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Thematic Investing

The World in 2030

Thematic Investing

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Key takeaways

- 2020-25 was a macro world of QE, GDP booms and inflation shocks but 2025-30 will be the era of micro themes
- What's next? Tech transformation with a backdrop of resource bottlenecks, generational shifts & return of fiscal discipline
- From AI to geopolitics, from demographic trends to populism, 10 themes will shape our world in the years up to 2030

Acronyms:

ABB = Anything but Bonds

QE = Quantitative Easing

AI = Artificial Intelligence

From macro to micro, from QE to AI

The 2020s kicked off with interest rates at 5,000-year lows. The second half of the 2020s begins with equity, crypto & gold at record highs, bond yields at 15-year highs, "US exceptionalism" globally accepted, and the onset of one of the most transformative technological revolutions in human history. We think micro themes will dominate macro in the coming 5 years: tech transforming our economy against a backdrop of populism, AI resource bottlenecks, generational shifts in power and wealth, and a return of government fiscal discipline.

10 themes for the next 5 years

1. **"Technology is eating the world"**: Agentic AI + Reasoning + Rich Simulations + Embodied AI = Industry 6.0 which is minimizing human intervention.
2. **Peak Monopoly:** Dominance of the "Magnificent 7" peaks as AI benefits broaden & politics pressures mega-caps via taxation and regulation.
3. **Digital Insecurity**: Ending the decade with the "death" of privacy, job market disruption, 10 deepfakes for every person on the planet and cybercrime as the 3rd largest GDP in the world.
4. **More!** Exponential growth of tech requiring more resources like infrastructure, compute, bandwidth, human capital, energy, water, skills and data centres.
5. **Rebuilding Everything**: US$94tn of funding needed by 2040 to rebuild ageing assets and expand the infrastructure supporting tech.
6. **The End of "ABB":** Self-driven or market-imposed, era of government fiscal excess ends, reversing the primal "Anything but Bonds" theme in asset markets.
7. **Populism:** "incumbents" were voted out in 26 of 32 elections in '24...populism means less globalization, immigration, and central bank independence.
8. **War & Peace:** Protectionism to continue; but "forever wars" set to end & America First policies to spur Asian & European stimulus & reform.
9. **Rise of the Zoomers...and Boomers!** US Boomers' net wealth = c.80% of world GDP. In 2030, over-65s and Gen Zs could spend c.US$28tn combined.
10. **Health The New Wealth**: 10mn global health worker shortage by 2030. Ageing population stretching resources. solution - Infusion of technology in biology.

Did you know?

In **2025**, there will be more silicon transistors on the planet than human cells.[1]

In **2025**, the costs of cybercrime are set to hit US$10.5tn, making it the world's 3rd largest 'economy'.[2]

In **2025**, narrow quantum advantage could be achieved.[3]

By **2026**, data centres will consume more energy than Japan.[4]

By **2026**, 30% of large companies will have publicly shared their cyber goals (vs less than 2% in 2021).[5]

By **2027**, global coal demand will plateau.[6]

By **2028**, the global wellness market could reach c.US$9tn, almost equal to the GDP of Japan + Germany + Switzerland.[7]

By **2030**, cars could have c.300mn lines of code. A modern fighter jet has only about 25mn lines.[8]

By **2030**, the Gen Z population could reach 2.6bn, making it as large as the current total population of China, the US, Indonesia, Pakistan and Nigeria combined.[9]

By **2030**, the land required for all the public data centres in the world will be larger than Singapore.[10]

By **2030**, globally, over-65s could spend almost US$15tn a year - that's almost the size of China's current GDP.[11]

By **2030**, we could reach a population tipping point. Global fertility could go below replacement rates, and 1 out of 6 people in the world will be over 60 years old.[12]

By **2040**, Gen Z's total income could be US$74tn, roughly 3x current US GDP.[13]

Sources: [1] Quantum Motion, Intel; [2] Cybersecurity Ventures, World Bank, UN; [3] SEEQC; [4] IEA; [5] Gartner; [6] IEA; [7] Global Wellness Institute, World Bank, UN; [8] McKinsey, Roland Berger; [9] BofA Global Research, Worldometer, UN; [10] ABI Research, Worldometer; [11] Ageing Analytics Agency, Brookings, World Bank and UN data; [12] IHME, WHO; [13] BofA Global Research, Euromonitor, World Bank, UN

10 themes for the next 5 years

Exhibit 1: Illustrating 10 themes for the next 5 years
What's next?

"Technology is eating the world"
Peak Monopoly
Digital Insecurity
More!
Rebuilding Everything
The End of "ABB"
Populism
War & Peace
Rise of the Zoomers... and Boomers!
Health The New Wealth
2030

Source: BofA Global Research
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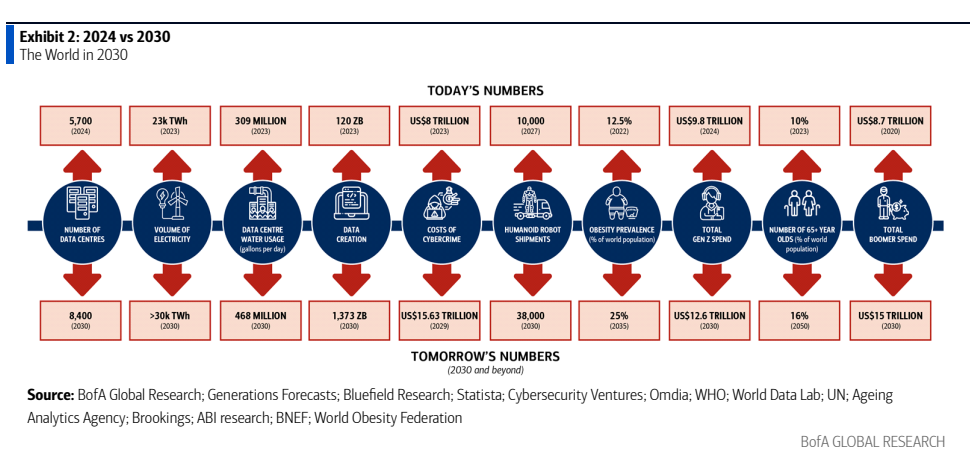
2024 vs 2030. Who will benefit?

Exhibit 2: 2024 vs 2030
The World in 2030



Source: BofA Global Research; Generations Forecasts; Bluefield Research; Statista; Cybersecurity Ventures; Omdia; WHO; World Data Lab; UN; Ageing Analytics Agency; Brookings; ABI research; BNEF; World Obesity Federation
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Exhibit 3: Beneficiaries of the 10 themes over the next 5 years
Analysing the beneficiaries from our 10 themes

Theme	Beneficiaries
"Technology is eating the world"	Tech Hardware, Semis, Telecom Equipment, Cloud
Peak Monopoly	Equal-weighted equity indices, Value stocks, International stocks
Digital Insecurity	Cybersecurity, Cyber Insurance
More!	Semis, Tech Hardware, Data Centres, Energy, Grid Tech, Energy Storage, Communications Networks, Utilities, Mining
Rebuilding Everything	Infrastructure, Materials, Industrials, Automation, Utilities, Building Products, Construction, Transportation
The End of "ABB"	Bonds, REITs, Commercial Real Estate, Small Cap stocks, Emerging Markets, Banks
Populism	TIPs, Gold, Crypto, Main Street Consumer stocks, European & Asian Defence stocks
War & Peace	Commodities, China & European equities, Space Exploration
Rise of the Zoomers... and Boomers!	**Ageing:** Healthcare (Hearing Aids, Dental Care, Vision Care, Biotech, Pharma, Genomics), Aged Care & Healthcare REITs, Financials (Life Insurance, Asset Management), Consumer (Travel, Beauty, Leisure)
	Gen Z: New Media, Big Tech, Consumer (Luxury, Leisure, eCommerce, Wellness, Beauty, Pets, Gaming), EdTech, Fintech
Health The New Wealth	Pharma/Biotech, Consumer (Nutrition, Beauty, Sports)

Source: BofA Global Research. NOTE: REITs = real estate investment trust. CRE = commercial real estate. TIPs = Treasury inflation-protected securities
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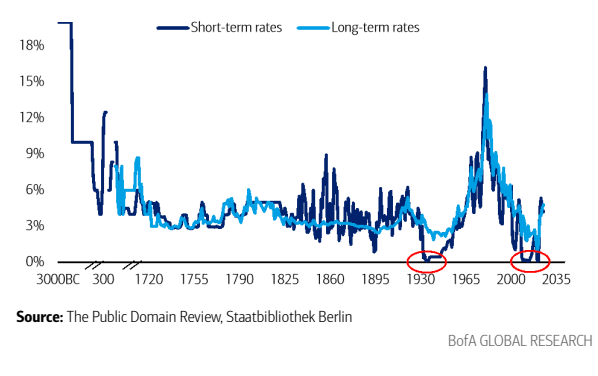
"Macro" to "Micro" in the next 5 years

The last 5 years: a very macro world

The first half of the 2020s started with a global pandemic that forced 4.5bn people into lockdown, historical QE (Quantitative Easing) in a US$30tn policy response from governments and central banks, a nominal GDP boom (US nominal GDP up 50% in the past 5 years), an inflation shock (>10% inflation for 2bn people), and a rates shock (0% to 5% rise in bond yields), alongside war (Russia/Ukraine/Israel/Hamas) and the emergence of AI. This all translated into 563 rate hikes, US$7tn in quantitative tightening, US$11tn in cumulative US deficit, US$36tn of US national debt, and US$1.2tn in US annual interest payments.

But the biggest change in asset prices is unarguably the secular inflection in bond yields, ending a 40-year bond bull market and ushering in the 3rd Great Bond Bear Market of the past 240 years. The return of 10-year US Treasury yields to their long-term average from a 5000-year low hit in March 2020 (Exhibit 4) has led to frequent booms and busts in asset prices, with the former more concentrated than the latter. Ultimately, macro has dominated over the past five years.

Exhibit 4: Interest rates since 3000BC
The biggest change of the 2020s so far...bond bear market



Source: The Public Domain Review, Staatbibliothek Berlin
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The next 5 years: the era of *micro*

The next five years will see micro developments take centre stage, as the pace of technological disruption accelerates amid widespread adoption of AI in businesses and societies.

Productivity growth will have to rise in turn, to justify expensive tech sector equity valuations and prices (US tech stocks hit a 100-year high relative to the rest of the US equity market last year). Any detrimental impact on employment will be met by greater regulation and taxation as populist-led governments shield their electorates. Moreover, powering AI and ensuring productive implementation in every aspect of our lives will require more of everything - from resources to infrastructure - and a significant improvement of existing assets.

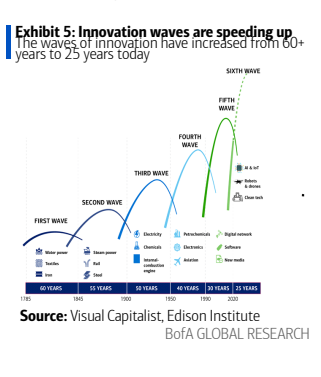
These huge funding requirements could not come at a less opportune time: record government debt and populist policies will prioritize breaking the inflation cycle in the US and reviving stagnant growth at the heart of Europe (Germany). Consequently, AI as a major technological/economic/social disruptor will face backlashes throughout the rest of this decade. Ultimately the *Zoomers* will have a major say in the government response and the extent to which AI disrupts our societies and the labour market, as well as how government debt is managed.

The years of exponentiation

Mega-trends and themes are transforming markets and businesses as never before, and we're only just getting started. The exponential growth of data (doubling every 2-3Y), cheapening computing power (Moore's law reincarnated) and the rise of a connected world (IoT, mobile devices, social media) will bring about the fastest transformation in human history. And the rate of change will accelerate even further from here due to 'techtanglement' - the interconnectedness of technologies. For example, AI also relates to e.g., robots, simulation and communications. These connections and interactions of technologies create a feedback loop. As AI-enabled products offer better capabilities, as AI is used as a tool for fuelling more innovation and as it creates demand to improve existing technologies, our world becomes ever more infused in this AI era.

Widespread adoption of AI is expected to lift productivity growth by creating a virtuous cycle of innovation at the heart of an era of *exponentiation*. Per our US Software team's report 'AI Revolution: A Polymath in Every Pocket', GenAI may catalyse a revolution in corporate efficiency that boosts S&P operating margins by 200bps (US$55bn) over the next 5 years. Per the BofA Research Investment Committee team, 'Transformational AI' can drive productivity growth to 3% by 2030, double the historical average and an economic boost on a par with the introduction of electricity and computers.

Exhibit 5: Innovation waves are speeding up
The waves of innovation have increased from 60+ years to 25 years today



Source: Visual Capitalist, Edison Institute
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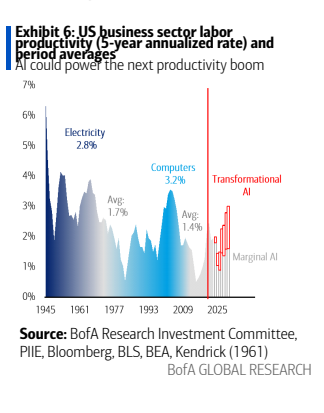
Exhibit 6: US business sector labor productivity (5-year annualized rate) and period averages
AI could power the next productivity boom



Source: BofA Research Investment Committee, PIIE, Bloomberg, BLS, BEA, Kendrick (1961)
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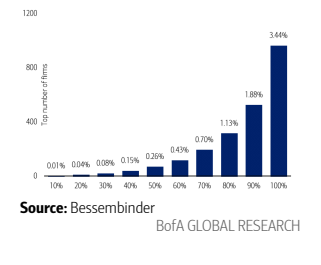
Disruption always wins.

What once seemed long-term, distant technologies are approaching faster than ever. However, humans typically underestimate this acceleration, failing to accurately assess the near-term potential of new or new forms of technologies and their impact on society. Consequently, understanding the technologies that may arrive much sooner than expected and identifying which will become disruptive is key - especially given returns are predominantly driven by a small share of disruptive companies. In fact, since 1926, US$55tn in shareholder wealth has been created, but just 3% of companies accounted for that entire amount (source: Bessembinder).

Exhibit 7: The top percentage of firms that generated shareholder wealth between 1926 and 2022 (by share of net wealth created)
Just 3% of all companies have generated net wealth in the US stock market since 1926



Source: Bessembinder
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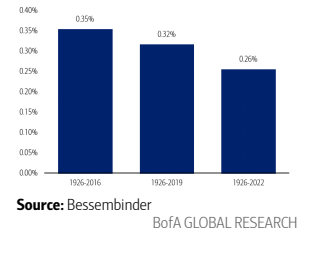
Exhibit 8: % of total US firms that accounted for 50% of net wealth in each time period
The percentage of firms that accounted for 50% of net wealth has decreased by 10ppts over a 6-year timeframe - that's 18 companies



Source: Bessembinder
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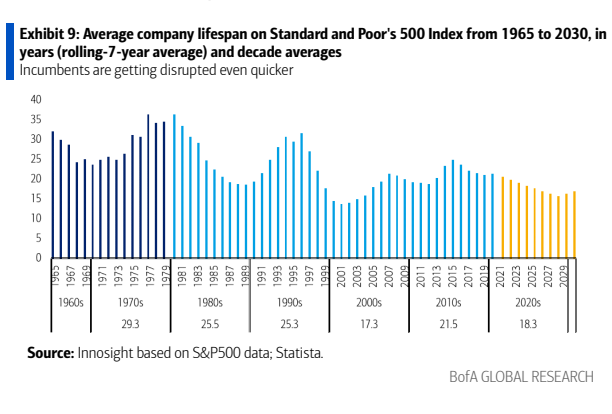
Life expectancy of incumbents keeps falling

The displacement of incumbents is growing by the day. In 1958, the average 7-year rolling lifespan of a company on the S&P 500 was 61 years. By the 1980s it had dropped to 30 years; by 2016, it was 24 years; as of 2021, 16 years (source: McKinsey). In 2020, the same McKinsey study stated that 75% of companies on the index would disappear. If we continue on this road, by 2027 companies could last just 12 years as they increasingly become disrupted (source: Innosights, S&P 500).

Exhibit 9: Average company lifespan on Standard and Poor's 500 Index from 1965 to 2030, in years (rolling-7-year average) and decade averages
Incumbents are getting disrupted even quicker



Source: Innosight based on S&P500 data; Statista
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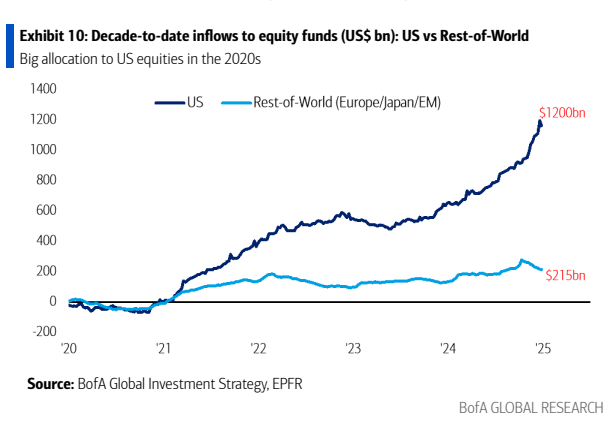
The costly price of tech disruption

The quest for AI dominance has sparked a massive rerating of stocks involved in this "arms race" in the first half of the 2020s. It has led to much market bullishness that a 4th industrial revolution is underway that will structurally boost productivity growth and increase profits.

This optimism on AI has driven a tremendous reallocation of capital to tech, which remains the leading sector in the world and particularly US equity markets (US$1.2tn inflow to US equity funds decade-to-date - Exhibit 10). This concentration of liquidity among a few names associated with AI has risen to extreme levels (the 'Magnificent 7' group of companies make up 36% of the S&P500 index market cap). Conversely, bears point out that from steam power to the internet, there has always been a lag between innovation and widespread social, corporate and economic adoption. In addition, the quickest way for AI to increase productivity is via a significant rise in unemployment, something governments and policymakers will be keen to avoid. They are likely to actively try to counter this via greater regulation and taxation (the tech sector is among the least regulated in the US).

Exhibit 10: Decade-to-date inflows to equity funds (US$ bn): US vs Rest-of-World
Big allocation to US equities in the 2020s



Source: BofA Global Investment Strategy, EPFR
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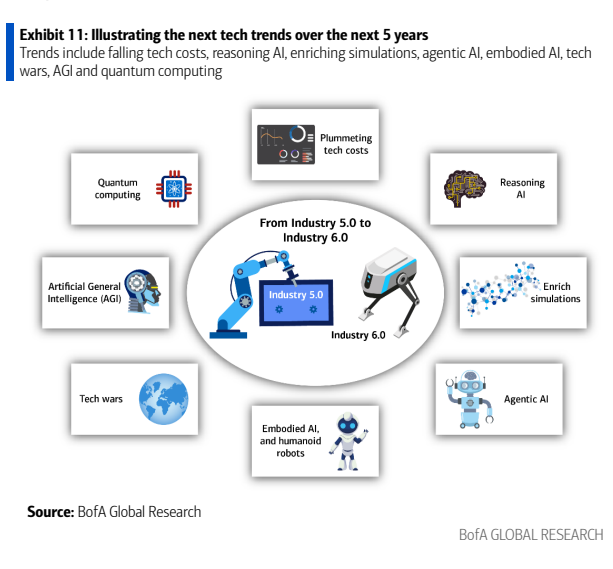
1. "Technology is eating the world"

Summary: Technology is moving us to a new phase in the next 5 years. Powered by the AI revolution, we will watch technology prices plummet. We will see AI's integration in all aspects of our lives. We will witness its game-changing role in leap-frogging innovation. Agentic AI will influence the job market, rich AI simulations will develop new products in healthcare, industrials and financial services. Furthermore, AI will interact with the physical environment, enabling the next generation of automation. At the same time, we are likely to see a tech war "arms race" between the Superpowers, complicated by accelerated deglobalization and tech protectionism, as well as privacy and demographic concerns.

Exhibit 11: Illustrating the next tech trends over the next 5 years
Trends include falling tech costs, reasoning AI, enriching simulations, agentic AI, embodied AI, tech wars, AGI and quantum computing



Source: BofA Global Research
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Welcome to Industry 6.0 - minimizing human intervention

The AI large language model (LLM) revolution has accelerated the adoption of Industry 5.0, which aimed to build on the Industry 4.0 digitalization era by integrating "human-centric" approaches into industrial processes. Industry 5.0 emphasized collaboration between humans and advanced technologies, such as AI-driven robots, to optimize workplace processes. We are now seeing AI integrated in every aspect of our economy and our lives, and "humanizing" automated processes. This is moving us from the humanization era (Industry 5.0) to Industry 6.0, which aims to minimize human intervention by creating a fully integrated, intelligent manufacturing systems based on the next generation of technologies.

