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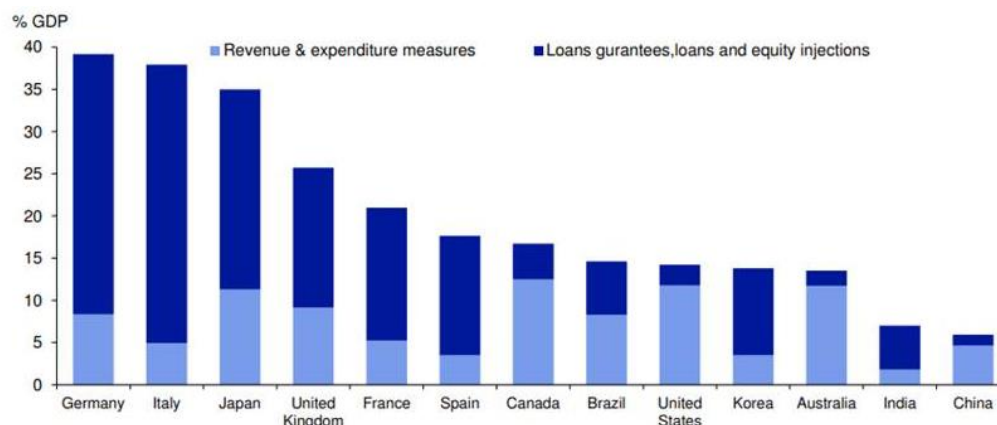


Dear Partner,

The third quarter of 2020 offered positive performance results to global equities. During the quarter Alkeon Growth Partners, LP returned 6.15% (net of all fees, expenses and incentive allocation) versus a 7.67% return for the MSCI AC World. For the year, Alkeon Growth Partners, LP returned 38.58% (net of all fees, expenses and incentive allocation) versus a -0.02% return for the MSCI AC World. Since its inception (January 1998), the strategy has annualized at 15.12% (net of all fees, expenses and incentive allocation) per year versus an annualized 4.07% return for the MSCI AC World. This translates into a total cumulative return of 2,362.87% for the strategy versus 148.00% for the MSCI AC World.

	Q3 2020	2020	Since Inception (cumulative)	Since Inception (annualized)
<b>Alkeon Growth Partners</b>	<b>6.15%</b>	<b>38.58%</b>	<b>2362.87%<sup>1</sup></b>	<b>15.12%<sup>1</sup></b>
MSCI World	7.52%	0.37%	152.75%	4.16%
MSCI AC World	7.67%	-0.02%	148.00%	4.07%

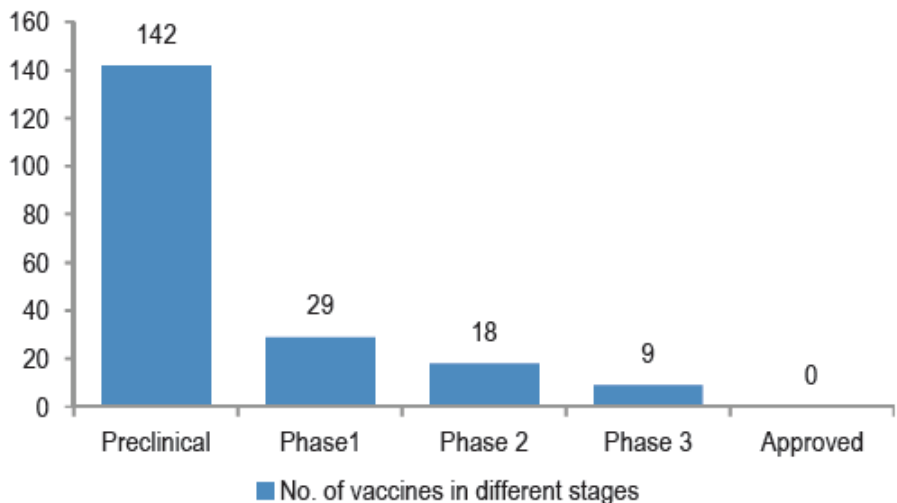
For decades now, equity investors are often reminded, “do not fight the Fed”. Given the events of this year, this basic principle can now be modified to “do not fight the Fed and Government”, as the dual tsunami of unprecedented global bank support and unconstrained fiscal stimulus provided by governments globally has buoyed equity markets.



