privately built rockets and shuttles could send humans back to the moon (only 24 people have visited the Moon, with the last one flying in 1972) and even put humans on Mars (Space X’s ambitious Mars targets: cargo 2022, cargo & crew 2024). Longer term, new space technologies could boost innovation just like the Moon missions did for computing. Nearer term, nanosatellites could deliver worldwide broadband to >40% of humanity not yet connected to the internet as well as accelerate 5G networks and new services. With more countries and corporates getting involved in space/satellites due lower costs and more functionality, the next decade is set to be the most exciting ever for space.

Space Age 2.0: privatization of space

- **Privatization of space:** Historically driven by governments, many private enterprises have started providing space services to governments and developing radical new technologies. Private companies benefit from focused leaders, less bureaucracy, commercial acumen and blank slate design.

- **Billionaires’ playground:** This new era of private space technology development is being driven by billionaires, most notably Elon Musk and Jeff Bezos. Sixteen of the world’s 500 billionaires have space investments, which could grow from a US$360bn market today, to potentially as big as US$2.7tn by 2045E (source: ULA).

- **Costs fall due to new technologies:** Due to reusable rockets, cost of space launches could fall by a factor of 100 (cf SpaceX, Blue Origin, Virgin Galactic, etc.). Much bigger rockets, such as Falcon Heavy and Starship (in the future) can cut costs further. Intercity travel using rocket technology could also become effective.

- **Wider support:** Space Age 2.0 also benefits from the involvement of many new countries (80+ countries with satellites in orbit), falling launch costs (Rocket Lab US$5mn), rising start-up investments (US$16bn since 2000, US$2.8bn in 2016) and a more favorable policy backdrop (various countries pushing for space tech).

Exhibit 65: Space Age 2.0 in a nutshell

Exhibit 66: Reusable rockets helping reduce costs dramatically

Reusable rockets – technological leap, huge cost reduction

- **Reusable rockets game changer:** Reusable rockets reduce rocket launch costs by an order of magnitude. One-time use rockets were too expensive for wider use as the first stages of rockets are expensive relative to the fuel costs. Recovery and reuse of rockets can significantly reduce costs per launch.
• **Private companies delivering innovation:** SpaceX landed a reusable rocket on land in Dec-15 and then on a drone ship in Apr-16. SpaceX first reused a recovered rocket and landed it back in Mar-17. The space company Blue Origin was the first to launch and recover a rocket in Nov-15.

• **Costs down dramatically and to fall further:** The Saturn V, which took man to the moon in 1969, cost almost US$2bn in 2018 dollars vs. US$95m for SpaceX’s Falcon Heavy launch in 2018 (source: The Guardian). This implies >90% cost reduction in real terms since the moon missions, with more savings to come due to reusability.

**Exhibit 67: Nanosatellite networks to transform connectivity**

**Exhibit 68: Intercity rocket travel on the horizon**

**Nanosatellites can transform communications & business**

• **Space has already been transformative:** Space technologies, especially satellites, have already greatly benefited humanity in communications (video/voice calls), entertainment (TV), inflight WiFi, weather monitoring, crop monitoring, climate change research and mapping (SatNav/GPS), among many other use cases.

**Exhibit 69: Cislunar-1000 Economy Vision Timeline (2015-45E)**

Source: ULA
Nanosatellites could win by sheer numbers: Nextgen nanosatellites could be transformative due to their sheer numbers. Nanosatellites can weigh only a few kgs, helped by miniaturization of electronics. Small size and falling launch costs can allow thousands of nanosatellites to be launched into low orbit. Planned launches of nanosatellites would dwarf the current c5000 satellites in orbit (targets: SpaceX’s Starlink 12,000 nanosatellites, OneWeb 600-700 and Amazon >3,000). Nanosatellite webs can link the whole world, enabling fast connectivity even in remote areas.

- Potential for disruption: Nanosatellite constellations may enhance current networks but also disrupt them. Worldwide satellite networks could bring many more people into the connected world and unlock many services like mapping, surveillance, autonomous cars and yet unknown services.

Space tourism for rich but intercity rocket travel promised

- Space tourism for the rich: Taking tourists into space is already close to reality. SpaceX has already agreed to take Japanese billionaire Yusaku Maezawa on the first space tourist trip to the moon with the mission expected in 2023 (Mr Maezawa plans to take 6-8 artists with him.) Seven people have paid to go to space before (e.g. to the International Space Station) but no space tourist has flown since 2009. This is seemingly about to change with several companies including SpaceX, Blue Origin and Virgin Galactic close to offering space tourism, having already successfully demonstrated their rocket capabilities over multiple launches and recovery. Space tourism, however, would be confined to the rich till costs fall.

- Intercity space flights could be more transformative: Launch of commercial intercity travel via space could open up major opportunities, dependent on cost reduction. If 10-12-hour long-haul flying times between global cities could be cut to 2-3 hours, there could be a market for such services, especially at the high end bracket. If costs fall enough to compete with current (profitable) business travel, there could be disruption for the airlines industry.

Investment: space technologies most impactful for 2020s

The first phase of nanosatellite network deployment is expected before 2025, which would not only help with the learning curve but also allow new services to be launched, some of which could become disruptive and widely embraced. Nanosatellites could also lead to significant increases in surveillance capabilities and therefore inhibit privacy further, becoming a political issue. Major improvements in intercity space travel could open up the long-haul business trip market for disruption and influence globalisation.

Exhibit 70: Investment Entry Points – Space

<table>
<thead>
<tr>
<th>Satellites</th>
<th>Aerospace</th>
<th>Surveillance</th>
<th>Private Space companies</th>
<th>Space Insurance (in future)</th>
</tr>
</thead>
</table>

Source: BofAML Global Research
Disclosures

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Investment rating | Total return expectation (within 12-month period of date of initial rating) | Ratings dispersion guidelines for coverage cluster*
---|---|---
Buy | ≥ 10% | ≤ 10%
Neutral | ≥ 0% | ≤ 5%
Underperform | N/A | ≥ 20%

* Ratings dispersions may vary from time to time where BofA Merrill Lynch Research believes it better reflects the investment prospects of stocks in a Coverage Cluster.

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