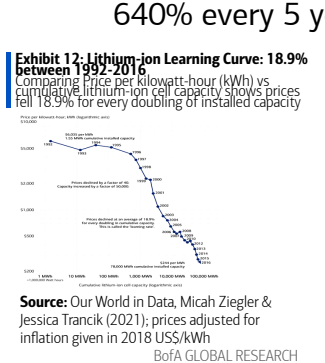
1. Tech-onomy: Technologies powering themselves towards lower prices

Investments in automation, AI and tech are reducing prices across the board and increasing returns. For example, while drive capacity has risen by more than 20,000x in the past 20 years, the price per gigabyte has fallen by >99%. More technology gets deployed to satisfy demand, leading to falling prices. Then these technologies become cost-effective in new applications, feeding increased demand again.

Tech costs are falling dramatically:

- In the past 30 years, the price of batteries has plummeted by 97% (source: Ziegler and Trancik).
- For solar panels, each doubling of installed capacity has led to the price of solar modules dropping on average by 20.2%.
- Solar cells made from perovskites (materials with strong light absorption and electric change properties) can propel solar efficiency and halve costs. In fact, perovskite solar cells have increased in efficiency from 3% in 2009 to 26% in 2024.
- The cost of sequencing a full human genome has come down by 99.99% in the past 20 years. The cost of computer memory chips has dropped by 640% every 5 years.

Exhibit 12: Lithium-ion Learning Curve: 18.9% between 1992-2016
Comparing Price per kilowatt-hour (kWh) vs cumulative lithium-ion cell capacity shows prices fell 18.9% for every doubling of installed capacity



Source: Our World in Data, Micah Ziegler & Jessica Trancik (2021); prices adjusted for inflation given in 2018 US$/kWh
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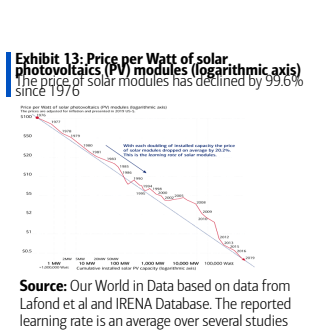
Exhibit 13: Price per Watt of solar photovoltaics (PV) modules (logarithmic axis)
The price of solar modules has declined by 99.6% since 1976



Source: Our World in Data based on data from Lafond et al and IRENA Database. The reported learning rate is an average over several studies reported by de La Tour et al in Energy. The rate has remained very similar since then. The prices are adjusted for inflation and presented in 2019 US$.
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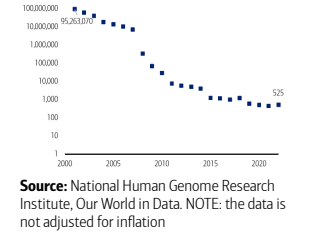
Exhibit 14: Cost of sequencing a full human genome (US$; log scale)
The cost of sequencing a full human genome has decreased from US$95mn in 2001 to US$525 in 2022 - that's a decrease of 99.99% in the last 20 years



Source: National Human Genome Research Institute, Our World in Data. NOTE: the data is not adjusted for inflation
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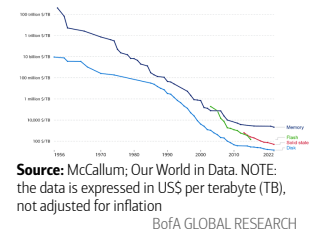
Exhibit 15: Cost of computer memory and storage (US$ per terabyte, TB)
Since the 1950s, the cost of computer memory chips has come down by 640% every 5 years



Source: McCallum; Our World in Data. NOTE: the data is expressed in US$ per terabyte (TB), not adjusted for inflation
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2. "Reasoning AI": adding the human element, one step before AGI

AI model capabilities are expanding to include tasks that require reasoning. All LLMs thus far have used algorithms for tasks that can be solved with rapid thinking, with increasingly sophisticated versions owing to their emergent properties. However, the new versions of models, like OpenAI's o1 and o3 models, can now break down complicated problems into separate tasks and hypothesis, using "reasoning" to get to a solution - like human thinking.

Thinking like a human?

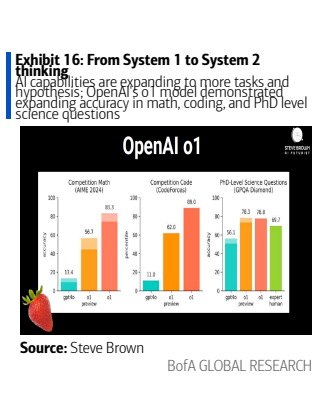
AI systems are going next and is the way to move intelligence levels forward for AI models. This is demonstrated in OpenAI's o1 model. It demonstrated better capabilities than the average human level at solving maths problems (increased accuracy of answers from 13% to 83%), coding capabilities (11% to 89% accuracy), and even outperforms humans at PhD-level science questions (78% with the AI model vs 70% human).

Adding "intelligence" and human thinking mechanisms into the models

Adding "intelligence" and human-thinking mechanisms into the models means the AI model is learning during training time but also at the usage stage, as demonstrated in OpenAI's o1 model that has increased the relative capabilities of its models beyond that of GPT-4. This has implications for the silicon market for AI, with several players vying to dominate the inference market in the way that Nvidia has dominated hardware for AI model training thus far.

> "The bottleneck of humanity is not to replace drivers, workers, lawyers or accountants. It's not to produce the next doctors, farmers or programmers...
>
> It is to come up with the next Albert Einstein, Marie Curie, Galileo, Issac Newton and Rosalind Franklin."
>
> **Amnon Sahashua, founder of Mobileye**

Exhibit 16: From System 1 to System 2 thinking
AI capabilities are expanding to more tasks and reasoning; OpenAI's o1 model demonstrated expanding accuracy in math, coding, and PhD level science questions



Source: Steve Brown
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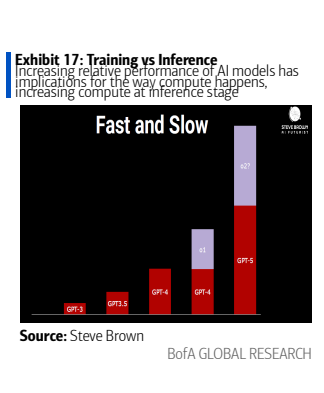
Exhibit 17: Training vs Inference
Improving relative performance of AI models has implications for the way compute happens, increasing compute at inference stage



Source: Steve Brown
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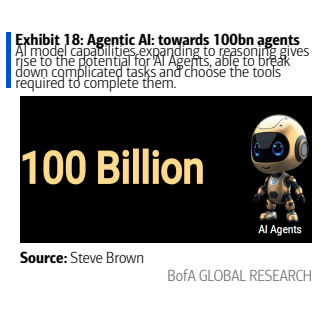
3. Agentic AI: A world of 100bn AI agents working alongside us

Agentic AI is the next big trend in commercializing AI models. It is able to use reasoning capability and build upon that to choose and use the right tools to complete the tasks it is set. At our Transforming World Conference, Steve Brown gave examples such as a marketing plan or a travel booking. He described using AI agents as a way to scale an organization and transform a company's workforce, as well as their ability to interact with other AI agents, e.g., to obtain an approval or review (e.g., legal or compliance). This doesn't mean human workers would be completely out of the loop, in his view, but that AI agents could be partners or subordinates that work for humans.

> "What we're looking at is a world of 100bn AI agents working alongside us. You can think of these not as tools now, but digital employees. Digital employees that work for electrons rather than dollars and cents."
>
> **Steve Brown, AI Futurist**

He sees these AI agents entering the workforce within the next year, with the availability of OpenAI's Operator AI agent tool expected in 2025 that could be "the next ChatGPT moment", in his view.

Exhibit 18: Agentic AI: towards 100bn agents
AI model capabilities expanding to reasoning gives rise to the potential for AI Agents, able to break down complicated tasks and choose the tools required to complete them.



Source: Steve Brown
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Exhibit 19: Human / Machine teaming
Agentic AI will increase the need for workflow orchestration and task management, choosing between humans, robots, and AI systems to complete tasks independently or collaboratively based on competencies.

Source: Steve Brown
BofA GLOBAL RESEARCH

4. AI-enriched simulations changing industries

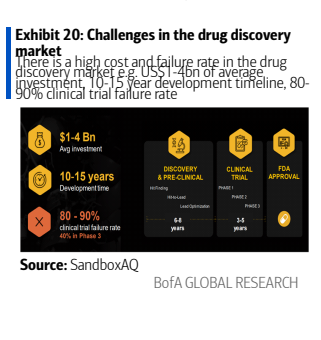
AI-enriched simulations are being leveraged for other innovations; for example, simulation for drug discovery and material breakthroughs. AI has helped to discover 45x times more crystals ever known to man. Using AI in drug discovery facilitated the finding of a candidate for liver cancer in just 30 days. Many of our everyday products are complex and over time designers have come to rely on computer-driven simulations, but they often take time to run. Even once possibilities are found, additional simulations are needed to ensure safety. AI simulation combines techniques from quantum physics and deep learning to enable sampling a vast dataset quickly and efficiently. AI and simulation technologies bring the ability to take a molecular structure and simulate it billions of times, making small changes each time to see which structure is optimal. We can now do this in a matter of weeks and months - a task that would take 10 years in the physical world.

What does the simulation process involve? How does it work? Bayesian statistics create methods that rival traditional simulation methods by finding the optimal solution based on the system's limited information. In this way, the method minimises the uncertainty of the next best solution, using existing knowledge to select the next best parameters.

Simulations have numerous applications: drug discovery, chips, chemicals, materials:

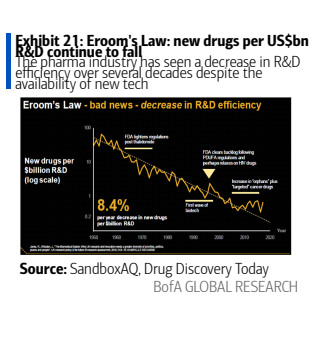
- **Drug discovery** involves high costs and has a high failure rate. The average investment is US$1-4bn and it typically takes 10-15 years to develop new drugs. There is a 90% failure rate, which makes the business model unpredictable. And revenues from the 10% of drugs that are successful have to pay for the 90% that failed.

Exhibit 20: Challenges in the drug discovery market
There is a high cost and failure rate in the drug discovery market (e.g. US$1-4bn of average investment, 10-15 year development timeline, 80-90% clinical trial failure rate



Source: SandboxAQ
BofA GLOBAL RESEARCH

Exhibit 21: Eroom's Law: new drugs per US$bn R&D continue to fall
The pharma industry has seen a decrease in R&D efficiency over several decades despite the availability of new tech



Source: SandboxAQ, Drug Discovery Today
BofA GLOBAL RESEARCH

The high failure rate helps explain Eroom's law (the observation that drug discovery becomes slower and more expensive over time), which implies a decrease in R&D efficiency. Eroom's law is where companies spend more per new drug on R&D than they make in revenue. New AI simulation work can change sectors such as life sciences from a lumpy business of mostly failure to one with predictable revenues, as it allows companies to take all the data, molecular information and run billions of simulations de-risking the molecules, reducing drug development time dramatically.

- **Chip design:** Electronic design automation (EDA) vendors have made tools for chip design using rule-based systems and physics simulation. But now AI can help chipmakers push the boundaries of Moore's Law (the observation that the number of chips in a circuit doubles every two years) further. Simulation can design chips faster than older methods, and make new and better chips. All in all, these tools can increase supply chain security and help mitigate shortages.

5. Embodied AI, physical intelligence & humanoid robots

AI is enabling rapid progress in robots, given the ability to programme and interact with them via language models. The term "embodied AI" was first used to describe the branch of AI that focuses on how computers, systems and technology can interact with the physical world. It typically includes AI for sensorimotor skills, navigation, and real-world interactions. But with the rise of generative AI, embodied AI is also being used to give this technology a physical form, typically a robot including autonomous vehicles and drones. The next half a decade will be the breakthroughs years of robotics thanks to AI.

Embodied AI approach would be to teach the robot to guess until it gets it right

Robots use AI to interact with the physical world and to learn from their interactions. They are equipped with a range of sensors and computer vision to take in data from the real world. Combined with generative AI, they can 'learn' from this data and also exhibit conversational and situational awareness. For example, to teach a robot to pick up a book, the traditional AI method would be to program it with the movements needed, e.g., lower hand, open hand, close hand, raise hand etc. In contrast, the embodied AI approach would be to teach the robot to guess, by having it make random attempts and learn from each until it achieves the goal.

New applications…towards autonomy? Embodied AI will bring new use cases

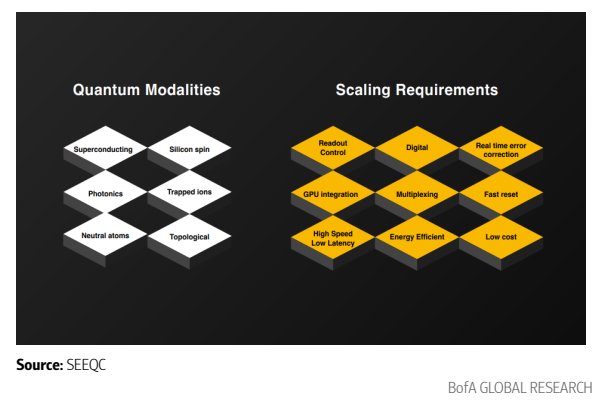
Innovations in metals (to make them stronger and lighter) and batteries (now lasting c.5hr shifts) are enabling them to become a reality. There are opportunities for productivity enhancements and removing dangerous or repetitive/onerous tasks from humans e.g., robots can help with assembly, in warehouses (e.g., packing and shipping items). Typically, we might think of robots as enabling us to automate tasks, with humans being the principal and robots being the agent. But as these robots become more capable of self-learning and completing tasks without being pre-programmed, their direction may shift from one of automation to autonomy.

6. Welcome to the quantum era. Quantum advantage as soon as 2025?

We are currently in the early prototype phase of quantum. Scaling up a quantum computers' qubit number involves solving for many problems such as error correction, cost, speed, and energy efficiency. Current quantum computing companies will need to solve these problems but will reach a limit on the qubit number they can achieve because of the complex architecture that they employ e.g., cabling and racks.

There are different ways of building quantum computers. Most quantum computers that are built by e.g., IBM, Google, Microsoft, Amazon, and other players, are based on superconducting qubits. But there are also other methods such as photonics, silicon spin, trapped ions, neutral atoms. And each has their own advantages and disadvantages. Like an orchestra which as all kinds of requirements to run smoothly e.g., staying in time and in tune, for a quantum computer to scale, they must solve problems such as readout control (measuring the quantum state of qubits), real time error correction, low cost, energy efficiency, high speed/low latency, multiplexing (dividing a communication channel into a number of 'logical' channels) and GPU integration.

Exhibit 22: A variety of requirements needed for scaling
To scale quantum, we need to solve problems such as readout control, energy efficiency, multiplexing, GPU integration, latency and real time error correction

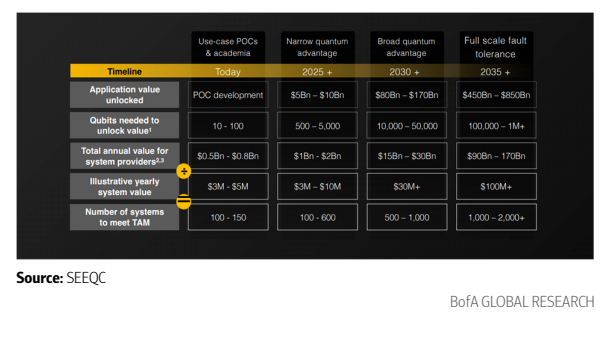


Source: SEEQC
BofA GLOBAL RESEARCH

QC companies investing to solve for scaling challenges unlocks TAM opportunity

Quantum computers are being built today: there are c.150 quantum computers in the world. But companies that are pursuing the current quantum computing architecture are buying the necessary architecture such as racks, electronics, RF components etc, which shows players are investing to solve these challenges for scaling QCs. This means that in a short period of time starting in 2025, we could start to see narrow quantum advantage unlocking a significant TAM (total addressable market) opportunity.

Exhibit 23: Timeline of quantum advantage and the TAM opportunity
In a short period of time starting in 2025, we could start to see narrow quantum advantage unlocking a significant TAM opportunity



Source: SEEQC
BofA GLOBAL RESEARCH

7. Artificial General Intelligence (AGI)...by 2028?

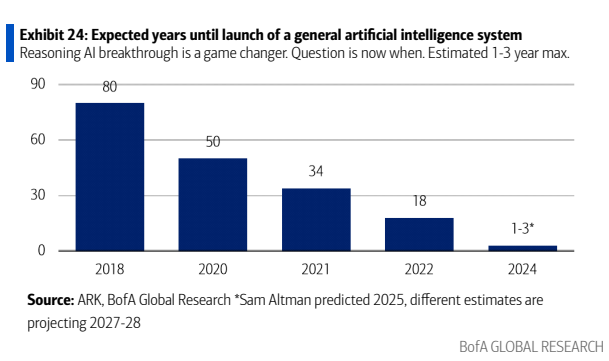
AI smart enough to automate AI research to improve itself, providing feedback loops where superintelligence is possible. Since the first discussions about general AI and technological singularity by mathematician Von Neumann in the mid-20th century, scientists and technologists have repeatedly predicted the coming of human-level intelligent machines in the near term. NVDA's CEO projected we will reach AGI by 2030, while futurist Steve Brown claimed it could be sooner than that in our Transforming World Conference, that AGI is between 1 year away and never being achieved. The assumption at the moment is 2027-28, as per company/press reports.

We should be afraid *and* excited

OpenAI believes it's no longer a research problem but an engineering one. We should be afraid *and* excited about it. A very powerful tech bringing human level intelligence available at scale on demand. The real breakthrough came in late 2024 with Open AI's o1 reasoning AI model, which pushed the boundaries of AI capabilities to break down complicated tasks like humans can, paving the way for AGI. As a result, Sam Altman, predicted that by 2025, machines would be able to think and reason like humans.

AGI is a winner takes all. Whoever gets there first has great power; hence, it's also a national security concern. It could give military advantage, accelerate R&D, make businesses more competitive, and much more. This is why AI is a global race between the US and China to get there first.

Exhibit 24: Expected years until launch of a general artificial intelligence system
Reasoning AI breakthrough is a game changer. Question is now when. Estimated 1-3 year max



Source: ARK, BofA Global Research *Sam Altman predicted 2025, different estimates are projecting 2027-28
BofA GLOBAL RESEARCH

2. Peak Monopoly

Summary: The US stock market has never been so concentrated, dominated by a handful of mega-cap companies, aka the "Magnificent 7". However, the monopoly of capital and returns by monopolistic tech peaks in coming years as AI gains broaden to a much wider array of corporations, and populist politicians target the monopoly of mega-cap wealth via taxes & regulations to ease deficits and placate impact of AI on labour market.

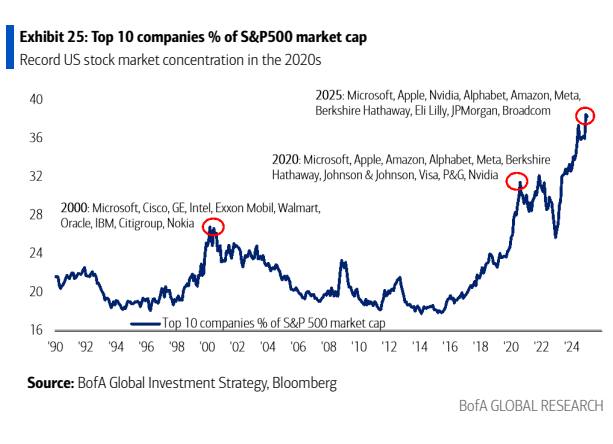
Beneficiaries: equal-weighted equity indices, Value stocks, International stocks.

The bigger, the better

AI has been *the* positive exogenous shock of the 2020s, as "Technology is eating the World" indicates. And AI has dominated investor bull psychology in the past two years encapsulated by the rise of the "Magnificent 7" (Microsoft, Nvidia, Apple, Amazon, Google, Meta & Tesla). Even before the AI-shock, these seven companies had become the "leadership" of the US stock market driven by their first-class products, brands & management. Investors also rewarded their strong balance sheets that could withstand the rise in interest rates in the early-2020s, and their monopolistic market positions that guaranteed revenue streams and low-cost suppliers. AI has added to their lustre whether via ability to fund AI capex (Microsoft, Apple, Amazon, Meta, Google spent US$62bn on capex in Q3'24), lead the provision of AI services (e.g., cloud computing), and provide the chips best suited to handle the computing required by AI (Nvidia).