**Exhibit 1. Fiscal Measures Announced in G20 Countries, September 2020, source Deutsche Bank.**

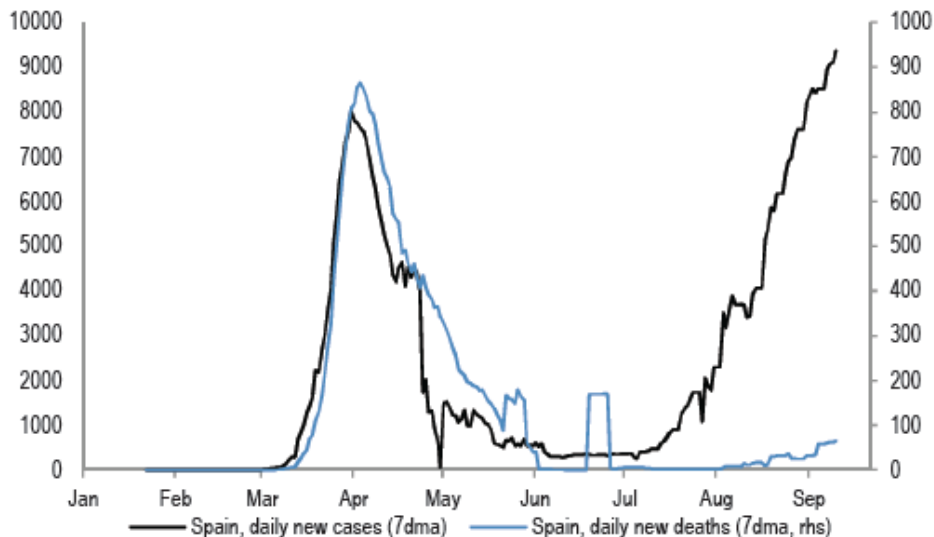
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This is a historic time, and as we continue to be humbled and saddened by the recent crisis, we also remain confident that optimism and science will soon prevail. There are more than 170 research teams around the world attempting to develop a vaccine, nine of which are in critical phase 3 trials – with early data expected to be announced very soon.



**Exhibit 2.** Number of Vaccines in Different Stages, source JP Morgan and WHO.

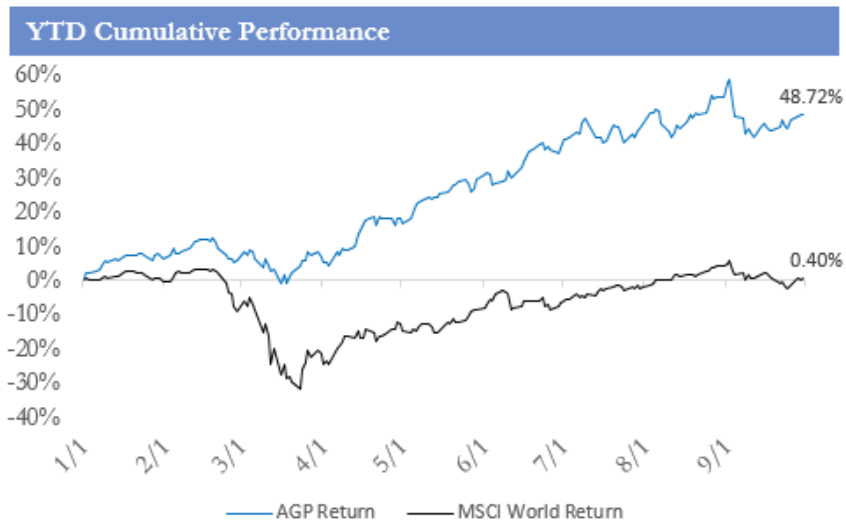
A vaccine is needed, as the number of cases has recently spiked and winter is approaching. Encouragingly, however, mortality rates are low, as testing and treatment have improved and the mix of new cases has skewed towards a younger population that generally copes with the disease better.



**Exhibit 3.** Spain Daily New Cases and Deaths, source JP Morgan.

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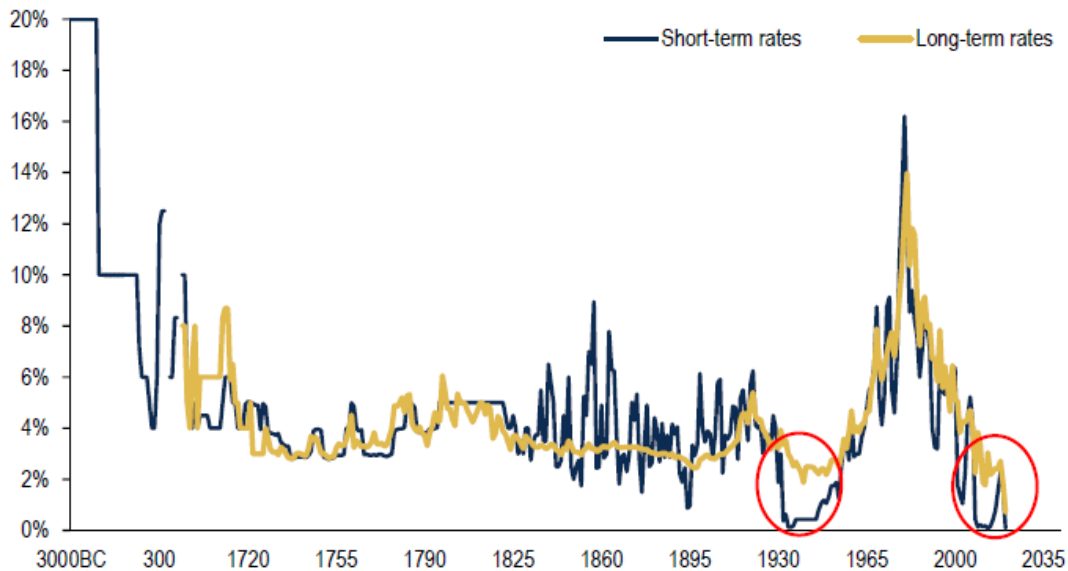
Having managed equity hedge fund strategies for decades, we have always tried our best to, one, prepare for major periods of uncertainty and dislocation, two, stay focused on taking advantage of volatility –not reacting to it–, and three, prepare to invest carefully and gradually during the depths of a correction. This period was no different, as we remained very active throughout the first nine months of the year, seeking to take advantage of opportunities on both the long and the short side. A daily graph of the year-to-date cumulative return of Alkeon Growth Partners, LP (gross of incentive fee) vs. the price movement of the MSCI World is shown below.



**Exhibit 4.** Daily Year-to Date Return through Q3 2020, Alkeon Growth Partners, LP (Gross of Incentive Fee) vs. the MSCI World Index, source Alkeon and Bloomberg.

*Historic Changes in Asset Allocation Create a Unique Environment for Stock Picking*

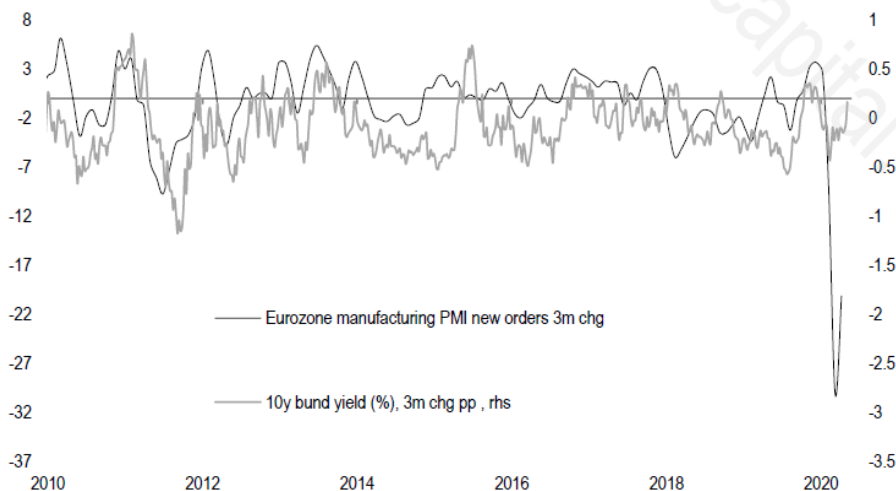
This is a historic time for the world and an equally unprecedented time for financial markets. In recent communications, we have detailed how, sadly, this crisis is creating one of the best stock-picking environments we have seen in our two decades of managing hedge fund strategies. The implications are long-lasting, as recent record government stimulus and record low interest rates affect and redefine traditional balanced equity/bond portfolio allocations, creating a scarcity of attractive asset choices.



**Exhibit 5.** Lowest Interest Rates in 5,000 Years, source Merrill Lynch.

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Simply put, we believe the events of 2020 mark the end of a long era during which Treasuries acted as portfolio diversifiers and market shock protectors. This has already been seen and felt in Europe. At the deepest point of the crisis in March, and when PMIs collapsed, Bund yields only fell marginally.