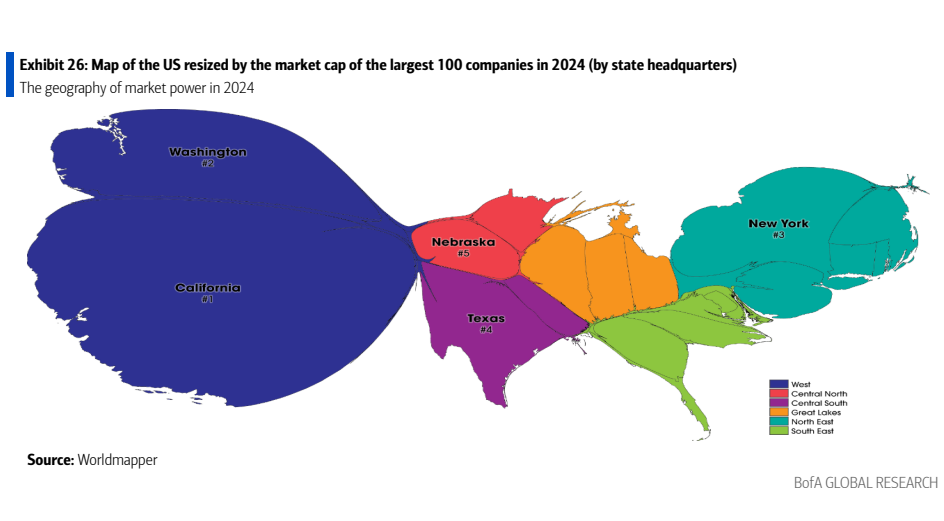
The combined market cap of the Magnificent 7 has risen to US$18tn, roughly equivalent to the GDP of China, and representing 35% of the market cap of the S&P 500. The US stock market is now the most concentrated in many, many decades (Exhibit 25). In the past two years nearly 60% of S&P 500 returns have been driven by these 7 companies (the number of companies outperforming the index has fallen to its lowest since 1998/99 - Exhibit 27). In addition, the dominance of the "Magnificent 7" has caused the US to rise a record-high 67% of the global stock market capitalization and has led to big shifts in regional wealth concentration (Exhibit 26).

Exhibit 25: Top 10 companies % of S&P500 market cap
Record US stock market concentration in the 2020s



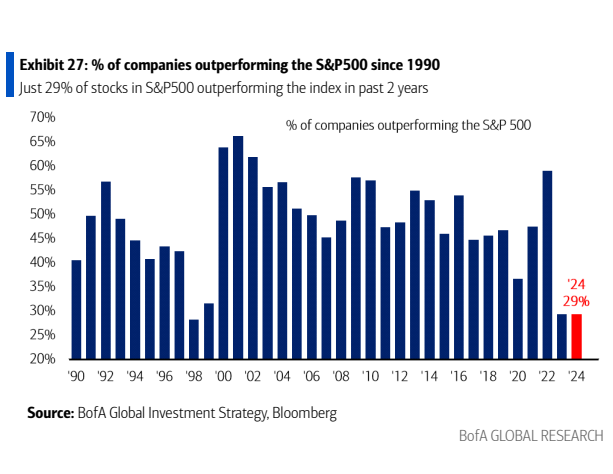
Source: BofA Global Investment Strategy, Bloomberg
BofA GLOBAL RESEARCH

Exhibit 26: Map of the US resized by the market cap of the largest 100 companies in 2024 (by state headquarters)
The geography of market power in 2024



Source: Worldmapper
BofA GLOBAL RESEARCH

Exhibit 27: % of companies outperforming the S&P500 since 1990
Just 29% of stocks in S&P500 outperforming the index in past 2 years



Source: BofA Global Investment Strategy, Bloomberg
BofA GLOBAL RESEARCH

The bigger they are, the harder they fall

Investors currently see little alternative to the leadership of the Magnificent 7 stocks, deterred by tariffs & debt in China, a lack of tech alternatives in Europe, higher interest rates weighing on small cap stocks, a global manufacturing recession for cyclicals, and a universal aversion to bonds. The lack of alternatives means liquidity has become more concentrated in the "US exceptionalism" theme, which in turn has become exceptionally expensive...the average P/E of the "Magnificent 7" is 62x trailing earnings.

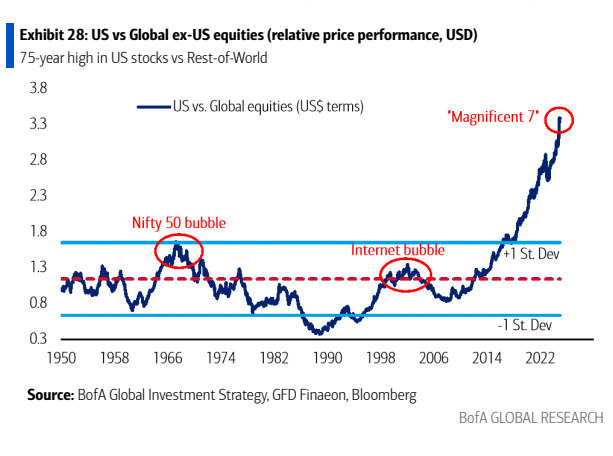
History is replete with eras of monopolistic dominance of goods & services (e.g., Standard Oil, US Steel, American Tobacco, De Beers, the East India Company, Hudson Bay) all of which ended in bubbles, and thereafter government regulations to placate angry electorates determined to end monopolistic dominance. And in recent years both China (Baidu/Alibaba/Tencent in 2020) & Denmark (Novo Nordisk in 2024) stock markets have shown how "concentration" can suddenly become detrimental to the broader index.

In 2025 one US stock market risk remains a full-blown "Magnificent 7" bubble, more concentration, more overvaluation, especially if the Fed can resume a rate-cutting cycle.

But this will sow the seeds for "peak monopoly". All great bull markets and bubbles are ended by policy. Sharply rising stock prices would engender rising bond yields & real rates. In turn, wealth inequality at a time of big public deficits and need for spending on infrastructure will see politicians target "monopolistic profits". In the US the "Magnificent 7" paid just US$53bn in cash taxes in the last 12 months, representing less than 0.5% of their combined market cap of US$18tn. Catalysts for higher taxes could be AI. The AI revolution is power-greedy, and some are already linking AI data centres to higher utility bills. Big tech steps to secure long-term power supply (e.g., Microsoft, Google, Amazon deals to secure nuclear power in the 2030s) illustrates the risk that excess AI electricity demand could in 2025/26 cause power prices to spike, forcing political pressure on tech companies to subsidize lower power prices for households. In addition, the mid-20s has seen a small but growing number of big tech antitrust cases.

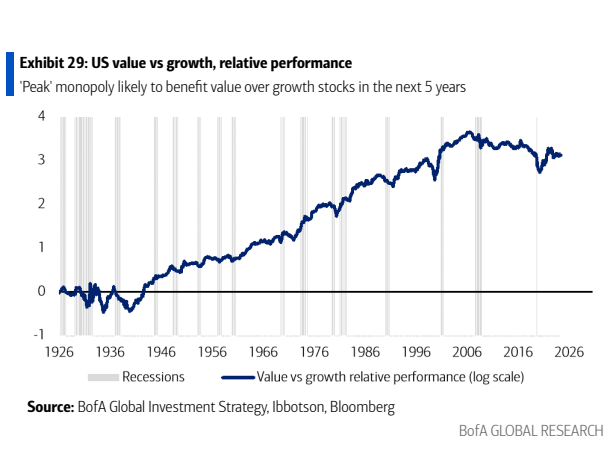
The "Magnificent 7" remain superbly placed to benefit their shareholders from the AI revolution. But as BofA's "The World in 2030" argues, the gains from AI in coming years are likely to accrue to the many not just the few. And today's market concentration is at risk should a '25 bubble cause bubble-popping interest rates and/or tax & regulatory policies targeting monopolistic profits, the "Magnificent 7" then flipping to the "Lagnificent 7" as their returns start to lag the broader global equity market. Increasing allocation to unloved "value" & "International" stocks, as well as equal-weighted equity indices, are the best way for asset allocators to play "Peak Monopoly" (Exhibit 28, Exhibit 29).

Exhibit 28: US vs Global ex-US equities (relative price performance, USD)
75-year high in US stocks vs Rest-of-World



Source: BofA Global Investment Strategy, GFD Finaeon, Bloomberg
BofA GLOBAL RESEARCH

Exhibit 29: US value vs growth, relative performance
'Peak' monopoly likely to benefit value over growth stocks in the next 5 years



Source: BofA Global Investment Strategy, Ibbotson, Bloomberg
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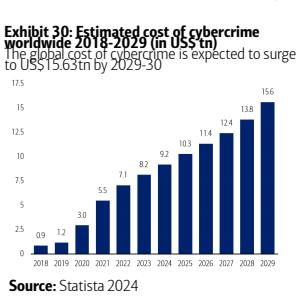
3. Digital Insecurity

3. Digital Insecurity

Summary: Many of us feel more anxious than ever before about technology risks given everything from cybersecurity hacks, AI agents displacing human workers, the rise of fake news and the spread of mis/disinformation through deepfakes, and social media addiction leading to loneliness. The global cost of cybercrime is expected to surge to US$15.63tn by 2029-30 (source: Statista). At the same time, an attempted deepfake attack occurs every 5 minutes (source: Onfido, Entrust). The number of deepfake videos has been doubling every 6 months since 2018 (source: Sensity, Information Matters). And deepfake damage costs are projected to reach US$40bn by 2027 (source: Deloitte). Finally, we need to reskill 1bn people by 2030, which is a third of all jobs worldwide, because of technology disruption (source: WEF, OECD).

Exhibit 30: Estimated cost of cybercrime worldwide 2018-2029 (in US$ tn)
The global cost of cybercrime is expected to surge to US$15.63tn by 2029-30



Source: Statista 2024
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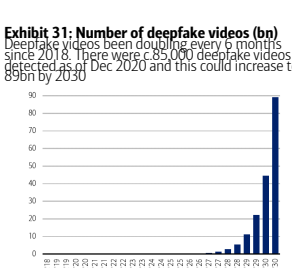
Exhibit 31: Number of deepfake videos (bn)
Deepfake videos been doubling every 6 months since 2018. There were c.85,000 deepfake videos detected as of Dec 2020 and this could increase to 89bn by 2030



Source: BofA Global Research, Sensity
Note: Since Dec'20, we have taken assumption of deepfake videos online doubling every 6 months
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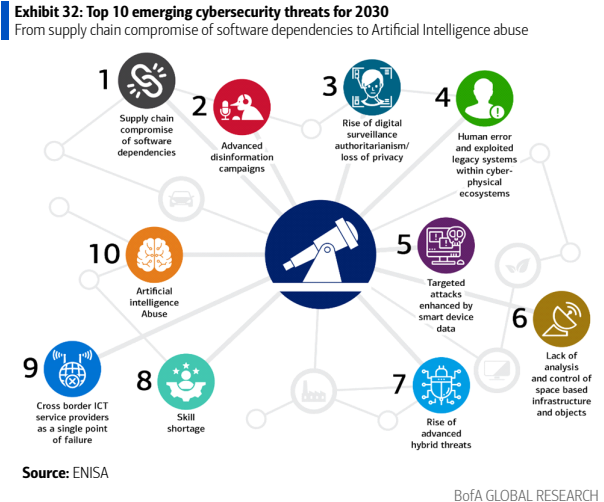
Cybersecurity: the digital black swan for 2030?

Cybersecurity is the #1 risk in a Transforming World because of how reliant we are on technology, in our view. Most of the world managed to get through COVID lockdowns and physically social distance, but would this have been possible without access to the digital world? The rise of Generative AI now creates a new 'threatscape'. For example, using the compute power of 10,000+ A100 Nvidia GPUs to train ChatGPT, it would take just 1 second to crack a password today (source NetSec, Hive Systems). Hacks now take an average of 277 days or about 9 months to identify and contain (source: IBM). And cybersecurity is increasingly becoming a matter of national security, with critical infrastructure more vulnerable to attacks. The costs of cybercrime are eyewatering and set to hit US$10.5tn by 2025E, making it the world's 3rd largest 'economy' behind only the US and China.

Exhibit 32: Top 10 emerging cybersecurity threats for 2030
From supply chain compromise of software dependencies to Artificial Intelligence abuse


1 Supply chain compromise of software dependencies
2 Advanced disinformation campaigns
3 Rise of digital surveillance authoritarianism/ loss of privacy
4 Human error and exploited legacy systems within cyber-physical ecosystems
5 Targeted attacks enhanced by smart device data
6 Lack of analysis and control of space based infrastructure and objects
7 Rise of advanced hybrid threats
8 Skill shortage
9 Cross border ICT service providers as a single point of failure
10 Artificial intelligence Abuse

Source: ENISA
BofA GLOBAL RESEARCH

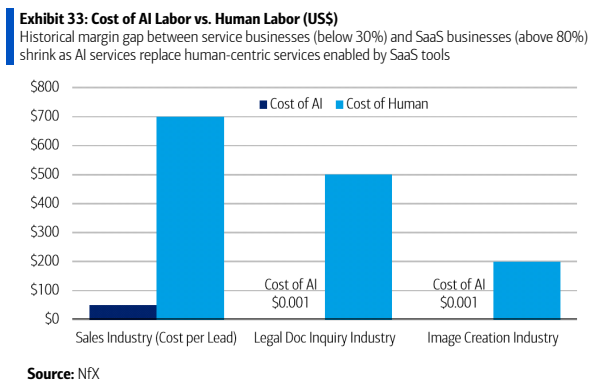
Deepfakes: is this the re(AI) life or is this just fantasy?

> **Did you know?**
> Every 5 minutes a deepfake attack occurs.
> Deepfake attempts were up 3,000% alone in 2023.
> Source: Onfido, Entrust
>
> 80% of companies don't have protocols to handle deepfake attacks.
> 3 seconds of audio is sometimes all that's needed to produce an 85% voice match from the original to a clone.
> Source: Security.org
>
> While the average cost of creating a deepfake is US$1.33, the expected global cost of deepfake fraud is in the billions.
> Malicious actors spend a mere 7 cents to reach 100,000 social media users with a weaponized deepfake.
> Source: Security Intelligence, Interpol
>
> Fake news costs the global economy US$78bn every year.
> Source: Roberto Cavazos

Deepfake videos are synthetically altered footage in which the depicted face or body has been digitally modified to appear as someone or something else, according to the Merriam-Webster dictionary definition. Another type of machine learning is added to the mix, known as Generative Adversarial Networks (GANs), which detects and improves any flaws in the deepfake within multiple rounds, making it harder for deepfake detectors to decode them. GANs are also used as a popular method of creating deepfakes, relying on the study of large amounts of data to "learn" how to develop new examples that mimic the real thing, with startlingly accurate results.

Jobs: will AI replace workers?

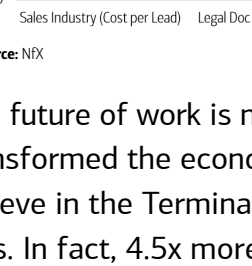
Exhibit 33: Cost of AI Labor vs. Human Labor (US$)
Historical margin gap between service businesses (below 30%) and SaaS businesses (above 80%) to shrink as AI services replace human-centric services enabled by SaaS tools



Source: NfX
BofA GLOBAL RESEARCH

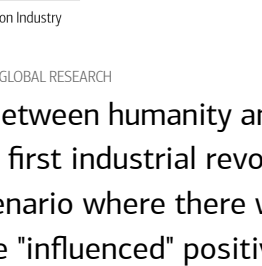
The future of work is not zero-sum between humanity and technology. Throughout history, technology has always created entirely new types of jobs as it has transformed the economy. From the first industrial revolution onward, employment has shifted as new technologies have become widespread. We don't believe in the Terminator Skynet scenario where there will be dire job losses from AI in the next 5 years. Per WEF, AI could create a net increase of 78mn jobs. In fact, 4.5x more jobs could be "influenced" positively by generative AI compared to those replaced by 2030 (source: Forrester).

Exhibit 34: Forecasting number of jobs influenced by generative AI vs number of jobs lost to generative AI in US
Automation and AI are overall expected to replace 4.9% of US jobs by 2030. Generative AI specifically will account for 30% of job losses, equal to 2.4mn positions.



Source: Forrester's 2023 generative AI jobs impact forecast, US
BofA GLOBAL RESEARCH

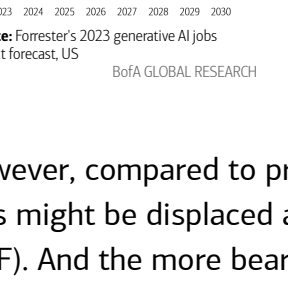
Exhibit 35: Global long-term AI implications on employment
Our BofA strategists are evenly split on whether AI will drive job creation or displacement in the next 5 years



Source: BofA Global Research. Results based on May'24
BofA GLOBAL RESEARCH

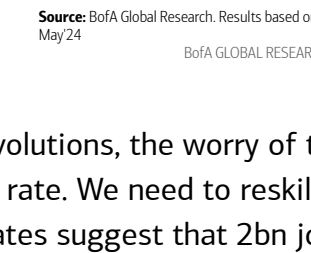
However, compared to previous revolutions, the worry of today is the unprecedented speed of disruption from AI agents, humanoid robots, etc, where more jobs might be displaced at a faster rate. We need to reskill 1bn people by 2030, which is 1/3 of all jobs worldwide, because of technology disruption (OECD, WEF). And the more bearish estimates suggest that 2bn jobs could disappear by 2030 (Thomas Frey). Contact centres, for example, could be largely automated within the next 3 years as companies look to reduce the c.US$118.6bn in annual costs paid to c.2.9mn US customer service human agents (US BLS). For instance, Klarna implemented an AI-powered customer service bot that decreased resolution times to sub-2 mins vs 11 mins and reduced the need for 700 (human) customer service agents.

Exhibit 36: Klarna's AI bot does the work of 700 human agents
Klarna's chatbot exhibits greater functionality relative to traditional bots



Source: Klarna, BofA Global Research
BofA GLOBAL RESEARCH

Exhibit 37: Digit (Agility Robotics)
Agility Robotics' Digit is designed for warehouse logistics and delivery



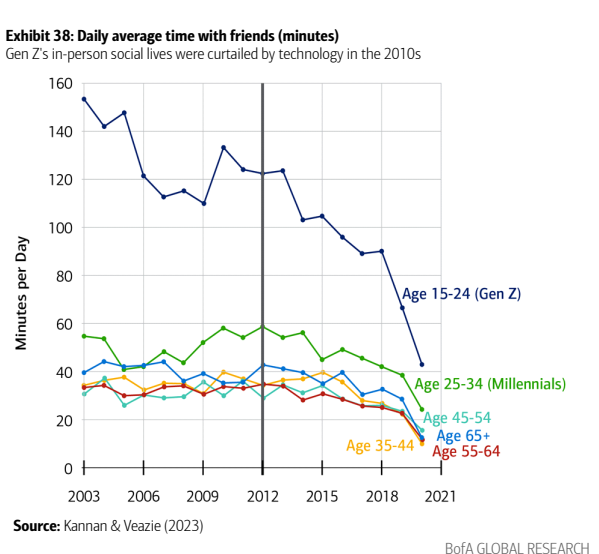
Source: Agility Robotics
BofA GLOBAL RESEARCH

Loneliness: from social media addiction?

> At an average of 143 minutes per day, per user, the world spends 720bn minutes per day using social platforms. Over a full year, that adds up to more than 260tn minutes, or 500mn years of collective human time! (source: Data Reportal)
>
> We now spend 5 years and 4 months across our lifetime on social media. In the same amount of time we could have flown to the moon 32x and back, walked the Great Wall of China 3.5x, climbed Mount Everest 32x, run more than 10,000 marathons and even walked our dogs 93,000 times (source: Short Stack, MediaKix).

The internet was supposed to make the world more open and connected, yet with nearly 5.5bn people now online, or 67% of the world's population (source: DataReportal), it paradoxically feels like we've never been more isolated. Between 2003 and 2019, the aggregate time spent alone, according to the American Time Use survey, went from 43.5% to 48.7% - pre-pandemic. Then, between 2019 and 2021, the percentage of time spent alone went up to 50.5%. Overall, the average American spends almost 9 additional hours a week alone. In 2014, Americans spent just under 40 hours each week alone. However, technology changed this. In 2014, when time spent with friends started to drop, this was also the first year in which more than 50% of the American population owned a smartphone. Furthermore, from these years onwards, front-facing cameras started to appear on smartphones, driving the shift towards even more screen time and fewer in-person interactions, according to sociologist Jean Twenge.

Exhibit 38: Daily average time with friends (minutes)
Gen Z's in-person social lives were curtailed by technology in the 2010s



Source: Kannan & Veazie (2023)
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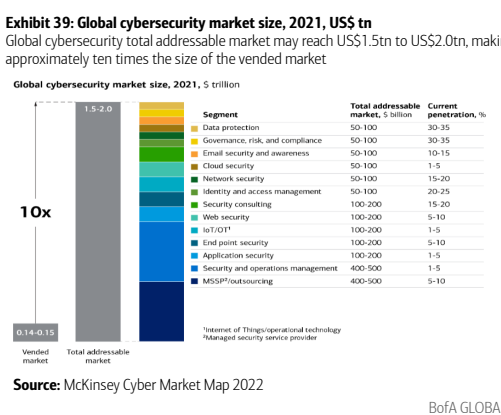
Cybersecurity market - investment solutions

US$1.5-2tn solutions TAM

Organizations around the world spent c.US$150bn in 2021 on cybersecurity, growing by 12.4% annually. As a result, the gap today between the US$150bn vended market and the fully addressable market is huge. At approximately 10% penetration of security solutions today, the total opportunity amounts to a staggering US$1.5tn to US$2.0tn addressable market. This does not imply the market will reach such a size any time soon (current growth rate is 12.4% annually off a base of approximately US$150bn in 2021).