**Exhibit 6.** Bund Yields Did Not Fall That Much When PMIs Fell, source Credit Suisse.

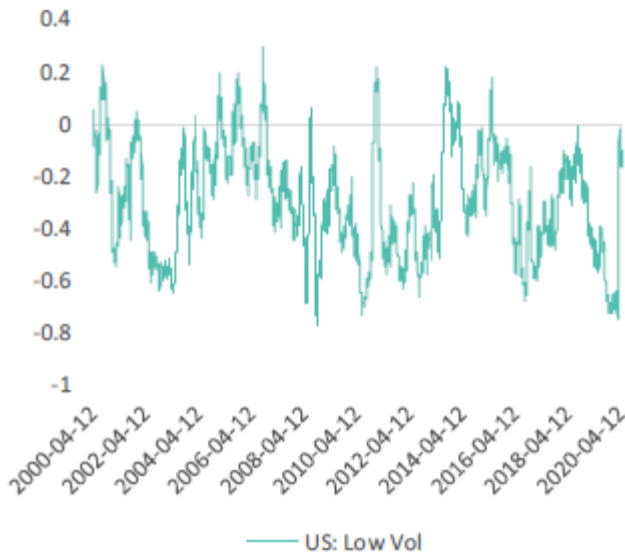
This is theoretically unsurprising, as approaching the zero-Treasury-rate level does create a natural barrier for the fixed-income “hedge” (protective) component of a balanced strategy. Interestingly, such “barrier risks” have affected not only fixed-income investments but also other similarly “defensive” strategies, such as low volatility equity strategies, which were designed to outperform in down markets – but failed to do so in the first quarter of this year during the crisis. For example, during the first quarter, the S&P 500 Low-Volatility Index suffered a decline equal to the broader market, failing to protect equity investors both on the way down and on the way up, as the index failed to participate fully in the subsequent recovery.



**Exhibit 7.** S&P 500 Low-Volatility Index vs. S&P 500 Index, Year-to-Date through Q2 2020, source Bloomberg.

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Reinforcing the idea that low-volatility stocks may not act defensively anymore, the correlation between low-volatility stocks and bond yields went from highly negative to almost zero by May.



**Exhibit 8.** Correlation of Low-Volatility (US) Stocks with Bond Yields has Gone from being Very Negative to Almost Zero, source Bernstein.

This is not unexpected, as the correlation between defensive sectors, such as staples, and interest rates is well-documented and has persisted for years. For example, the chart below shows the dramatic outperformance of the MSCI Europe Food & Beverage Index vs. the broader market and its correlation to the 10-year Treasury yield. Yet, as yields approach the zero-level “barrier”, such pattern of outperformance may end.

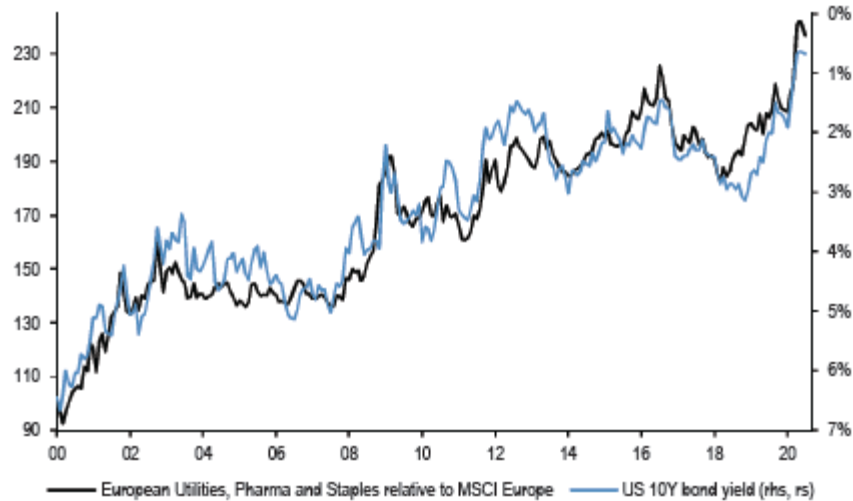


**Exhibit 9.** MSCI Europe Food & Beverages Index vs. 10-Year Treasury Yield, source JP Morgan.

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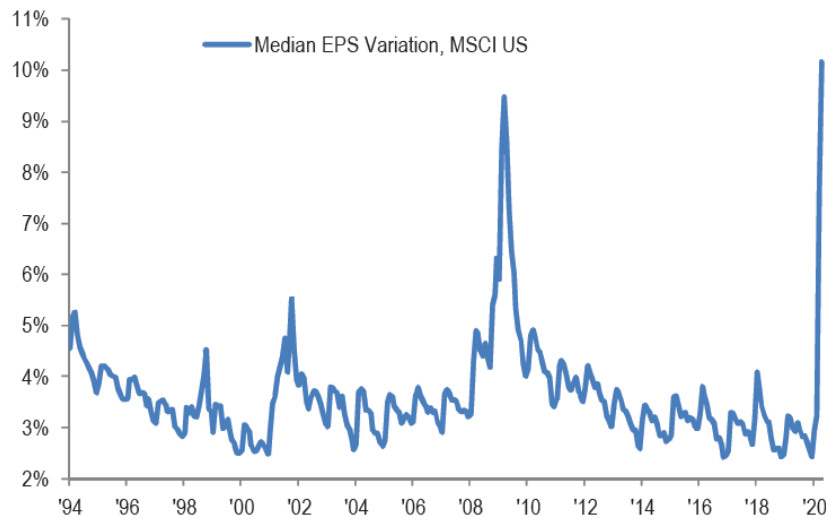
A similar relationship holds between the relative performance of European pharma, utilities and staples and the 10-year Treasury yield.



**Exhibit 10.** *European Utilities, Pharma and Staples relative to MSCI Europe vs. 10-Year Treasury Yield, source JP Morgan.*

Not only is this new era of asset allocation enhancing the broader stock-picking opportunity set, but also this is happening at a time in which, due to COVID, performance dispersion remains very high. It is precisely this rapidly changing equity backdrop, driven by high variability in reported earnings and forward earnings expectations, which creates unique opportunities for alpha-generation, in our view.

For example, and just looking at the second quarter’s market highlights, earnings results were broadly negative, but exhibited a strong dichotomy between companies with strong secular tailwinds and those more dependent on the economy. According to JP Morgan, 34% of S&P 500 companies reported higher revenue growth than pre-COVID estimates.<sup>2</sup> Notably, reported results showed significant bifurcation between Nasdaq 100 companies (earnings surprise of 2% and revenue growth of 9%) and cyclically sensitive small-caps (earnings surprise of -29% and revenue growth of -42%). Moreover, and unsurprisingly, earnings estimate dispersion reached a new record high (100th percentile), driven by high uncertainty in sectors most impacted by COVID. This created a unique environment for stock picking in the second and third quarter.

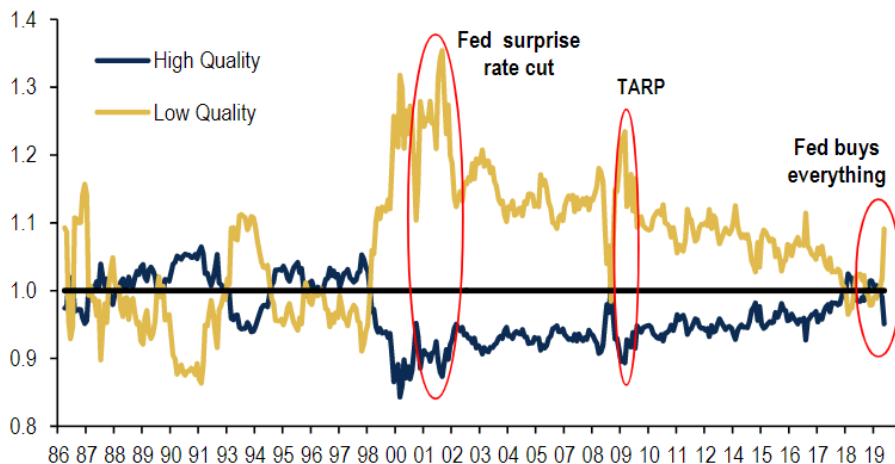


**Exhibit 11.** *Variation in EPS Estimates - MSCI US, May 2020, source JP Morgan.*

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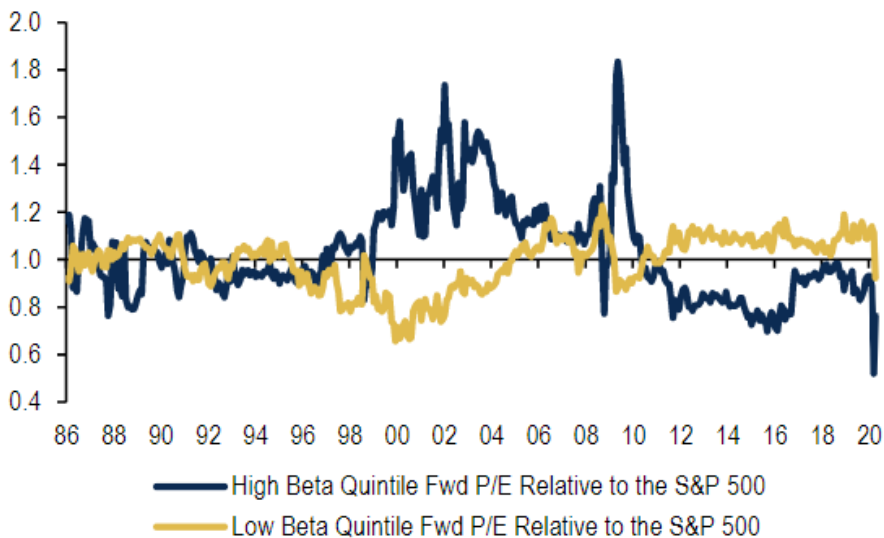
Overall, we believe this is one of the best investment environments we have seen, as opportunities for stock picking remain compelling across large segments of the market, in our view. For example, as shown below, high quality stocks remain cheap vs. low quality stocks, even though in theory (and intuitively) riskier assets should trade at a discounted valuation.