Exhibit 39: Global cybersecurity market size, 2021, US$ tn
Global cybersecurity total addressable market may reach US$1.5tn to US$2.0tn, making it approximately ten times the size of the vended market

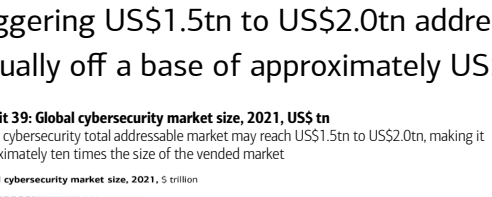


Source: McKinsey Cyber Market Map 2022
BofA GLOBAL RESEARCH

US$1.75tn cumulative cyber spend by 2025

The imperative to protect increasingly digitized businesses, Internet of Things (IoT) devices, and consumers from cybercrime will propel global spending on cybersecurity products and services to US$1.75tn cumulatively for the five-year period from 2021 to 2025 and cybersecurity spending will grow from US$262.4bn in 2021 to US$458.9bn in 2025 (source: Cybersecurity Ventures)

Exhibit 40: Global cybersecurity spending US$ bn
US$1.75tn cumulatively over 2021-2025: spending will grow from US$262.4bn in 2021 to US$458.9bn in 2025



Source: Cybersecurity Ventures
BofA GLOBAL RESEARCH

Authentication (not detection) is the solution to deepfakes

At our Transforming World Conference 2023, we hosted Henry Ajder, a leading expert on AI deepfakes and in his view, detection is not a silver bullet that solves AI deepfakes. He doesn't believe it will play a meaningful role because it is not reliable enough in critical contexts, does not scale well, and can cause more harm than good when deployed with confidence when that confidence is unfounded. He thinks we should be looking for 'content authentication', e.g., Adobe's Content Authenticity Initiative. It provides a breakdown of how the image has been manipulated, generated, or edited.

Exhibit 41: Content authentication the solution to deepfakes
Cryptographic securing of metadata can provide transparency at source

Authentication at source will be key

Source: Henry Ajder
BofA GLOBAL RESEARCH

Exhibit 42: Detecting deepfakes: current tools not sufficient
AI detection tools thus far are not accurate enough to be relied upon

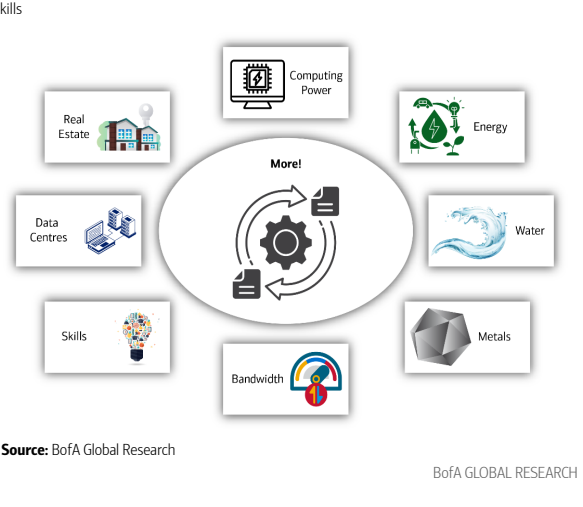
Don't bet on deepfake detection

Source: Henry Ajder
BofA GLOBAL RESEARCH

4. More!

Summary: A Transforming World has transforming needs. Exponential growth of technology will require significantly more resources and infrastructure, adding to the already growing requirements from population growth. The rise of artificial intelligence (AI) in particular is accelerating demand for data, computing power, bandwidth and expanded infrastructure such as energy, water, commodities and data centres. Several bottlenecks are already emerging in these areas, as well as gaps in the skills and human capital required to deliver them. New technologies and solutions are needed to avoid structural deficits between 2025 and 2030.

Exhibit 43: AI and future tech require a vast increase in resources
Expansion of AI requires more of everything: compute, energy, water, data, bandwidth, metals, and skills



Source: BofA Global Research
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Our Transforming World is hungry - and thirsty - for more

Exponential technology requires a lot more of…everything!

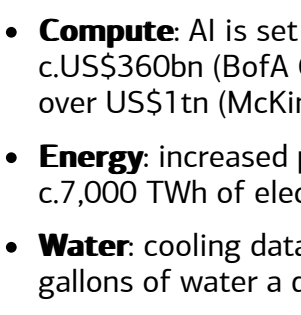
Simply put, deepening technology adoption alongside population growth means we need significantly more resources to enable the productivity gains and economic growth potential from AI and future technologies. The key investment opportunities in the next 5 years include:

- **Compute**: AI is set to accelerate demand for more powerful chips such as GPUs, with the TAM for AI accelerators set to treble between 2024-2030 to c.US$360bn (BofA Global Research). Manufacturing capacity and supply chains are expanding to accommodate, with an overall market opportunity of over US$1tn (McKinsey).
- **Energy**: increased power generation, storage and grid connections will be required for the electrification of industry, transport and buildings, adding c.7,000 TWh of electricity demand globally by 2030 (IEA). Within that, data centres could add c.250TWh in the US alone by 2030 (McKinsey).
- **Water**: cooling data centres and advanced manufacturing adds demand to already strained freshwater supplies. Global data centres consumed 309m gallons of water a day on average in 2023, projected to rise to 468m by 2030 (Bluefield Research).
- **Metals**: increased demand for critical minerals from AI, renewable energy and electric vehicles is expected to lead to structural shortages of several metals by 2030, including copper, nickel, lithium, cobalt and silver. Trade tensions are already increasing, such as China's recent ban on exports of gallium and germanium - both required in semiconductor chip manufacturing (BofA Global Research).
- **Bandwidth**: rising AI/tech adoption will stress internet infrastructure, requiring more fibre and advanced networks such as 5G, and beyond (6G, plus new satellite-based networks). In the US, the largest network provider, Verizon, said network traffic doubled between 2020-24, and it predicts it will double again between 2025 and 2030 owing to demand from AI tools (Bloomberg/Verizon).
- **Skills**: shortages in skilled labour, e.g., in AI, data science and hardware engineering, could worsen in the next 5 years; 1bn people are set to retrain/reskill by 2030 owing to tech disruption (OECD).
- **Real Estate:** more land will be needed to accommodate growing technology requirements. Per Bloomberg >7,000 public data centres are either built or in development, but more will be needed - ABI research forecasts 8,400 will be in operation by 2030 (vs 5,700 in 2024, and 3,600 in 2015).

Accelerating AI Accelerators: 60x TAM growth 2020-30

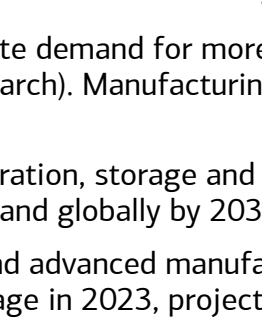
Semiconductors are crucial enablers of future technologies, with demand broadening as their capabilities expand. Demand for graphic processing units (GPUs) that can handle tasks simultaneously (known as parallelism) is accelerating, predominantly to train AI models. On top of that, demand for specialised chips for AI inference is set to grow as the usage of AI models grows, leading to several companies investing to customise or develop their own hardware for cost and efficiency gains (e.g. Google's tensor processing units (TPUs), Amazon Trainium). Combined, BofA Semiconductor research team project the market for AI accelerators to rise from c.US$45bn globally in 2023 to c.US$360bn per year by 2030 as more AI use cases emerge and commercialise - 60 times that of the 2020 TAM (US$6bn). Semis vendors under their coverage see even higher market potential, reaching US$400-600bn by 2030.

Exhibit 44: Semiconductor market projected to reach US$1tn by 2030
Several global trends are driving increased semiconductor demand, including the rise of AI, electrification of industry/autos, and communications



Source: McKinsey
BofA GLOBAL RESEARCH

Exhibit 45: AI Accelerator revenues projected to treble to 2030
Total market for AI Accelerators could increase from c.US$124bn in 2024 to c.US$360bn by 2030, owing to AI training and inference requirements



Source: BofA Global Research estimates
BofA GLOBAL RESEARCH

Semis Foundations of Future Tech: US$1tn market by 2030

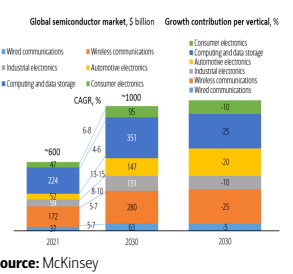
It's not just AI, though: the semiconductor market is expected to reach US$1tn in value by 2030 per McKinsey (vs US$600bn in 2021), with increasing demand also from electronics, autos, industrial and communications networks in addition to data/compute requirements for AI. This will require significantly more semiconductor manufacturing capacity - 56% by 2030 per SIA/BCG - but also several other components in the supply chain. Per BofA's Asia tech research analysts, AI is dramatically increasing the memory demand curve, with High bandwidth memory (HBM) capacity to double from 2024-2027 for example (from 210k to 405k wafer starts per month). Given the increasing strategic national and economic importance, the sector is increasingly supported by several government policies such as the CHIPS Act in the US to incentivise this manufacturing domestically.

Energy: Shifting power from a commodity to a technology

We're going to need a lot more energy capacity to accommodate increasing demands from technology, in addition to decarbonisation and energy security goals. This has broader macro implications, gradually shifting the provision of energy from that of an extracted commodity in finite quantities with volatile prices, to a generated technology with widespread availability, decreasing cost as the scale of production increases. This is already evident in reducing prices observed in e.g. wind, solar and batteries in the past decade, and set to continue to 2030. Consumer and industrial energy choices are beginning to reflect that. Household electricity usage trebles when adding an electric vehicle and heat pump, for example. Electrifying heavy industry and data centres will increase consumption even more. Volumes of electricity flowing through global electricity grids could rise by 30% to >30k TWh as soon as 2030 per BNEF.

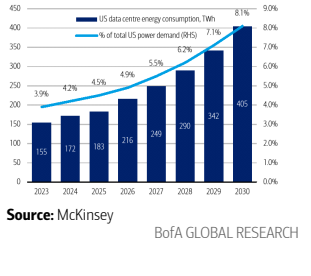
> "The 'energy transition' often refers to the shift from a carbon-based energy system to a zero emissions system. Though this change is occurring and is crucial, the real transition we need to understand is from energy as a commodity to energy as a technology."
>
> **Azeem Azhar, CEO Exponential View**

Exhibit 46: Global electricity demand growth to 2030
Electrification of transport, industry, heating and technology set to require c.7,000 TWh additional electricity, more than annual electricity demand of the US/EU combined



Source: IEA World Energy Outlook 2024
BofA GLOBAL RESEARCH

Exhibit 47: US data centre energy consumption (TWh) and as % of total US power demand (RHS)
c.250 TWh new electricity demand in the US alone through 2030 from data centres, rising to 8% of US power demand



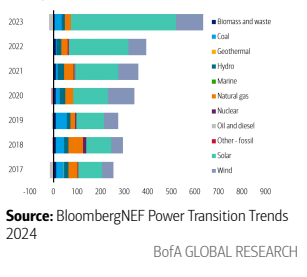
Source: McKinsey
BofA GLOBAL RESEARCH

From Energy Transition to Energy Addition

Today, most *installed* energy generating capacity comes from dispatchable power sources such as fossil fuels. But the majority of *new* energy-generating capacity in the next 5 years is expected from clean energy sources. 91% of all new power capacity added worldwide in 2023 was wind and solar, with 6% gas or coal, and 3% other clean energy sources including hydro and nuclear per BNEF. The increasing scale of energy addition required with-guaranteed availability for uses such as data centres means the race is on to secure the necessary energy-generating assets. Several tech companies have signed power purchase agreements (PPAs) with a range of providers to power data centres to try to secure this already, and more will likely be needed.

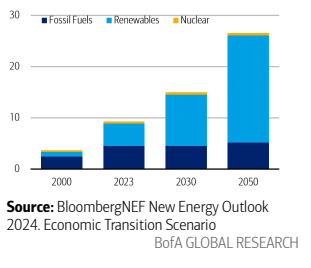
Whilst clean energy assets dominate new capacity additions, multiple sources of energy generation will be needed to meet these increasing demands for power, varying by region. Existing fossil fuel and nuclear assets will remain essential in the absence of stronger government policies or technology breakthroughs in new energy resources, remaining 33% of energy generating capacity in 2030 and 22% by 2050 in BNEF's baseline projections.

Exhibit 48: Global net power capacity additions by technology
Clean energy sources accounted for 94% of net power additions in 2023 (91% from wind & solar), with 6% from fossil fuels



Source: BloombergNEF Power Transition Trends 2024
BofA GLOBAL RESEARCH

Exhibit 49: Cumulative installed electricity capacity (TW)
Whilst the majority of new energy additions are clean energy, existing firm dispatchable power from fossil fuels & nuclear remains essential in the absence of stronger government policies and incentives



Source: BloombergNEF New Energy Outlook 2024. Economic Transition Scenario
BofA GLOBAL RESEARCH

Chips are hot! Cooling them risks water scarcity

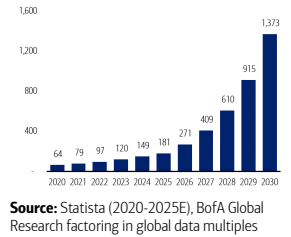
Growing agricultural, residential and industrial uses are increasing the risk of water scarcity. Some 2/3 of the world's population face shortages as soon as 2025 (WWF). Accelerating AI is set to compound this. Data centres require water for cooling purposes, to avoid equipment overheating and inefficiency. They already consume on average 309mn gallons of water a day (enough to supply 3.3mn people). This is projected to increase to 468mn per day by 2030 (source: Bluefield Research) as ever more AI data centres require power and cooling. The scale of these requirements is leading to some data centres being the largest single consumers of water in the areas where they are located, leading to conflicts of interest with other industrial users and residents (e.g., Microsoft data centres in Iowa, per Bloomberg).

Exploding data consumption needs more bandwidth

The digital universe has reached the level of the Yottabyte, with 90% of the world's data having been created in the past two years (source: IBM). According to IDC, the amount of data created is projected to double every 2-3 years, Meanwhile, according to Statista, we created c.64ZB of data in 2020, 120ZB by the end of 2023, and this is projected to grow to 181ZB by 2025, and nearly 8-fold to 1,373ZB by 2030. Significant capacity additions to the network and bandwidth are needed to enable this growth to continue. Per Bloomberg, US network operator AT&T reported demand on its wireless networks was up 30% in 2023, with AI likely to increase this further. Similarly, Verizon reported that its network traffic doubled over 2020-24, and it predicts it will double again by 2030 owing to demand from AI tools.

> AI is the next growth machine for us because it creates mountains of data that will need to be carried, for example, from data centers to end-users for analysis and then back to data centers.
>
> **Verizon Consumer CEO Sowmyanarayan Sampath, via Bloomberg, Mar 2024**

Exhibit 50: Global data generation per year (zettabytes)
In 2023 the world generated 120 zettabytes of data every year. By 2030 this number will more than double, requiring significant network bandwidth expansions to accommodate it



Source: Statista (2020-2025E), BofA Global Research factoring in global data multiples every 2-3 years
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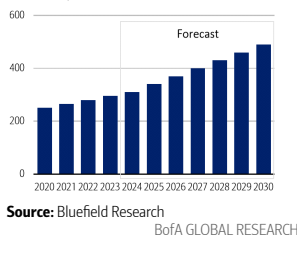
Exhibit 51: Computing is thirsty work
Global data centre water consumption projected to rise >50% 2024-30

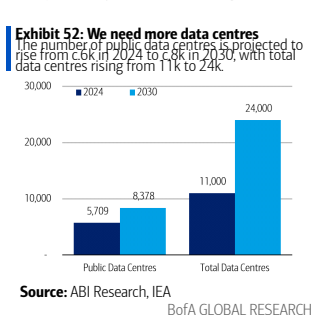


Source: Bluefield Research
BofA GLOBAL RESEARCH

Real Estate required for thousands more data centres

Where will all the data centres be built? It's clear that much more land will be required. In 2024 there were a total of 11,000 operational data centres, but as much as 24,000 are expected to be required by 2030. The larger, more power and resource hungry sites are 'public data centres' - space rented out to third parties for their equipment/server storage, of which there were c.5,700 operational in 2024, 7,000 when including those already planned or under construction. More will likely be needed owing to increased AI workloads, with up to 8,400 public data centres projected to be in operation by 2030 - the majority of this growth from cloud computing hyperscalers (sources: Bloomberg, ABI Research, IEA, McKinsey).

Exhibit 52: We need more data centres
The number of public data centres is projected to rise from c.6k in 2024 to 11k in 2030, with total data centres rising from 11k to 24k



Source: ABI Research, IEA
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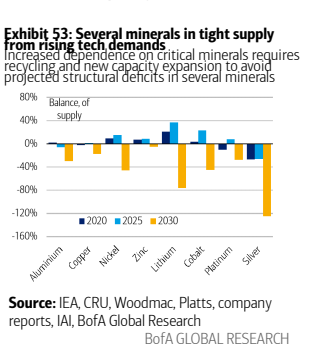
Exhibit 53: Several minerals in tight supply from rising tech demands
Increased dependence on critical minerals requires recycling and new capacity expansion to avoid projected structural deficits in several minerals



Source: IEA, CRU, Woodmac, Platts, company reports, IAI, BofA Global Research
BofA GLOBAL RESEARCH

Metals important for future technologies - we are living in a material world!

Several mined materials are becoming increasingly critical for multiple overlapping technologies, particularly in the energy, transport and aerospace sectors. This poses 1) scarcity risk - BofA metals strategists already foresee structural deficits by 2030 in several critical minerals owing to these trends (including copper, nickel, lithium, cobalt and silver), and 2) geopolitical risk - the concentration of minerals in a few geographical areas, many controlled directly or indirectly by China, risks a race to control the resources required. Trade restrictions are already emerging, e.g. China restricting Gallium and Germanium exports, required in advanced semiconductor manufacturing.

We need more people

Per OECD up to 1/3 of the global workforce will need to be reskilled by 2030 owing to a combination of disruptive technologies, and even higher 40% of workforce may need to reskill as a result of implementing AI and automation by 2028 (source: WEF). However despite such fears of AI and future technologies impacting and displacing jobs, there are several shortages of the skills required for these growing technologies already. Per the Financial Times, advances in AI are being slowed by a global shortage of workers with skills in areas such as deep learning, natural language processing, and robotic process automation, with just 22,000 AI specialists globally in 2022 per Deloitte, and a 50% gap between AI positions needed and available skilled workers to fill them (Reuters). Filling this skills gap will be crucial to continue the continued growth of AI and related technologies.

5. Rebuilding Everything

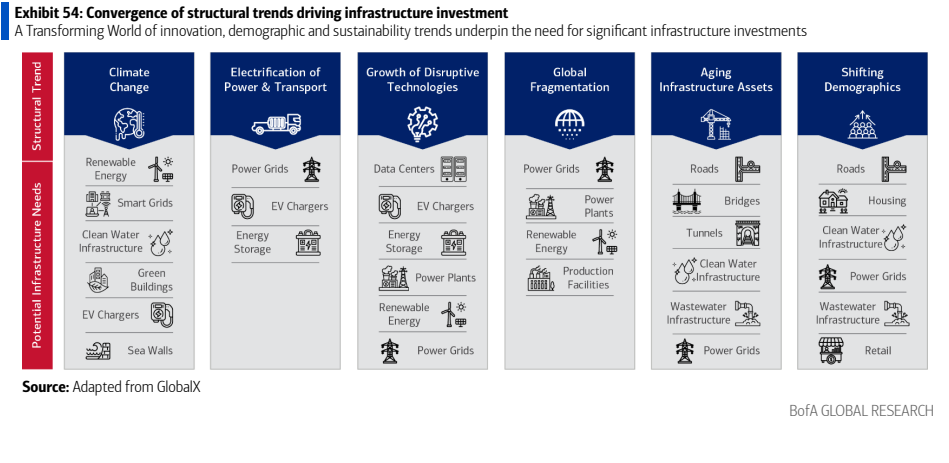
Summary: Global Infrastructure needs to be expanded and modernised to accommodate converging demographic, sustainability and innovation trends. But there's a funding gap - US$94tn is required globally by 2040 (source: Oxford Economics), and an estimated US$500bn is needed each year by 2030 *on top* of available public funds (source: Brookfield). This spans several structural trends - including decarbonisation, electrification, disruptive technologies, reshoring, shifting demographics and ageing of existing assets - all requiring a significant increase in infrastructure investment.

The long and winding road to nextgen infrastructure

The relationship between technology, economic growth and infrastructure is closely tied to both expansion *and* modernisation requirements.