B+ or Better vs. B or Worse Fwd. P/E relative to BofA Universe (1986 - present)



**Exhibit 12.** High Quality Looks Cheap vs. Low Quality but Expect Re-Rating, May 2020, source BofA US Equity & Quant Strategy.

In another large-scale, aggregate mispricing example, low-beta stocks appear overpriced relative to high-beta stocks.

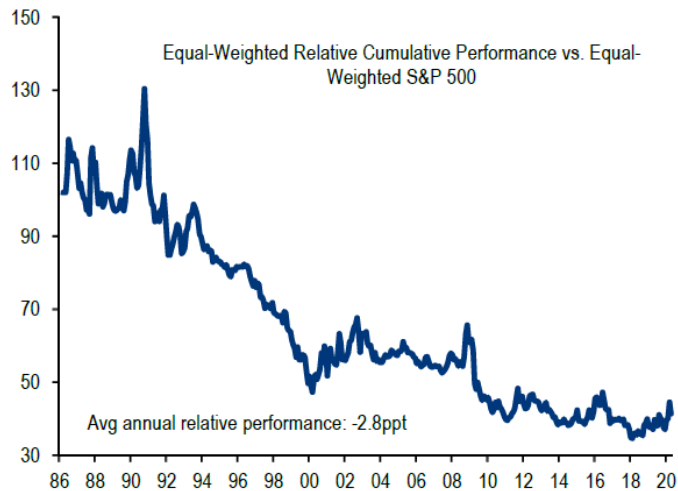


**Exhibit 13.** Relative Fwd. P/E of S&P 500 Index Low Beta and High Beta Quintiles (1986-Present), May 2020, source BofA US Equity & Quant Strategy.

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This is remarkable, as low beta-stocks have underperformed for decades.



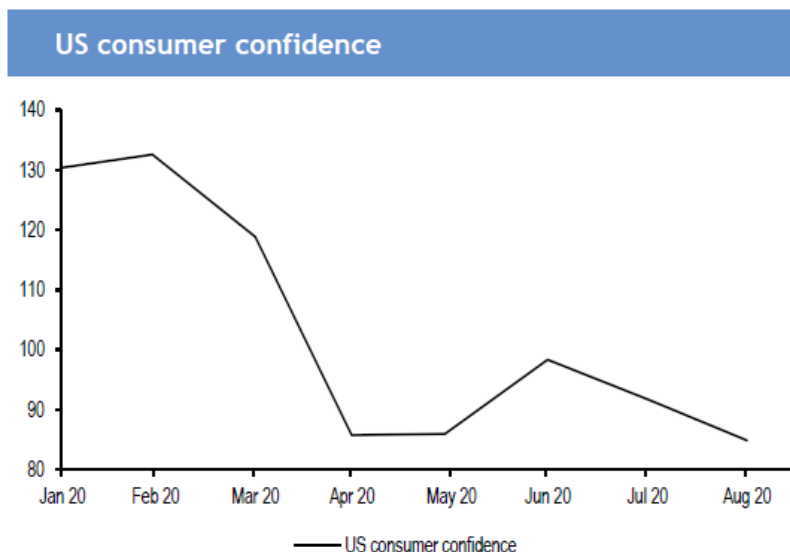
**Exhibit 14.** *Relative Performance of S&P 500 Index Bottom Beta Decile Stocks, source Merrill Lynch.*

In summary, we believe this is an exciting new era for stock picking, one of the best we have ever seen. Given this constructive backdrop, and in the following, we assess long-term trends for major equity markets and sectors. Section I of the letter discusses our analysis of the broad equity market risk/reward opportunity and our outlook going forward. Section II of the letter then reviews key investment opportunities globally, analyzes the attractive relative and absolute valuations for equities and highlights the risk/reward dichotomy we currently see between high quality growth sectors and others. Section III of the letter discusses in detail our outlook for technology stocks and the secular growth opportunities we see in the sector. Finally, Section IV of the letter closes with a brief overview of the broader macroeconomic picture.

**I. Broadly Balanced Equity Backdrop for Long-Term Investors**

Overall, as we look towards 2021 and beyond, we see a generally balanced backdrop and risk/reward opportunity for equities.

First, on the negative side, we are concerned about the unprecedented unemployment levels and the strength of the recovery, particularly as US consumer confidence remains low.

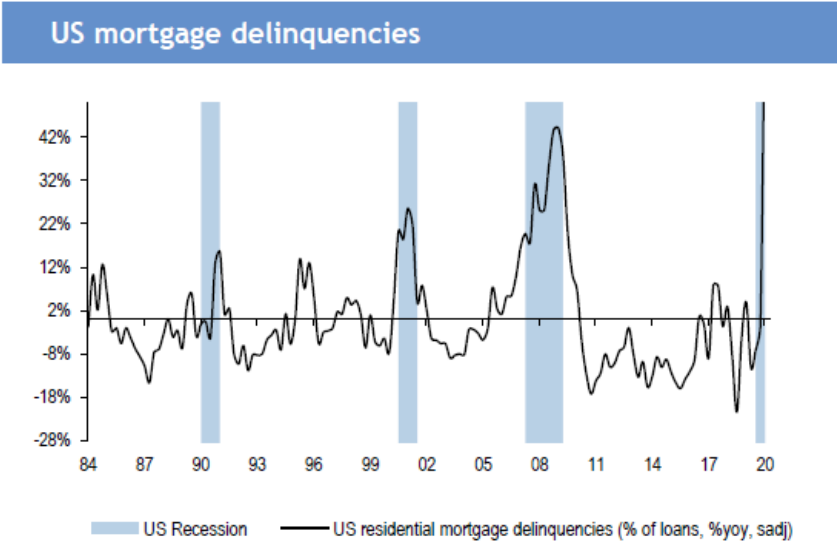


**Exhibit 15.** *Consumer Confidence, source JP Morgan.*

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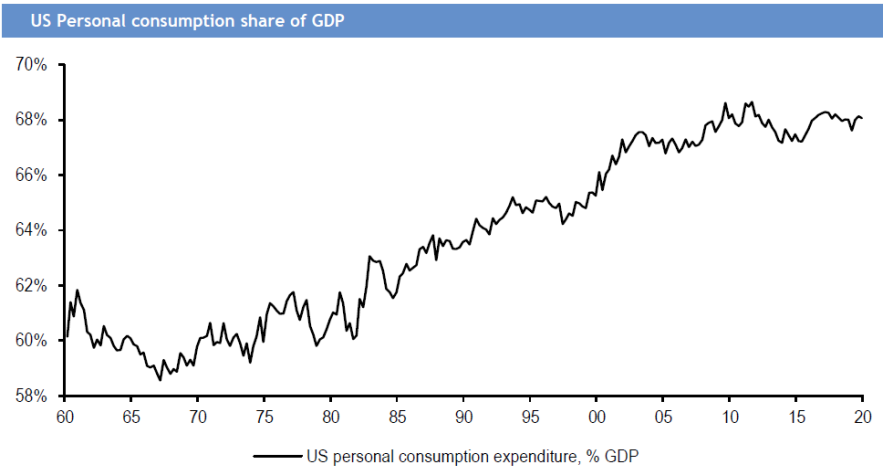


How quickly can a battered consumer return to a normalized level of purchasing behavior and activity, one ought to wonder. And what will be the pace of employment and capex recovery? Of particular concern is the fact that delinquency rates for consumer loans and mortgages are rising.



**Exhibit 16.** *US Mortgage Delinquencies, source JP Morgan.*

It is noteworthy that we have not had significant consumer-led weakness for more than a decade, and as such, the implications are potentially significant, as a stalling consumer can certainly affect the overall economy secularly.