- **Addition**: Expanding infrastructure to support digital technologies and several structural trends, including data centres, high-speed data networks, and energy installations to power them.
- **Rebuilding ageing assets**: Older infrastructure such as power grids, water systems and transport networks require replacement and modernisation to integrate new technologies such as IOT/sensors, AI monitoring and intervention.

Exhibit 54: Convergence of structural trends driving infrastructure investment
A Transforming World of innovation, demographic and sustainability trends underpin the need for significant infrastructure investments

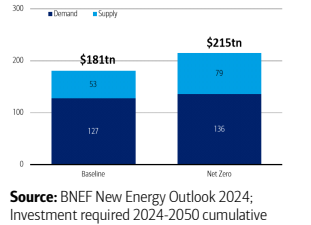

Structural Trend
Potential Infrastructure Needs
Climate Change
Electrification of Power & Transport
Growth of Disruptive Technologies
Global Fragmentation
Aging Infrastructure Assets
Shifting Demographics

Source: Adapted from GlobalX
BofA GLOBAL RESEARCH

Energy transition: towards a decarbonised, decentralised, digital energy system

The global energy system is transitioning towards more diversified sources of power generation and storage, which requires significant infrastructure and technology. Global investment trends are beginning to reflect this, with close to US$2tn invested in a range of clean energy assets in 2023 (double that of 2020). However, much more is needed. BNEF projects investment needs will rise to US$3tn per year based on current technologies/policies on average over 2023-30, and could reach US$5tn on average per year if further policies were instated. Power generation, EVs and grids made up c.90% of this investment in 2023, but the range of sectors is diversifying to clean industry (steel, ammonia, bioplastics), storage and electrified heat, for example.

Exhibit 55: Global Energy Investment: c.US$200tn in the next 25 years
US$181-215tn of energy investment required between 2024-2050 across demand (e.g. EVs, heat pumps) and supply (energy generation and storage)



Source: BNEF New Energy Outlook 2024; Investment required 2024-2050 cumulative
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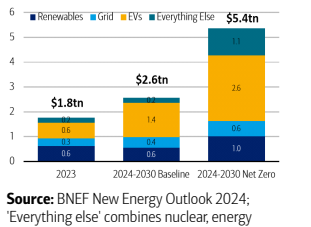
Exhibit 56: Energy Transition Investment increasing
c.US$2tn invested in clean energy technologies in 2023. This is projected to rise to US$2.6tn on average annually 2023-2030, but could exceed US$5tn



Source: BNEF New Energy Outlook 2024; 'Everything else' combines nuclear, energy storage, carbon capture, hydrogen, electrified heat and clean industry
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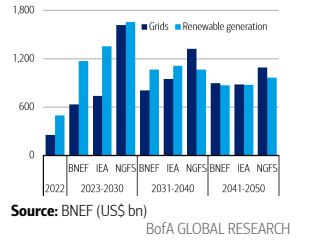
The power we're supplying…it's electrifying! Grid reinforcements are needed

Simultaneous electrification of transport, buildings and industry creates several difficulties in balancing the production, transmission, storage and demand for energy. The electricity grid needs to add considerable new capacity to accommodate this, in addition to upgrading and replacing existing assets. Investment in supporting supply chains is necessary as well, such as cable manufacturing, but also metals. Copper required for electricity networks could double in 2020-40 for example, per the IEA, outpacing the volume required in electric vehicles.

This requires a combination of investment and technologies. A range of external projections from BNEF, IEA and NGFS suggest the US$250bn spent annually on the grid in 2022 could more than treble between 2023 and 2030, with countries spending up to 1% of their respective GDP. A quarter of the investment between 2024-35 would be in asset replacements per BNEF, rising to 33% between 2035-50. Key technology investments can mitigate this, such as smart grid infrastructure, virtual power plants, regional and subsea interconnectors, and reconductoring - advanced conductors that can double capacity on existing lines.

Exhibit 57: Average annual grid spending needs to 2050 (US$ bn)
Whatever the scenario, significant growth in grid capex is required, rising from half that of power generation in 2022 to exceeding it by 2040-50



Source: BNEF (US$ bn)
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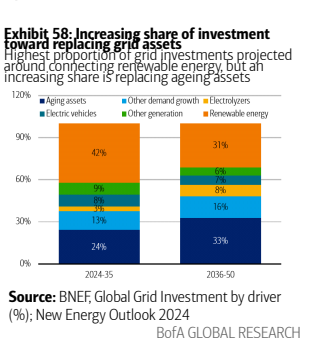
Exhibit 58: Increasing share of investment toward replacing grid assets
Highest proportion of grid investments projected around connecting renewable energy but an increasing share is replacing ageing assets



Source: BNEF, Global Grid Investment by driver (%); New Energy Outlook 2024
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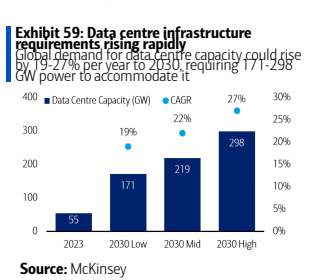
Disruptive Tech needs more data centres and related infrastructure

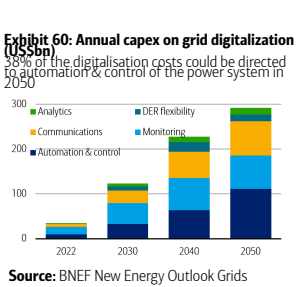
Data centres in particular are key to enabling AI and several related technologies, with capacity set to increase rapidly. McKinsey projects that by 2030 scaling data centre infrastructure will require more than US$1tn, US$250bn of which in installation of mechanical and electrical systems. The power requirements to meet the increasing demand could be 171-298 GW. To put the pace of demand growth in context, to avoid a supply deficit, at least twice the data centre capacity built between 2000 and 2024 would need to be built in less than a quarter of the time.

Exhibit 59: Data centre infrastructure requirements rising rapidly
Global demand for data centre capacity could rise by 19-27% per year to 2030, requiring 171-298 GW power to accommodate it



Source: McKinsey
BofA GLOBAL RESEARCH

Exhibit 60: Annual capex on grid digitalization (US$bn)
38% of the digitalisation costs could be directed to automation & control of the power system in 2050



Source: BNEF New Energy Outlook Grids (2023) DER = Distributed Energy Resources
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Grids get digital and automated

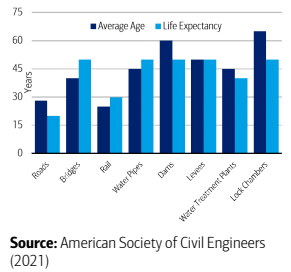
Changing energy generation/consumption patterns will require better monitoring, optimisation and control of the electricity grid, all of which can be enabled through digitalisation and automation. Annual grid spend on digital technologies is set to more than treble between 2022 and 2030 per BNEF to over US$100bn, trebling again to 2050, shifting from the largely monitoring spend today, to technologies required to enable more distributed energy resources. Automation & control would make up the majority of these investments (38% by 2050 per BNEF). This not only enables the reliable provision of energy, but also identifies bottlenecks more quickly, brings more energy resources online when required, and achieves peak load shifting through pricing incentives - all of which is expected to increase in the next 5 years.

Ageing assets meet reshoring & energy security

Ageing infrastructure in several developed economies needs to be rebuilt and modernized. In the US, roads, dams, and water plants have all exceeded their life expectancy on average. Furthermore, half of US power grid infrastructure assets are >20 years old, and 30% of EU power lines are over 40 years old, which could reach 90% by 2050 (Eurelectric). In the US alone a c.US$3tn infrastructure funding gap exists between 2020-2029, with US$6tn needs vs US$3tn funded (per ASCE).

This has not gone unnoticed by governments and investors. Since 2021, more than US$1tn in private manufacturing investments have been announced in the US, for example, following incentives such as the US Infrastructure Investment and Jobs Act launched in November 2021. Focus has been on reviving manufacturing in several industries (particularly semiconductors, EV/batteries, and renewable energy) with multiple national security and economic objectives such as energy security, tech self sufficiency, reducing price volatility and geopolitical risk.

Exhibit 61: Ageing infrastructure in the US needs upgrading
In the US roads, dams, and water plants all exceed their life expectancy on average



Source: American Society of Civil Engineers (2021)
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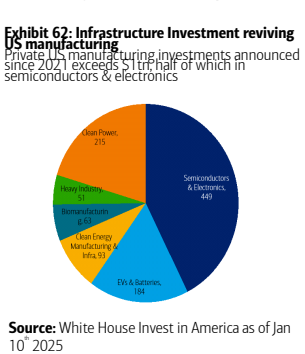
Exhibit 62: Infrastructure Investment reviving US manufacturing
Private US manufacturing investments announced since 2021 exceeds $1tn, half of which in semiconductors & electronics



Source: White House Invest in America as of Jan 10th 2025
BofA GLOBAL RESEARCH

Demographic trends driving infrastructure investment

A combination of urbanisation, ageing populations and changing consumer/retail preferences are all driving increased infrastructure investment needs. The global urban population exceeded the rural population for the first time in 2007. The world has continued to urbanise since - now 55% of the population. By 2030, the UN expects the world to have 43 megacities (vs 31 in 2018) with a population of 10m+. By 2050, it expects some 66% of the global population to be living in cities on average, rising to 87% in developed countries (vs 70% in 1980). Asia and Africa are set to contribute the majority of this growth (90%).

Such rapid urbanisation will require smart solutions in infrastructure - particularly in mobility (e.g., mass transit, shared and eventually autonomous vehicles), clean energy, housing, water, food production (e.g. vertical farming), technology (e.g., telecommunications), and waste management.

6. The End of "Anything But Bonds"

Summary: The end of 5,000-year lows in interest rates, fiscal excess, inflation….the "Anything but Bonds" trade has been the most powerful Wall St trend of the past 5 years; in the next 5 years either self-driven or market-imposed, we believe the era of government fiscal excess ends, reversing "Anything but Bonds" pricing in asset markets.

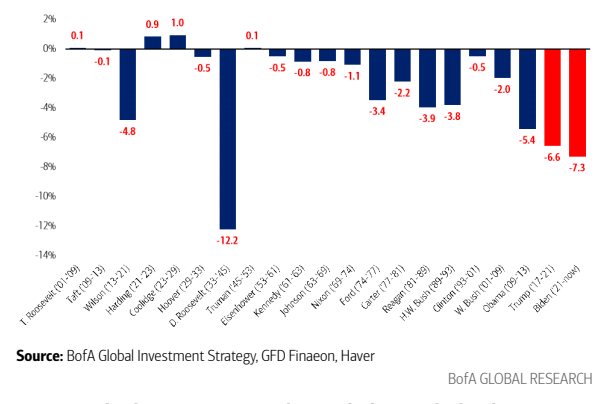
Beneficiaries: Bonds, REITs, CRE, Emerging Markets, Banks.

Big Government, Big Debt, Big Bond Bear

Big government has been one of the biggest themes of the 2020s. Central banks dominated economic policy making for much of the past 30 years. Fiscal policy was secondary. Asset prices in the 2010s were particularly driven by extreme monetary policies such as Quantitative Easing, Zero Interest Rates, Negative Interest Rates. By the start of the 2020s, interest rates had fallen to 5000-year lows (Exhibit 4). This has changed dramatically in recent years as a global pandemic, wars, and fiscal excess ended the 40-year long bond bull market (1981-2020). Now both governments and central banks share responsibility for economic growth.

The US federal budget deficit has averaged 9% of GDP in the past 5 years, the 2020s, with the past two administrations running the largest deficits since FDR in the '30s/'40s (See Exhibit 64). The US$7tn US government sector is now the 3rd largest economy in the world in GDP terms. Big government has aided and abetted big nominal GDP growth (up almost 50% in past 5 years). The trend is global. Governments running budget surpluses have become rare… last time China ran a budget surplus was 2007, US 2001, Japan 1992, France 1974, Italy 1905.

Exhibit 63: US government budget balance (% GDP) under each administration since 1900
Biden & Trump deficits highest since FDR



Source: BofA Global Investment Strategy, GFD Finaeon, Haver
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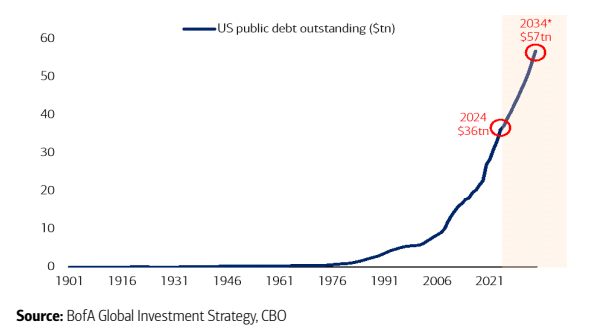
Bigger deficits mean big debt. Global government debt has risen 40% in the past 4 years to almost US$100tn (US = 34% of total, China 15%, Japan 11%). The government sector is now the sector of leverage rather than corporations or households. The US has led the debt binge. Its national debt is now US$36.0tn, rising US$1.0tn every 100 days, and is projected to hit US$40tn in the first 400 days of the new Trump administration (Exhibit 64). As central banks unwound exceptional monetary support - peak QE saw the Fed buy c.US$13bn worth of bonds every trading hour - the cost of government debt surged…US annual interest payments are currently running at US$1.2tn.

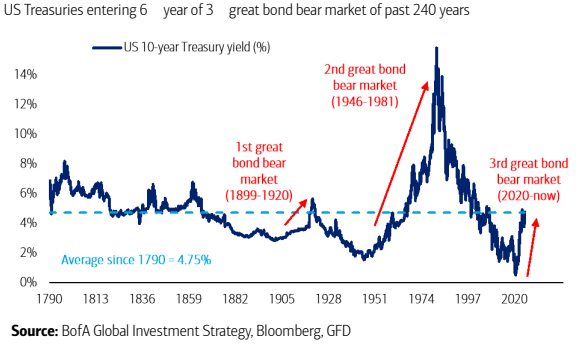
Big government and big debt have caused a big bear market in bonds (Exhibit 65). 10-year rolling returns have just turned negative for the first time in the past 100 years (Exhibit 66). The price return from the 30-year US Treasury is -50%. Bond sensitive sectors have suffered, e.g., REIT returns are negative decade-to-date.

Exhibit 64: US national debt (US$ tn)
US national debt rising by US$1.0tn every 100 days



Source: BofA Global Investment Strategy, CBO
BofA GLOBAL RESEARCH

Exhibit 65: US 10-year Treasury yield since 1790
US Treasuries entering 6th year of 3rd great bond bear market of past 240 years



Source: BofA Global Investment Strategy, Bloomberg, GFD
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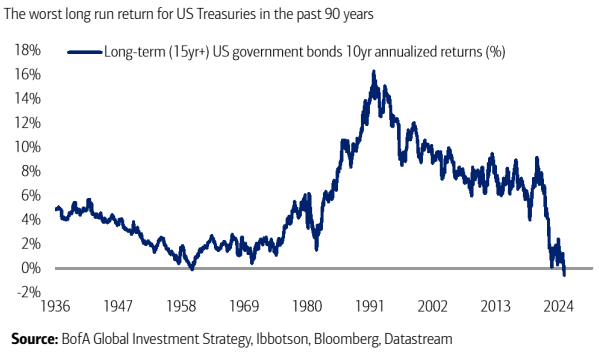
Exhibit 66: US 15yr+ Treasuries: 10-year rolling annualized returns (%)
The worst long run return for US Treasuries in the past 90 years



Source: BofA Global Investment Strategy, Ibbotson, Bloomberg, Datastream
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The End of "Anything but Bonds"

Great bull markets begin with investors deeply underweight an asset class, a shift in policy, and a macro catalyst. Asset allocators should not forget that the US economy has been in recession for just a couple of months in the past 15 years. In the second half of the 2020s we expect the aversion to bonds and bond-sensitives to end, driven by markets, governments, and central banks.

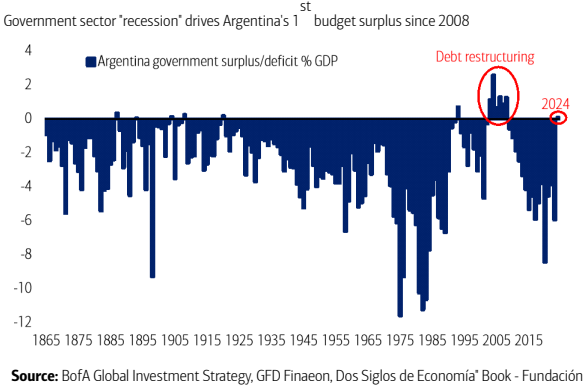
Markets…financial markets are demanding greater fiscal discipline. In recent years bond *vigilantes* have delivered a series of "shots across the bow"…to the UK government in Oct'22, to the US Treasury in Aug'23, to the French government in Dec'24. In each case, the rise in bond yields caused a change in fiscal behaviour. The rising level of western government debt owned by foreigners (23% for US Treasuries, 29% UK Gilts, 47% Germany Bunds, 51% France OATs) will increase the hand of the bond market over domestic fiscal policies which will be subject to more elevated rates volatility and geopolitical developments (foreign holdings of US Treasuries rose to a record of US$8.6tn in Nov'24, of which 8.9% is owned by China). Higher foreign ownership also increases spill-over effects via the currency market, with the mix of rising bond yields and a plunging currency putting heightened pressure on local governments to cut budget deficits.

Government…the new US government set to be more spendthrift than the Biden administration, partly to fund tax cuts. A more militarily isolationist Trump means cuts to the huge US$1tn defence budget (larger than the next 9 largest country military budgets combined). The new Department of Government Efficiency (DOGE) is targeting US$1-2tn of cuts. While neither are guaranteed to succeed, they signal to bond investors intent to rein-in spending. Tax cuts remain central to 2nd Trump administration, but new forms of tax revenue can creatively be designed (e.g., Treasury underwrites new GSEs to reduce home equity interest rates, spur home equity refinancing, increase volume of property transactions & tax receipts). In addition, the new US administration expects deregulation to spur nominal growth to reduce the deficit as a % of GDP. And the fashion for government discipline best exemplified by the new Milei's government in Argentina which delivered a very rare budget surplus in '24 (just the 13th budget surplus since 1865 - Exhibit 67) by shrinking the government sector (via budget consolidation), in turn boosting growth to 5%, reducing inflation to a 4-year low.

Central banks…finally the threat of higher bond yields and real rates to a US economy that is driven by asset prices & wealth also raise the prospect that should bond markets become more disorderly, central banks will be forced to resume bond purchases to cap the level of bond yields (YCC…"Yield Curve Control") and cap the level of government interest payments (ICC…"Interest Cost Control"). Japan and the Bank of Japan remain the global precedent. Today the BoJ owns c.50% of the JGB market.

Driven by markets, governments, central banks or recession, the returns from bonds are likely to improve in the second half of the 2020s. Once the "Anything but Bonds" theme ends, secular bull markets in bond-sensitives such as REITs, Commercial Real Estate, small cap stocks, Emerging Market assets, and banks will begin.

Exhibit 67: Argentina government surplus/deficit % GDP
Government sector "recession" drives Argentina's 1st budget surplus since 2008



Source: BofA Global Investment Strategy, GFD Finaeon, Dos Siglos de Economía" Book - Fundación Norte y Sur
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7. Populism

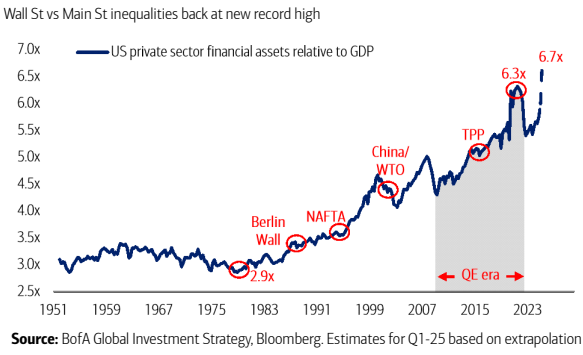
Summary: Populism is politically very popular in the 2020s; populist policies in coming years mean less globalization, less immigration, less central bank independence, and fiscal policy divergence between the US (less government spending) & Europe (more government spending).

Beneficiaries: TIPs, Gold, Crypto as hedges against 3-4% inflation & erosion of central bank independence; Main St consumer stocks in US & Europe on higher-for-longer wage growth; European fiscal winners over US fiscal losers (e.g. EU>US defence stocks).

A global political theme

Populism is politically on the rise in the 2020s. *Occupy Wall Street*, Brexit, Trump 1.0 were all harbingers in the 2010s, and the political trend has deepened in the 2020s. Electorates are increasingly shunning mainstream political leaders and parties in response to rising inflation, rising immigration, and rising inequality (the asset prices on Wall St are 6.7x the size of the GDP of Main St - Exhibit 68).

Exhibit 68: US private sector financial assets relative to US GDP
Wall St vs Main St inequalities back at new record high



Source: BofA Global Investment Strategy, Bloomberg. Estimates for Q1-25 based on extrapolation of NYA index YTD return for the quarter, and BofA Economics projection for US GDP
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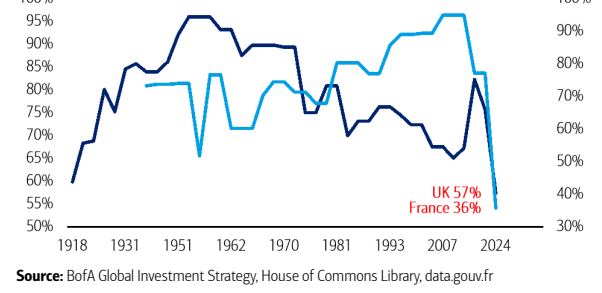
In 2024, elections were held in countries that accounted for 40% of the world's population, 60% of world GDP, and 80% of the world's equity market cap. Trump's sweep in the US Presidential election was the most consequential populist victory, but voters notably ousted "incumbents" in 26 of the 32 elections in 2024, a year that saw the share of votes won by mainstream parties fall to its lowest in the UK since 1918 in (57%), to its lowest level in France since 1945 (36% - Exhibit 69). The German election on February 23rd looks set to be the next populist milestone. The German economy has been stagnant for 10 years, and "far-left" and "far-right" parties have recently attracted over 40% of regional election votes.

Exhibit 69: Mainstream* parties' share of parliamentary election vote (% of turnout)
The bear market in mainstream political parties



Source: BofA Global Investment Strategy, House of Commons Library, data.gouv.fr
*mainstream parties in UK = Conservative Party, Labour; in France = Conservatives (Republicans, UMP, RPR), Centrists, Socialist Party

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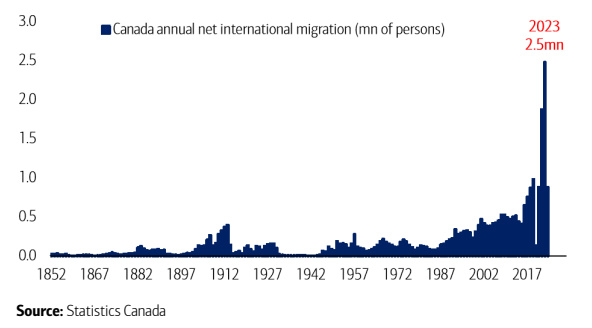
Globalization, Immigration, Independence

Populist policies in coming years mean less globalization, less immigration, less central bank independence, a new 3-4% normal for inflation, and fiscal policy divergence between the US (less government spending) & Europe (more government spending).

Globalization is not populist. Globalization arguably peaked in the '90s/early-2000s, and has certainly been in retreat since Trump abandoned the Trans-Pacific Partnership on day 1 of his first administration. In the 2020s the US-China trade & tech war has grown under the Biden administration, and pandemics & wars have further dented free trade. Trump 2.0 promises further "America First" trade policies (tariffs) to protect US intellectual property & industrial production, as well as extract greater revenues from US allies & foes to help pay for US deficits. Global capital, goods & services won't flow as freely as they did in the '90s/early-2000s, and lower supply causes higher prices all things equal, especially if "Europe First" & 'China First' policies retaliate. Unless and until protectionism causes recession, this means inflation stays high in coming years.

Immigration is not populist and new immigration policy will also prove inflationary via a lower supply of labour. Immigration into the US and other developed nations has been great in the past decade. For example, demographic data in both Canada and the UK in 2024 revealed a historic dichotomy between population growth and the birth-death ratio. In the UK, the number of births fell to the same level as the number of deaths for only the third time in the past 185 years, and yet the UK population grew 1.1%, its highest growth in 74 years. It was the same story in Canada where the population grew 3.2% in 2023 (highest since 1957), yet the birth-death ratio also fell to one. Record levels of immigration to the UK & Canada (2.5mn in 2023 - Exhibit 70) explain how the populations grew so rapidly.

Exhibit 70: Canada annual net international migration (mn of persons)
The 2020s have witnessed record levels of immigration to advanced economies



Source: Statistics Canada

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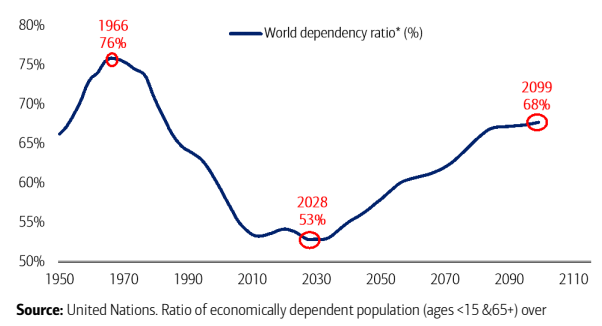
Immigration is a positive for Wall St. An increase in supply of workers constrains the growth of wages and labour costs (good for margins), but a larger population in aggregate boosts consumer spending, particularly with government support to help assimilate migrants. But the politics in North America & Europe in coming years must respond to populist demands for tighter immigration. Canada, the most pro-immigration G7 country of the 2020s, recently legislated to reduce temporary foreign workers from 7% to 5% of the population. Lower immigration will support domestic wages and encourage companies to hoard labour. They will also coincide with a trough in the global dependency ratio, i.e. the number of old and young relative to the working population is set to rise around the world for the first time in decades (Exhibit 71). The "price" of working people (wage growth) set to be much stronger in coming years relative to the past two decades.

Exhibit 71: World dependency ratio (UN projections)
The "price" of working people set to rise faster in the next 5 years vs past two decades



Source: United Nations. Ratio of economically dependent population (ages <15 &65+) over working-age population

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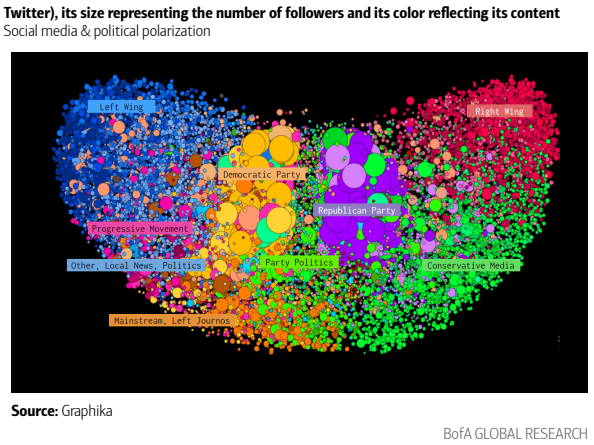
Central bank independence may also come under threat as populist politicians reduce the dominance of central banks in economic policy. In anticipation of this, central bank policy may become even more acquiescent to governments needing strong nominal economic growth to fund deficits and placate electorates that remain highly polarized (Exhibit 72). Regardless of whether less central bank independence is justified and deserved, moves in that direction likely to spur inflation expectations on Wall St.

Exhibit 72: Map of the US political landscape: each circle is an account on X (formerly Twitter), its size representing the number of followers and its color reflecting its content
Social media & political polarization



Source: Graphika

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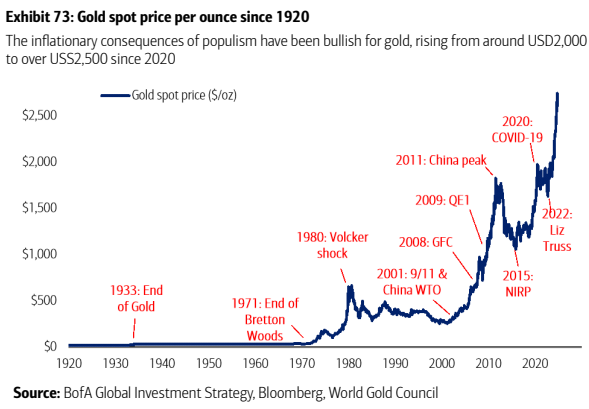
Finally, the impact of populism on fiscal policy will vary by region. In both the US & Europe electorates are demanding measures to improve housing affordability, one of the impediments to wealth equality. But US populists want smaller government, debt & deficits. In contrast, European populists want to end fiscal orthodoxy and increase government spending, especially in the core countries of France & Germany.

Populism is likely to spur demand for TIPs, Gold (Exhibit 73), Crypto as hedges against a "new normal" of 3-4% inflation in the late-2020s and the erosion of central bank independence. Populism is bullish for wages and Main St consumer stocks in US & Europe. Populism is bullish for European fiscal winners (think defence, domestic small cap, homebuilding, Ukraine reconstruction stocks) relative to US fiscal losers (e.g., defence stocks).

Exhibit 73: Gold spot price per ounce since 1920
The inflationary consequences of populism have been bullish for gold, rising from around USD2,000 to over US$2,500 since 2020



Source: BofA Global Investment Strategy, Bloomberg, World Gold Council

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8. War & Peace

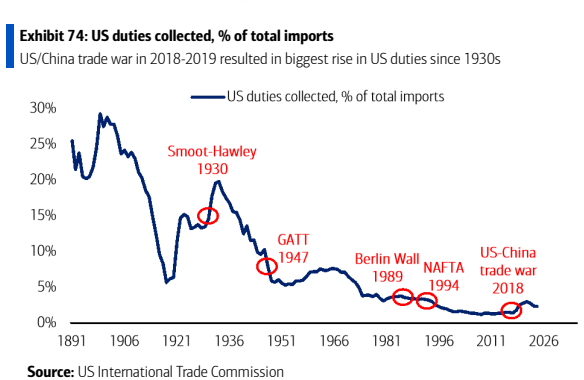
Summary: Global trade & tech protectionism is set to continue; for Trump, tariffs address "unfair trade practices", raise US import duty revenues, achieve non-trade objectives; but the US "forever wars" are set to end to the benefit of Europe; and America First policies will spur Asian & European stimulus & reform.

Beneficiaries: gold & crypto, commodities, US exporters, China & European domestic stocks.

The End of Globalization

The 1990-2010 era of peace and globalization has been replaced in the past 10 years by trade wars, military wars, greater geopolitical conflict. The US has become more protectionist, and the 2018-2019 trade war resulted in the largest rise in % of US duties collected since 1930 and Smoot-Hawley (Exhibit 74). And the US-China battle for economic, technological, geopolitical supremacy has disrupted global supply chains, causing China to shift its exports to the rest of the world, away from the US, EU, Japan -Exhibit 75), and giving birth to the early-2020s theme of reshoring.

Exhibit 74: US duties collected, % of total imports
US/China trade war in 2018-2019 resulted in biggest rise in US duties since 1930s



Source: US International Trade Commission

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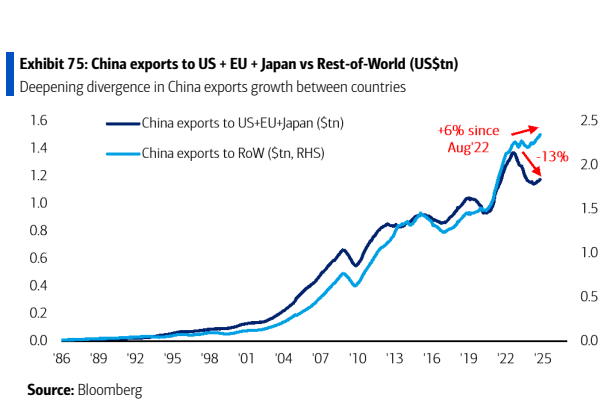
Exhibit 75: China exports to US + EU + Japan vs Rest-of-World (US$tn)
Deepening divergence in China exports growth between countries



Source: Bloomberg

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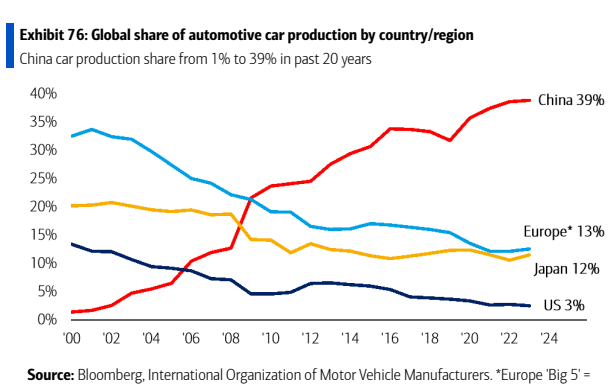
Biden followed Trump's protectionism, as a trade war was followed by a tech war. The US Inflation Reduction Act and CHIPS and Science Act of 2022 was designed to boost investment in domestic tech/AI/energy infrastructure and the economy, maintained and extended tariffs (on steel/aluminium/lithium/etc they were raised from 7.5% in '19 to 25% in '24, EVs pushed from 25% in '18 to 100% in '24, semiconductors from 25% in '18 to 50% in '25), and introduced curbs on China's access to advanced chips. Industries in which China's dominance has grown have also become targets for tariffs and restrictions. China accounted for 60% of EV sales in 2023 (vs Europe 25%, US 10% - per the IEA) and its share of global auto production has soared from 1% to almost 20% in the past 20 years (...as Europe's share has declined from 34% to 13%, Japan 21% to 12%, US 12% to 3% -Exhibit 76). In recent years, the US & Europe have both imposed tariffs on China EVs and the US issued a ban on smart cars from China & Russia.

Exhibit 76: Global share of automotive car production by country/region
China car production share from 1% to 39% in past 20 years



Source: Bloomberg, International Organization of Motor Vehicle Manufacturers. *Europe 'Big 5' = Germany, Spain, France, Italy, UK.

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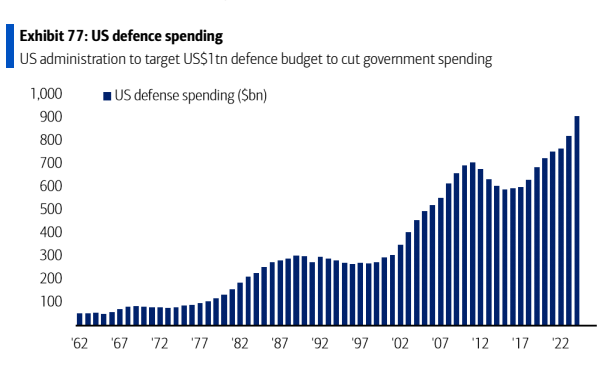
War

Global trade & tech protectionism is set to continue. Trump's tariffs address "unfair trade practices", raise US import duty revenues, and achieve non-trade objectives. "America First" continue. Trump has threatened a 60% tariff on all Chinese imports, singled out BRICS, Mexico, Canada, EU for higher tariffs (collectively these countries make up 50% of global GDP), and has called for an "External Revenue Service" to collect tariffs. US objective is to reduce the US$1tn defence budget (Exhibit 77) to ease pressure on the US budget deficit, and force allies to pay their "fair share" of the West's military commitments (the US currently contributes 16% of NATO's EUR 4.6tn annual budget).

Exhibit 77: US defence spending
US administration to target US$1tn defence budget to cut government spending



Source: Office of Management and Budget

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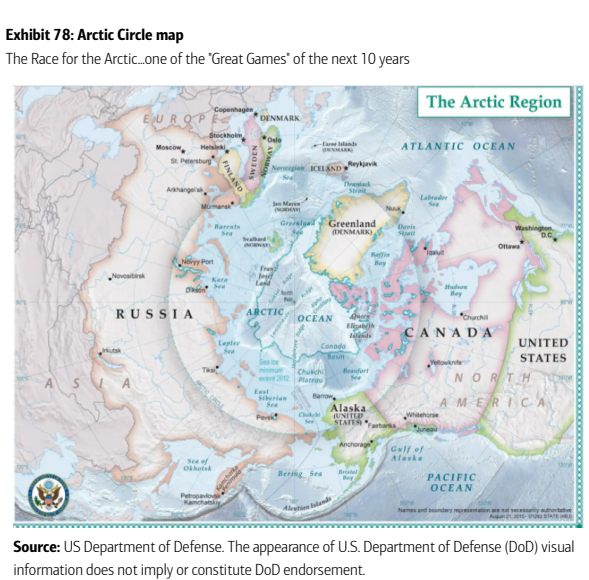
One of the "Great Games" on the next 10 years will be the "Race for the Arctic". The intensifying race for global resources means US and Russia will continue to butt heads to monopolize control of the cheaper/safer Northern Sea Route shipping lane (than Suez) and exploitation of 15% world's undiscovered oil, 30% world's undiscovered natural gas (worries over Spratly Islands are likely to give way to worries over geopolitical spats to secure Spitsbergen/Svalbard - Exhibit 78).

Exhibit 78: Arctic Circle map
The Race for the Arctic...one of the "Great Games" of the next 10 years



Source: US Department of Defense. The appearance of U.S. Department of Defense (DoD) visual information does not imply or constitute DoD endorsement.

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Peace

The less anticipated good news for investors is the "peace" in the "War and Peace" theme that will drive bullish regional themes.

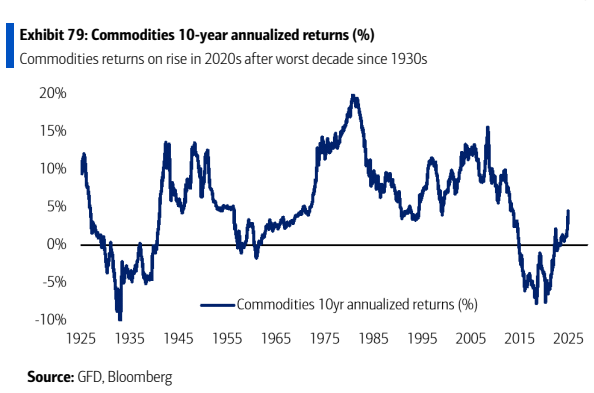
First, the US driven by budget needs is very likely to force resolutions to the Russia-Ukraine war, as well as conflict in the Middle East. This is very bullish for Europe. The Russia-Ukraine war is the 487th military conflict in Europe in the past 2000 years, and Europe is a "peace-winner" and a "war-loser". The best equity decades for European assets relative to the rest-of-the-world in the past century were 1950s after WW2 & Marshall Plan (stocks up 191%) & 1980s as Soviet Union ended & Berlin Wall fell (stocks up 164%). Europe is the winning region should the US end "forever wars".

Second, "America First" policies are likely to spur "Europe First" and "China First" policies. The EU/China both set for aggressive policy easing in response to US tariffs, lower rates, cheaper currencies at a time of cheap equity valuations relative to the US. China, which has been one of the biggest losers from de-globalization given its reliance on trade (38% of GDP) and as the world's largest exporter (US$3.6tn in 2024), likely to prioritize measures that boost the domestic economy via a rise in Chinese consumption as a share of GDP. In Europe, coming years will see efforts to reduce reliance on China for trade, US for security (European defence stock likely winner of this push), Russia for energy, reforms advocated by the Draghi report to address growth & demographics.

War & Peace

Tech & trades wars and protectionist policies will, in the absence of recession, continue to be inflationary as they restrict flow of goods, services, labour, capital. Both gold and commodities (10-year annualized returns have turned positive in recent years - Exhibit 79) have benefitted from the shift to protectionism in the past 10 years. They should be expected to continue to do so. Crypto is also a good hedge for currency instability. More optimistically, reforms & stimulus in China & Europe in response to the secular US tariff regime suggest investors will be rewarded by asset allocation to US exporters and Chinese & European domestic demand plays in coming years.

Exhibit 79: Commodities 10-year annualized returns (%)
Commodities returns on rise in 2020s after worst decade since 1930s



Source: GFD, Bloomberg

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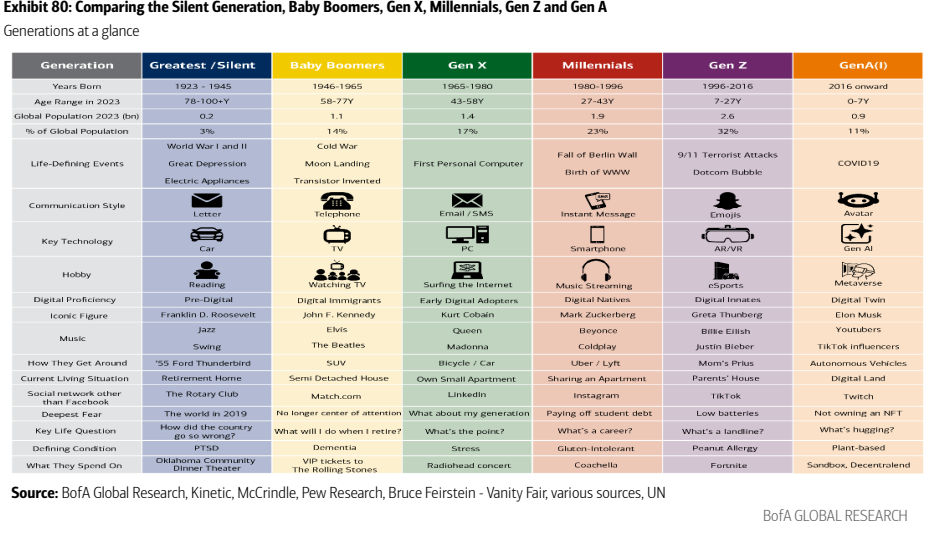
9. Rise of the Zoomers...and Boomers!

Summary: Over the next 10 years, we expect increased consumer spending, particularly from Gen Zs and the ageing Boomer population. Why?

- Boomers have amassed significant wealth that they will unwind during their retirement. As an example, US Boomers have built US$82tn in net worth as of 2024 Q3 (source: Federal Reserve, Survey of Consumer Finances and Financial Accounts of the US). Globally, over-65s are projected to spend almost US$15tn a year by 2030, up from US$8.7tn in 2020 (source: Ageing Analytics Agency; Brookings).
- Younger generations will benefit from the Great Wealth Transfer in the coming decades. Some US$84tn could be transferred to them from older generations by 2045 (source: Cerulli Associates).
- Gen Zs will continue to represent the largest cohort of the global population over the next 10 years at c.30% (source: BofA Global Research, United Nations). Their global income levels are set to be the largest of all generations, increasing from US$9tn in 2023 to US$36tn in 2030E and US$74tn in 2040E (source: BofA Global Research, Euromonitor). This generation could also see the largest increase in spend of US$2.7tn between 2024 and 2030, reaching US$12.6tn (source: BofA Global Research, World Data Lab, Generations Forecasts, UN).

With large wealth and spending levels over the next 10 years, the consumption patterns of Gen Zs and ageing Boomers will have a strong influence on the global economy. Gen Z's preferences are shifting away from the old economy towards tech-compatibility, sustainability, and New Media. And an ageing population entails greater spend on healthcare, aged care, leisure and financials.

Exhibit 80: Comparing the Silent Generation, Baby Boomers, Gen X, Millennials, Gen Z and Gen A
Generations at a glance



Generation	Greatest / Silent	Baby Boomers	Gen X	Millennials	Gen Z	GenA(I)
Years Born	1923 - 1945	1946-1965	1965-1980	1980-1996	1996-2016	2016 onward
Age Range in 2023	78-100+Y	58-77Y	43-58Y	27-43Y	7-27Y	0-7Y
Global Population 2023 (bn)	0.2	1.1	1.4	1.9	2.6	0.9
% of Global Population	3%	14%	17%	23%	32%	11%
Life-Defining Events	World War I and II Great Depression Electric Appliances	Cold War Moon Landing Transistor Invented	First Personal Computer	Fall of Berlin Wall Birth of WWW	9/11 Terrorist Attacks Dotcom Bubble	COVID19
Communication Style	Letter	Telephone	Email / SMS	Instant Message	Emojis	Avatar
Key Technology	Car	TV	PC	Smartphone	AR/VR	Gen AI
Hobby	Reading	Watching TV	Surfing the Internet	Music Streaming	eSports	Metaverse
Digital Proficiency	Pre-Digital	Digital Immigrants	Early Digital Adopters	Digital Natives	Digital Innates	Digital Twin
Iconic Figure	Franklin D. Roosevelt	John F. Kennedy	Kurt Cobain	Mark Zuckerberg	Greta Thunberg	Elon Musk
Music	Jazz Swing	Elvis The Beatles	Queen Madonna	Beyonce Coldplay	Billie Eilish Justin Bieber	Youtubers TikTok influencers
How They Get Around	'55 Ford Thunderbird	SUV	Bicycle / Car	Uber / Lyft	Mom's Prius	Autonomous Vehicles
Current Living Situation	Retirement Home	Semi Detached House	Own Small Apartment	Sharing an Apartment	Parents' House	Digital Land
Social network other than Facebook	The Rotary Club	Match.com	LinkedIn	Instagram	TikTok	Twitch
Deepest Fear	The world in 2019	No longer center of attention	What about my generation	Paying off student debt	Low batteries	Not owning an NFT
Key Life Question	How did the country go so wrong?	What will I do when I retire?	What's the point?	What's a career?	What's a landline?	What's hugging?
Defining Condition	PTSD	Dementia	Stress	Gluten-Intolerant	Peanut Allergy	Plant-based
What They Spend On	Oklahoma Community Dinner Theater	VIP tickets to The Rolling Stones	Radiohead concert	Coachella	Fortnite	Sandbox, Decentraland

Source: BofA Global Research, Kinetic, McCrindle, Pew Research, Bruce Feirstein - Vanity Fair, various sources, UN

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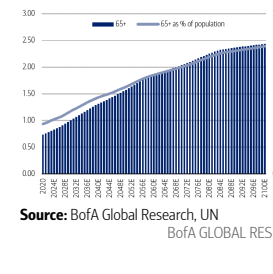
Boomers have amassed wealth to spend and pass on

The Silver Dollar: over-65s spending US$15tn a year by 2030

Baby Boomers are a generation born between 1946 and 1965 which means they will all be at least 65 years of age by 2030. The global population aged 65+ could increase by c.25% by 2030. And it could double by 2052 and triple by 2098.

Exhibit 81: Population aged 65+ (bn, LHS) and as % of the global population (%, RHS)
Global population aged 65+ rising from 10% in 2023 to 16% in 2050E



Source: BofA Global Research, UN

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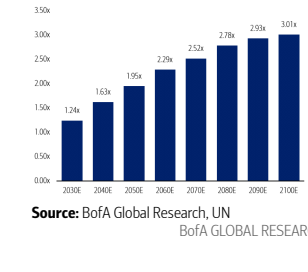
Exhibit 82: Population aged 65+ vs 2023
The number of 65 year olds could increase by c.25% by 2030



Source: BofA Global Research, UN

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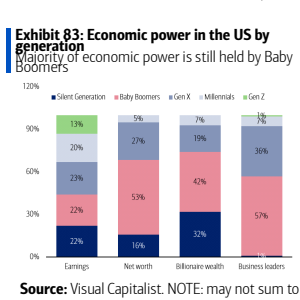
Boomers have amassed significant wealth. For example, as of 2024 Q3, US Boomers had accumulated US$82tn in wealth (source: Federal Reserve) - that's more than half of all US household wealth, while representing just 20% of the US population. US Boomers enjoyed a 54.7% increase in median wealth for 65-74-year-olds in 2016 and a 95.6% increase for over 75s compared with 1989 median wealth levels. They hold the most economic power in the US, in terms of net worth, billionaire wealth and business leaders by generation. Globally, over-65s are projected to spend almost US$15tn a year by 2030, up from US$8.7tn in 2020 (source: Ageing Analytics Agency; Brookings).

Exhibit 83: Economic power in the US by generation
Majority of economic power is still held by Baby Boomers



Source: Visual Capitalist. NOTE: may not sum to 100% due to rounding

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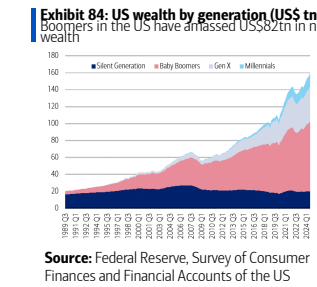
Exhibit 84: US wealth by generation (US$ tn)
Boomers in the US have amassed US$82tn in net wealth



Source: Federal Reserve, Survey of Consumer Finances and Financial Accounts of the US

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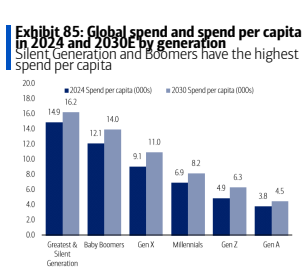
The Great Transfer of Wealth to younger generations like Gen Z

We expect this Boomer wealth to be passed on to younger generations. Between 2023 and 2030, the Boomer population could decrease from 1.1mn (14% overall) to 918,000 (11%) (source: BofA Global Research, UN). By 2030, some US$18.3tn could be passed on globally from those with at least a US$5mn net worth (source: Wealth-X). More than US$84tn in assets could be transferred to younger generations by 2045, with US$53tn of that coming from Baby Boomer households. And by 2048, US$105tn could be passed down (source: Cerulli Associates). Between 2024 and 2030, overall, the Gen Z population could spend US$12.6tn, an additional US$2.7tn vs 2024, the largest increase of all the generations. The Silent Generation and Baby Boomers also have the largest per capita spend over the same period as they spend their wealth.

Exhibit 85: Global spend and spend per capita in 2024E and 2030E by generation
Silent Generation and Boomers have the highest spend per capita



Source: BofA Global Research, World Data Lab, Generations Forecasts, UN

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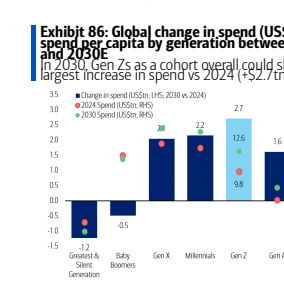
Exhibit 86: Global change in spend (US$) and spend per capita by generation between 2024 and 2030E
In 2030, Gen Zs as a cohort overall could show the largest increase in spend vs 2024 (+$2.7tn)



Source: BofA Global Research, World Data Lab, Generations Forecasts, UN

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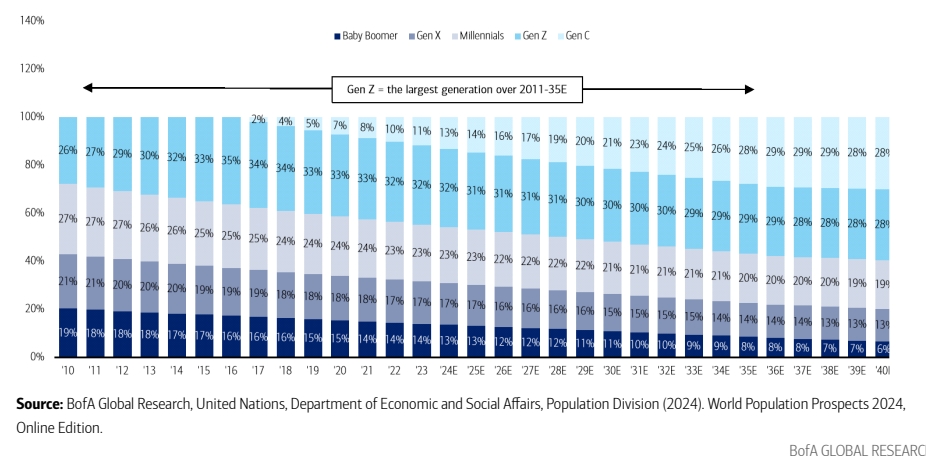
Gen Z: the largest, and richest generation by c.2035

Gen Zs (born 1996-2016) represented the largest cohort of the global population at 32% in 2023 and they should remain the largest until around 2035E. This means that their consumption decisions and patterns have a strong influence on the economy. The eldest Gen Zs are c.28 years old and the youngest are 8. They've never known a life without Google, 40% prefer hanging out with friends virtually than in real life, they will spend 6 years of their life on social media and they won't use credit cards. They're the 'clicktivists': flourishing in a decade of social rights movements, with 4 in 10 in our proprietary BofA seeing themselves as 'citizens of the world'. The Gen Z revolution is starting, as the first generation born into an online world is now entering the workforce and compelling other generations to adapt to them, not vice versa. Thus, they are about to become most disruptive to economies, markets and social systems.

Exhibit 87: Global population by generation
Gen Z will be the largest cohort over the next 10 years



Source: BofA Global Research, United Nations, Department of Economic and Social Affairs, Population Division (2024). World Population Prospects 2024, Online Edition.

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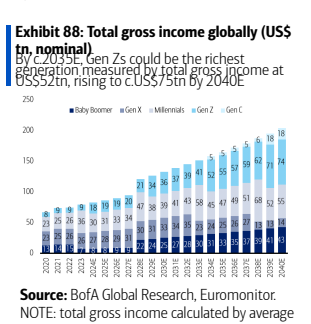
Show me the money

We estimate the total income of Gen Z at US$9tn in 2023 or 10% of global income, according to Euromonitor's gross average income database. By generation, this places Gen Zs' total income as the third largest (behind Millennials and Gen X). But by 2034, their total gross income could be US$52tn, making them the richest generation (Exhibit 88). And by 2040, their income could increase to US$74tn, accounting for 36% of total global income, the largest by total income levels and generation (Exhibit 88).

Exhibit 88: Total gross income globally (US$ tn, nominal)
By 2034, Gen Zs could be the richest generation measured by total gross income at US$52tn, rising to US$74tn by 2040E



Source: BofA Global Research, Euromonitor
NOTE: total gross income calculated by average gross income*population by age category. NOTE: Gross income = income before taxes and social security contributions from all sources including earnings from employment, investments, benefits and other sources such as remittances.

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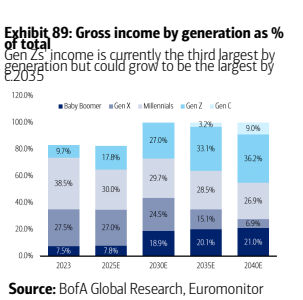
Exhibit 89: Gross income by generation as % of total
Gen Zs' income is currently the third largest by generation but could grow to be the largest by 2035



Source: BofA Global Research, Euromonitor

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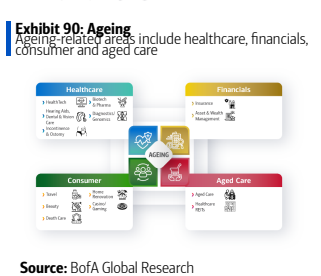
Trades

Exhibit 90: Ageing
Ageing-related areas include healthcare, financials, consumer and aged care



Source: BofA Global Research

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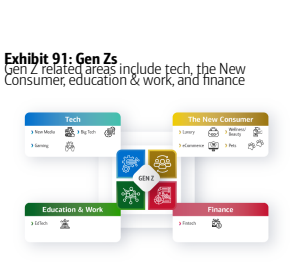
Exhibit 91: Gen Zs
Gen Z-related areas include tech, the New Consumer, education & work, and finance



Source: BofA Global Research

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Ageing: healthcare, financials, consumer, aged care

Healthcare: prevalence of age-related health conditions

Global gains in life expectancy mean a major shift in the causes of mortality from infectious diseases and acute illness to chronic diseases and degenerative illnesses. Some 80% of older adults have one chronic condition, and 50% have two or more (source: NIH). Ageing-associated non-communicable diseases or "diseases of the elderly" - cardiovascular disease, cancer, diabetes, and Alzheimer's - are responsible for 74% of deaths globally (source: WHO).

- **Hearing Aids, Dental & Vision Care**: Globally, 430mn people or over 5% of the world population suffer from some form of hearing loss (Source: WHO). Globally, about 30% of people between the ages of 65-74 have no natural teeth (source: WHO) and more than 1 in 7 of all US adults aged 65+ have lost all of their teeth (source: CDC). Globally, at least 2.2bn people have a vision impairment or blindness, of which at least 1bn have a vision impairment that could have been prevented or has yet to be addressed (source: WHO), and roughly 37% of elderly citizens' vision remain uncorrected (source: Essilor and Boston Consulting Group).
- **Incontinence & Ostomy**: Incontinence is the inability to control one's bladder or bowel movements. Urinary incontinence affects around 300mn people worldwide (source: Incontinence UK) and up to 35% of the total population over 60 is estimated to be incontinent, with women twice as likely as men. 1 in 3 women are estimated to have bladder problems.
- **Diagnostics/Genomics:** Currently, the consumer-driven use of genomics remains low, with those using it looking at the combination of family planning and personal DNA tests. Early adopters tend to be people who are already using other tech-enabled health products such as wearables and health tracking.
- **HealthTech:** Healthcare technology (HealthTech) is still in its infancy in many cases, but researchers will have exponentially growing volumes of data to use as input, and can harness the positive effects of network learning to apply it. Sub-areas include AI, Big Data, mobile health, telemedicine/telehealth, additive manufacturing, diagnostic services, and wearables.

Aged Care: senior housing & living facilities

87% of adults over-65 want to age in place (source: AARP) and up to two-thirds of US adults aged 65+ need assistance with daily living activities. Home and health care are among the top three priorities for people as they age. The market includes renovations, senior housing, nursing care, and senior living.

- **Aged Care:** The overwhelming majority, 75%, of the 50+ cohort in the US wants to stay in their own homes as they age. When purchasing a home, convenient access to healthcare facilities and shopping tend to play a significant role, cited by 40% of American aged 69+ (source: AARP Public Policy Institute). Households 55+ account for half of all current home improvement spending (source: Joint Centre for Housing Studies at Harvard University).
- **Healthcare REITs:** Healthcare REIT assets fall within the following sub-asset classes each with their own niche in meeting the needs of seniors: 1) Senior housing (including independent living; assisted living and continuing care retirement communities; 2) skilled nursing facilities; 3) hospitals; 4) medical office buildings (MOBs); and 5) life sciences. Across the acuity spectrum, hospitals have the highest levels of acuity, followed by skilled nursing facilities (SNF) and then senior housing.

Financials: ushering in the age of saving

Longevity risk - the risk that people live longer than expected, or "too long" - is putting the survival of retirement systems at risk. For individuals who have not secured an income for life, the risk is that they outlive their savings.

- **Insurance:** younger generations have saved less for their futures, vs Baby Boomers at the same point in their life cycles. While the life insurance industry is perceived as a business that pays benefits upon death, in mature markets it is heavily exposed to the living benefits part of the economy, helping individuals prepare for retirement and broadly budgeting for the future.
- **Asset and Wealth Management:** 20% of US adults aged 50+ have no retirement savings (source: AARP) and a fifth of non-savers would be encouraged to save if investment products were simplified (source: Aegon).

Consumer: the silver dollar

- **Travel:** Holidays remain one of the leisure priorities for the 60+ age group as they enjoy both purchasing power and more free time.
- **Beauty:** Ageing affects an individual's appearance, health and fitness. The ageing population, particularly the Baby Boomer cohort, in many cases have both the willingness and the spending power to utilize products and procedures to fight the cosmetic signs of ageing.
- **Death Care:** The 60+ cohort comprises the majority of pre-need customers within the death care market, in terms of planning and paying for their own funeral or cemetery plot.

Gen Z: tech, consumer, education & work, finance

Tech: from Millennial radical honesty to Gen Z cautious curation

Gen Z are tech-dependent digital natives, with 45% of US teens online 'almost constantly'. This generation is more cautious about what it puts online, more likely to use ad blockers, more likely to move on if a site takes too long to load and less open to automation in their life than Millennials. This generation is also more likely to watch eSports than traditional sports. As such, Gen Z will accelerate some of the trends started by Millennials, e.g., the demise of old media.

- **New Media:** Gen Z watches more eSports than traditional sports; only 26% of under 18s watch broadcast TV vs 45% of Millennials. Gen Z will drive a faster shift towards eSports, video & music streaming consumption. Total reality will be the nextgen media platform to enable this in the future.
- **Big Tech:** 40% of Gen Z prefer interacting online with friends vs in person. Integrated services (social media, messaging, online shopping, payments) show the connected importance of multi-vertical platforms, reducing friction between consumers and products, but beware of data privacy regulatory headwinds.

The new consumer: sustainable, insular and product-focused

Gen Z's key consumer characteristics are sustainability, insularity, and product over experience. This generation's climate change activism feeds into its consumption patterns. Only half of legal age teens in the US can drive. The majority of Gen Z also has some sort of meat restriction (and does not drink alcohol).

Furthermore, this generation is influencing consumer-driven sustainable activism through agendas such as single-use plastics. Harmful consumer sectors, such as fast fashion, may be the focus next. Further, around 40% of teens prefer to meet up online, which not only makes this generation the loneliest but also impacts consumer habits, from athleisure and affordable luxury to pets and entertainment. Finally, Gen Z still holds traditional preferences for goods over experiences in sectors such as clothing and homeownership.

- **Luxury:** Status symbols continue to matter for this generation, with social media an 'always on' place to measure and compare social markers.
- **eCommerce:** Over a quarter of Americans are online 'almost constantly' (source: Pew Research). Gen Z will continue to drive the switch to eCommerce beyond the COVID-19 lockdowns. Even social media can play a role (social eCommerce): monetising social media influence through shoppable ads is enabling a new vector of interaction for retailers with consumers that has less purchasing friction and better conversion rates.
- **Wellness/Beauty:** Hygiene and health are the new wealth, with growing focus on skincare vs makeup. DM and younger generations have a rising focus on plant-based alternatives. The EM consumer is also a structural driver for FMCG (fast moving consumer goods).
- **Pets:** Gen Z is purportedly the loneliest generation and a surge in pet ownership for companionship over lockdown means heightened long-term demand for pet products. Gen Z and Millennials appear increasingly willing to pamper pets with high-quality products.

Education & work: progress has stalled owing to long-term impact of COVID

Gen Z was set to be the most educated generation ever. But progress stalled and even reversed due to the pandemic. The share of children receiving primary, secondary, and tertiary education had already plateaued pre-COVID. And the share of high school graduates going into higher education in the US is declining, as large student loans make the benefits of university increasingly unclear. COVID was estimated to cost today's students at least US$10tn in lifetime earnings and 50% of lower secondary school graduates are not expected to have the minimum levels of proficiency vs 40% normally.

- **EdTech:** Gen Z has had the least amount of work experience during the teen years but their affinity with tech and tech-focused education may help them enter the workforce as 1bn people will need retraining over the next decade owing to automation.

Finance: responsible, mobile and mindful of ESG

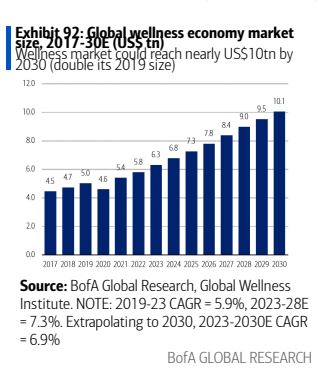
Gen Z experienced the effects of the last financial crisis through their families, resulting in a more fiscally conservative cohort cautious about taking on personal debt. However, alongside Millennials, Gen Z welcomes new technology as a means of managing finances from phones to cryptocurrencies. This implies that banks and asset managers will need to reassess their services to retain their youngest customers. Finally, Gen Z's social activism extends to finance, where four out of five consider ESG in their investments.

- **Fintech:** Cash is no longer king nor even considered hygienic by many, compounded by the growth in mobile/eCommerce transaction volumes. Younger generations are the most open to new payment methods e.g., phone, cryptocurrency.

10. Health The New Wealth

Summary: We believe healthcare is one of the industries set to be most impacted by AI over the next 5 years. AI drug discovery could shorten the time for R&D development from decades to weeks. And AI agents could fill the 10mn global health worker shortage expected by 2030 (source: WHO). However, it's not just AI transforming healthcare but also demographic trends, with the focus on wellness. It is now a larger market than many other major industries including the green economy, IT, sports, and pharmaceuticals. Worth US$6.3tn today, wellness is 4x larger than the global pharmaceutical industry (US$1.6tn) and 30% larger than the green economy (US$4.8tn). GLP-1 will likely be a key 'lifestyle' enabler. By 2030, more Americans will have tried GLP-1 than the entire Canadian population today. Beyond treating obesity, we see many other sectors indirectly being impacted (consumer staples, food retailers, restaurants, apparel retail, gambling, alcohol, tobacco, senior living).

Exhibit 92: Global wellness economy market size, 2017-30E (US$ tn)
Wellness market could reach nearly US$10tn by 2030 (double its 2019 size)



Source: BofA Global Research, Global Wellness Institute. NOTE: 2019-23 CAGR = 5.9%, 2023-28E = 7.3%. Extrapolating to 2030, 2023-2030E CAGR = 6.9%

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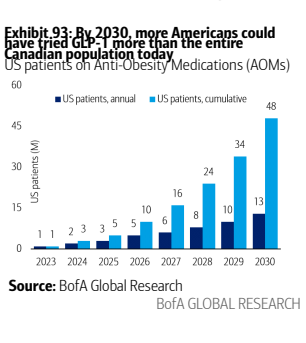
Exhibit 93: By 2030, more Americans could have tried GLP-1 more than the entire Canadian population today
US patients on Anti-Obesity Medications (AOMs)



Source: BofA Global Research

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AI: from GPT to GLP-1 - the transformation is here

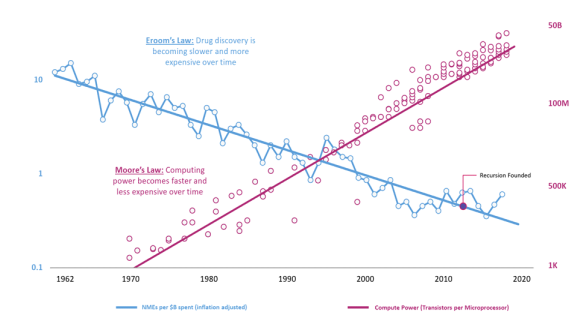
AI drug discovery & diagnostics

> **Did you know?**
> The number of new drugs approved per billion US dollars spent has halved roughly every 9 years since 1950, falling around 80x in inflation-adjusted terms
>
> Scientists/humans can only hold 6-7 data points in their mind at one time, while drug discovery's iterative process can be done millions of times within minutes by AI in the lab
>
> AI can process CT scans and MRI images 10-100x faster than human scientists.
>
> Google's DeepMind correctly diagnosed eye diseases 94.5% of the time in a trial with Moorfields Eye Hospital

The drug development process has well-known inefficiencies that AI could disrupt. Interesting applications include: (1) AI-assisted therapeutic target selection; (2) personalized genomic screening for diagnosis and personalized therapy; (3) clinical trial optimization for streamlining enrolment, fragmenting patient populations, and precision targeting based on mutations to increase the chance of response; and (4) optimizing healthcare systems, resulting in efficiencies in time and cost. However, given the complexity of biological systems, the data used to train AI models in healthcare will likely be much more densely packaged and more difficult to ingest compared to more generalist use cases of OpenAI's ChatGPT.

Drug discovery involves high costs and has a high failure rate (90%), which makes the business model unpredictable. The average investment is US$1-4bn and it takes 10-15 years to develop the drugs. And revenues from the 10% of drugs that are successful have to pay for the 90% that fail. However, with AI, results can now be achieved in 8 weeks that would otherwise have taken 8 months and US$2.5bn in expenses. Without AI simulation, this wouldn't have happened until 2032. GPUs, combined with quantum computers, will make AI healthcare even better (source: Jack Hidary, CEO of SandboxAQ).

Exhibit 94: Contrasting trends in computing power and drug discovery efficiency
With computing power increasing to an all-time high, drug discovery has become notably slower



Source: Company Filings, Recursion Pharmaceuticals Download Day 2023 BofA Global Research

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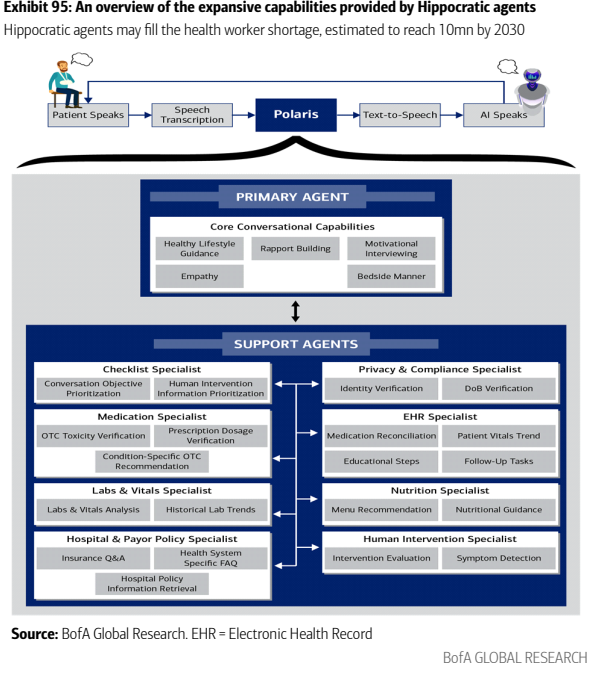
AI agents > health workers

Hippocratic AI healthcare agents leverage 20 capital-intensive foundation models that ensure safety and enable development of new use cases within minutes. These agents exhibit better performance than human nurses in a growing list of use cases, ranging from detecting toxic dosages of OTC drugs to calling 200k individuals during a heatwave, performing an assessment and arranging transportation to a medical site if exhibiting symptoms. The second use case would likely be cost-prohibitive if done with human nurses. Adoption is accelerating and agents receive high satisfaction scores, while costing significantly less at US$9-10/hour vs US$40-90/hour for human nurses.

While we don't expect large-scale AI-driven labor displacement in the near term, AI agents could fill the 10mn global health worker shortage expected by 2030, according to the World Health Organization (WHO). However, our view is that it may become increasingly difficult to compete with AI agents. According to the US Bureau of Labor Statistics, there are approximately 3.3mn registered nurses (US$41/hour average pay) and 55k medical scribes (US$18/hour average pay).

Exhibit 95: An overview of the expansive capabilities provided by Hippocratic agents
Hippocratic agents may fill the health worker shortage, estimated to reach 10mn by 2030



Source: BofA Global Research. EHR = Electronic Health Record

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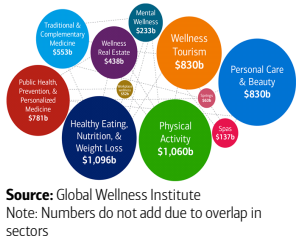
Health & Wellness: bigger than green or IT economies

Wellness is now a larger market than many global mega-industries, including IT, sports, and pharmaceuticals. In spite of the rapid growth of green/sustainability businesses, the wellness market is more than 30% larger than the green economy (US$4.8bn). A striking stat: the wellness market is now roughly 60% the size of all global health expenditures (US$10.6tn). In 2028, it will reach nearly US$9tn (almost double its 2019 size) and represent 6.8% of global GDP (source: Global Wellness Institute). The sectors with the most powerful annual growth rates from 2019 to 2023 are: 1) wellness real estate (18.1%), 2) public health, prevention and personalized medicine (15.2%), and 3) mental wellness (11.6%) (source: Global Wellness Institute).

Exhibit 96: The Global Wellness economy reached new peak of US$6.3tn in 2023, and is forecast to hit US$9tn by 2028
The wellness industry is now roughly four times larger than the global pharmaceutical industry (US$1.6tn) and nearly half as big as all consumer health expenditures (US$10.6tn)



Source: Global Wellness Institute
Note: Numbers do not add due to overlap in sectors

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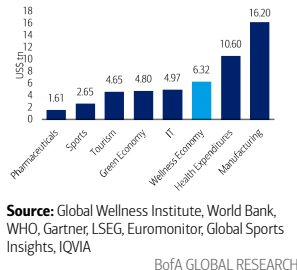
Exhibit 97: Global wellness economy versus other major industries market size in 2023
Wellness is now a larger market than many global mega-industries, including IT, sports, and pharmaceuticals



Source: Global Wellness Institute, World Bank, WHO, Gartner, LSEG, Euromonitor, Global Sports Insights, IQVIA

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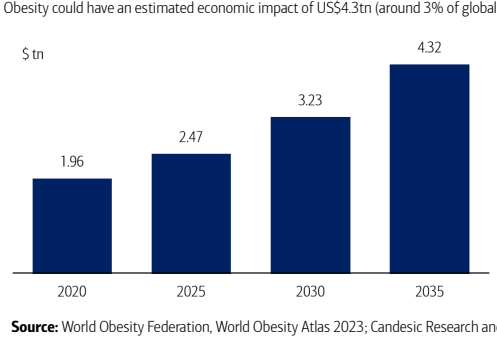
GLP-1: "the everything drug?"

> **Did you know?** The costs of obesity are greater than Germany's GDP

Obesity could cost the global economy US$4.3tn by 2035

Obesity remains one of the most pressing public health challenges of our time. More than half of the world's population is projected to be overweight or obese by 2035, with an estimated economic impact of US$4.3tn (around 4% of global GDP). For the US specifically, according to the CDC (Centers for Disease Control and Prevention), obesity costs the healthcare system nearly US$173bn a year.

Exhibit 98: Global economic impact of high BMI (BMI ≥ 25kg/M2), 2020-2035
Obesity could have an estimated economic impact of US$4.3tn (around 3% of global GDP) by 2035



Source: World Obesity Federation, World Obesity Atlas 2023; Candesic Research and Analysis

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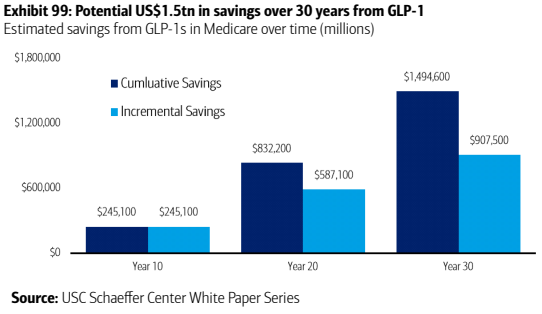
GLP-1 reducing obesity could save US healthcare US$1.5tn over 30 years

A USC Schaeffer white paper found that coverage for new obesity treatments could generate US$245bn in cost offsets to Medicare in the first 10 years alone. By 30 years, these offsets would increase to US$1.5tn assuming that 100% of obese people take GLP-1. As of mid-2023, about 4m people used one of the drugs, which represents only 1% of the US population.

Exhibit 99: Potential US$1.5tn in savings over 30 years from GLP-1
Estimated savings from GLP-1s in Medicare over time (millions)



Source: USC Schaeffer Center White Paper Series

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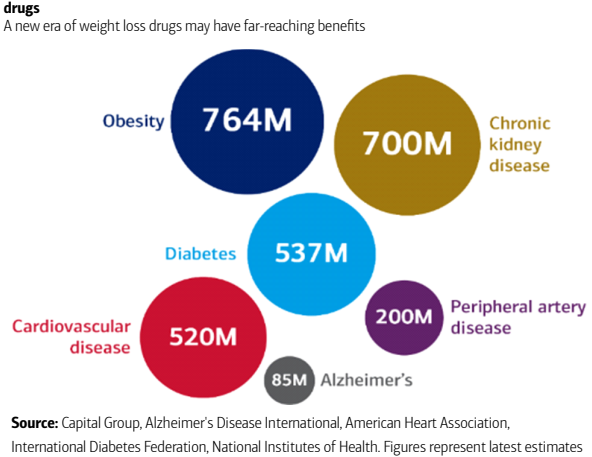
More Americans will have tried GLP-1s by 2030 than there are Canadians today

5mn US patients are expected be on GLP-1s for weight loss in 2026 (1.7% of adults), and >10mn patients will have tried them for the same reason at some point (3.7% of adults). Looking ahead to 2030, 13mn patients could be on GLP-1s for weight loss (4.8% of adults) and c.48mn could have tried them for the same reason at some point (17% of adults). 48mn is about 1/7th of the entire US population. Canada's population today is around 40mn, implying that by 2030 more Americans will have tried GLP-1s than there are Canadians today (source: BofA Global Research).

Other impacts: Alzheimer's, consumer food staples, apparel, gambling, smoking

GLP-1s could impact other treatment areas beyond obesity such as Alzheimer's and cardiovascular disease. Furthermore GLP-1s have downstream effects such as lower appetite and a reduction in cravings/addictive behaviors. The impact of these effects is unclear but they could change consumer behavior over the longer term, with some industries benefiting while others are at higher risk. Broad adoption of GLP-1 drugs could impact consumer-focused sectors including 1) snacks and beverages, 2) restaurants, 3) tobacco, 4) gaming, 5) apparel, and 6) food retail.

Exhibit 100: Global patient populations across potential treatment areas for GLP-1 class drugs
A new era of weight loss drugs may have far-reaching benefits



Source: Capital Group, Alzheimer's Disease International, American Heart Association, International Diabetes Federation, National Institutes of Health. Figures represent latest estimates available, as of November 16, 2023. Peripheral artery disease figure from NIH

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Appendix I: Key Projections Summary

Exhibit 101: Showcasing projections to illustrate Thematic trends over the next 5 years
Overview of the 6 Thematic trends over the next 5 years

Theme	Topic	Projection	Source
"Tech is eating the world"	AI agents	AI agents could enter the workforce as soon as 2025	Steve Brown
	AGI timeline	We could see AGI by 2027-8	Company/press reports
	Quantum advantage	We could have quantum advantage as soon as 2025	SEEQC
	Reasoning	By 2025, machines will be able to think and reason like humans	Sam Altman
Digital Insecurity	Cyber goals	By 2026, 30% of large companies will have publicly shared their cyber goals (vs less than 2% in 2021)	Gartner
	Cost of cybercrime	By 2025, cybercrime costs could reach US$10.5tn, making it the world's 3rd largest 'economy' behind the US and China	Cybersecurity Ventures, World Bank, UN
	Deepfake videos	Since 2018, the number of deepfake videos is now doubling every 6 months	Sensity, Information Matters
	Cost of deepfakes	By 2027, deepfake damage costs are projected to reach US$40bn - that's almost Paraguay's GDP	Deloitte, World Bank, UN
	Reskilling	By 2030, we need to reskill 1bn people which is 1/3 of all jobs worldwide	OECD, WEF
	AI impact on jobs	By 2030, 4.5x more jobs will be "influenced" positively by generative AI compared to those replaced	Forrester
More!	Compute	By 2030, semis manufacturing capacity could increase by 56%, reaching a market opportunity of over US$1tn, as large as the GDP of Netherlands	SIA, BCG, McKinsey, Worldometer, UN
	Energy	By 2030, in the US alone, data centres could add c.250TWh of electricity demand - that's more than the electricity Spain consumes in a year	McKinsey, BP - Statistical Review of World Energy, US EIA
		Electricity going through global grids could reach >30kTwH by 2030 - that'd be enough electricity for more than 1/3 of the planet for a year	BNEF, US EIA, Worldometer, UN
	Water	In 2023, data centres used as much water as the population the size of New York City, but this could rise to a city as large as Shenzhen's by 2030	Bluefield Research, Energy Saving Trust, World Population Review
		By 2025, 2/3 of the world's population could face water shortages	WWF
	Bandwidth	120 ZB of data created in 2023, storage equal to everyone having 15x iPhone 16 Pro Max. This could reach 1,373 ZB by 2030...171 iPhones each	BofA Global Research, Statista, Worldometer, UN
	Real estate	We could have 8,400 public data centres by 2030 (vs 5,700 in 2024). This would require an amount of land larger than the entirety of Singapore	ABI research, Worldometer
Rebuilding Everything	Infra funding gap	There is an infrastructure funding gap globally of US$94tn by 2040 - that's more than 5x the size of China's current GDP	Oxford Economics, World Bank, UN
	Clean energy spend	Investment in clean energy assets could be US$3tn p.a. until 2030 - that'd be as large as Nvidia's current market cap	BNEF; Nvidia market cap as of 06 Jan 25
	Grid spend	The US$250bn spent on the grid in 2022 could more than treble between now and 2030 reaching a level nearly the size of Switzerland's GDP	BNEF, IEA, NGFS, World Bank, UN
	Data centre infra spend	By 2030, scaling data centre infrastructure will require more than US$1tn - an amount equal to the current market cap of Broadcom	McKinsey; Broadcom market cap as of 06 Jan 25
	Data centre energy use	By 2026, data centres will consume more energy than Japan	IEA

	Future mobility	By 2030, cars could have c.300mn lines of code. A modern fighter jet has only about 25mn lines	McKinsey, Roland Berger
Rise of the Zoomers... and Boomers!	Boomer population	By 2030, global fertility could go below replacement rates...and 1 out of 6 people in the world will be over 60 years old	IHME, WHO
	Boomer spend	By 2030, globally, over-65s could spend almost US$15tn a year - that's almost the size of China's current GDP	Ageing Analytics Agency, Brookings, World Bank and UN data
	Great Wealth Transfer	US$105tn could be transferred to younger generations by 2048 - that's roughly 4x the size of the US' current GDP	Cerulli Associates, World Bank, UN
	Gen Z population	By 2030, the Gen Z population could reach 2.6bn, as large as the total population of China, the US, Indonesia, Pakistan and Nigeria combined	BofA Global Research, Worldometer, UN
	Gen Z income	Gen Z's global income levels could reach US$36tn in 2030E, the GDP of China, Japan, Germany, India, UK, France and Thailand combined	BofA Global Research, Euromonitor, World Bank, UN
	Gen Z spend	Gen Z spend could reach US$12.6tn in 2030, as large as the GDP of Japan, Germany, India and the Netherlands combined	BofA Global Research, World Data Lab, Generations Forecasts, UN
Health The New Wealth	AI agents	AI agents could fill the 10bn global health worker shortage expected by 2030	WHO, BofA Global Research
	Wellness market size	Wellness market = US$6.3tn, 4x larger than global pharma industry (US$1.6tn). It could double in size by 2028 and represent 6.8% of world GDP	Global Wellness Institute
	Obesity	More than half of the world population could be overweight/obese by 2035, with an estimated economic impact of US$4.3tn (c.4% of global GDP)	World Obesity Federation, World Bank, OECD
	Obesity x healthcare	For the US, obesity costs the healthcare system nearly US$173bn a year - that's roughly double Luxembourg's GDP	CDC, UN
	GLP-1 penetration	By 2030, more Americans will have tried GLP-1 than the entire Canadian population today	BofA Global Research, UN
	Drug simulation	With AI we can now simulate drugs in a matter of weeks rather than months. Without AI simulation, this wouldn't have happened until 2032	Jack Hidary, CEO of SandboxAQ

Source: BofA Global Research

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Appendix II: Section Authors

Exhibit 102: 10 Themes for the Next 5 Years
Author block

Theme	Team	Authors
"Technology is eating the world"	Global Thematic Investing	Haim Israel, Martyn Briggs, Felix Tran, Lauren-Nicole Kung
Digital Insecurity		
More!		
Rebuilding Everything		
Rise of the Zoomers...and Boomers!		
Health The New Wealth		
Peak Monopoly	Global Investment Strategy	Michael Hartnett, Elyas Galou, Anya Shelekhin, Myung-Jee Jung
The End of "ABB"		
Populism		
War & Peace		

Source: BofA Global Research

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Investment rating	Total return expectation (within 12-month period of date of initial rating)	Ratings dispersion guidelines for coverage cluster[R1]
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Neutral	≥ 0%	≤ 30%
Underperform	N/A	≥ 20%

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