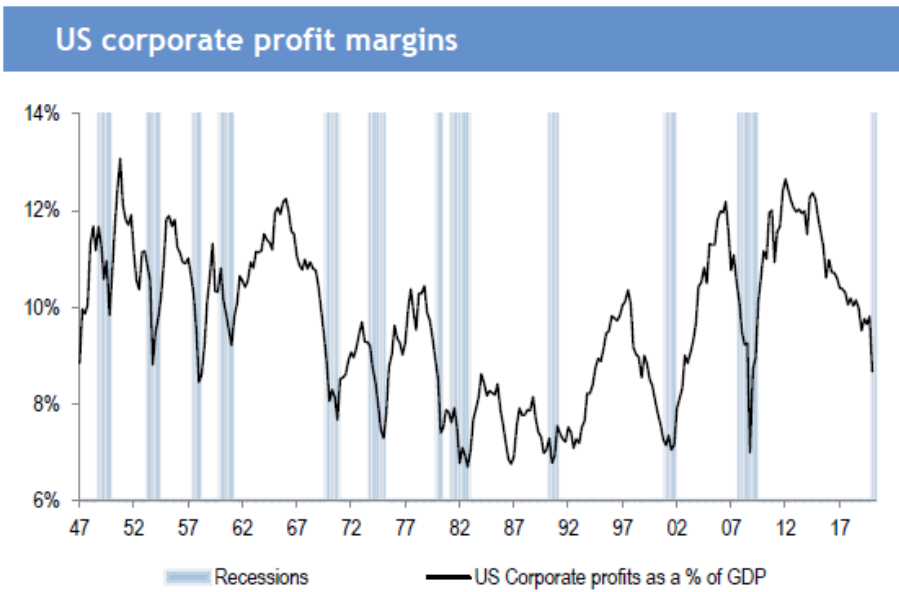


**Exhibit 17.** *US Personal Consumption Share of GDP, source JP Morgan.*

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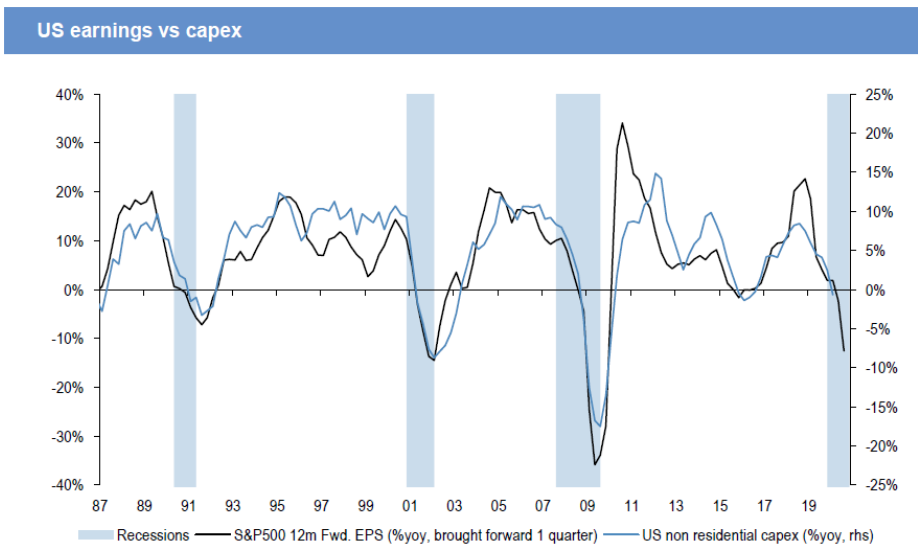
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Also of concern, on the corporate side, margins have been moving lower, even prior to the recession, and overall profits are vulnerable, as corporates have recently increased debt.



**Exhibit 18.** *US Corporate Profit Margins, source JP Morgan.*

This can create a negative loop effect, as lower earnings can severely affect capex, prolonging a period of subdued economic growth. The high correlation between these two important time series is shown below.



**Exhibit 19.** *US Earnings vs Capex, source JP Morgan.*

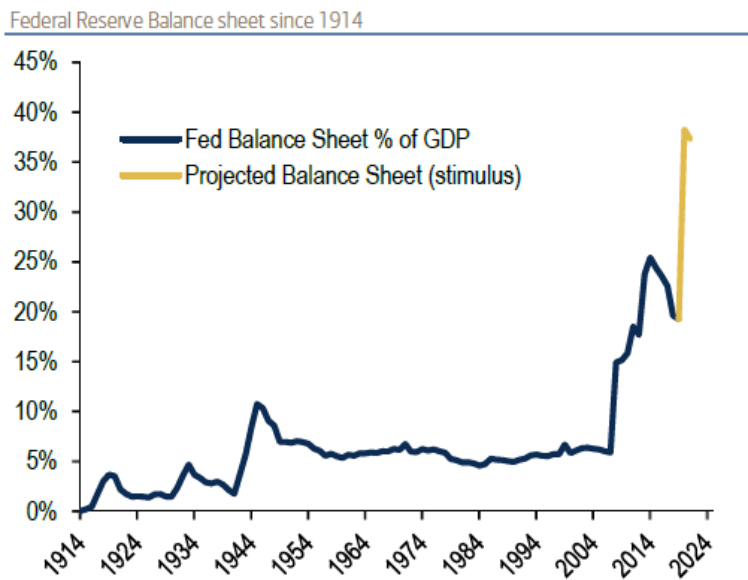
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Lastly, the recovery is not coming cheap, as this is a brand new era in economic and market history, with unprecedented fiscal and monetary support, which has elevated Government spending to the highest level since World War II.



**Exhibit 20.** Government Spending Surges, source Merrill Lynch.

In this new chapter of economic history, maximum government spending is met with record liquidity injection by the Fed. This is of course positive for equities near-term, but it does create serious long-term structural challenges, including the possibility of a Japan-like disinflationary spiral.



**Exhibit 21.** Fed Balance Sheet, source Merrill Lynch.

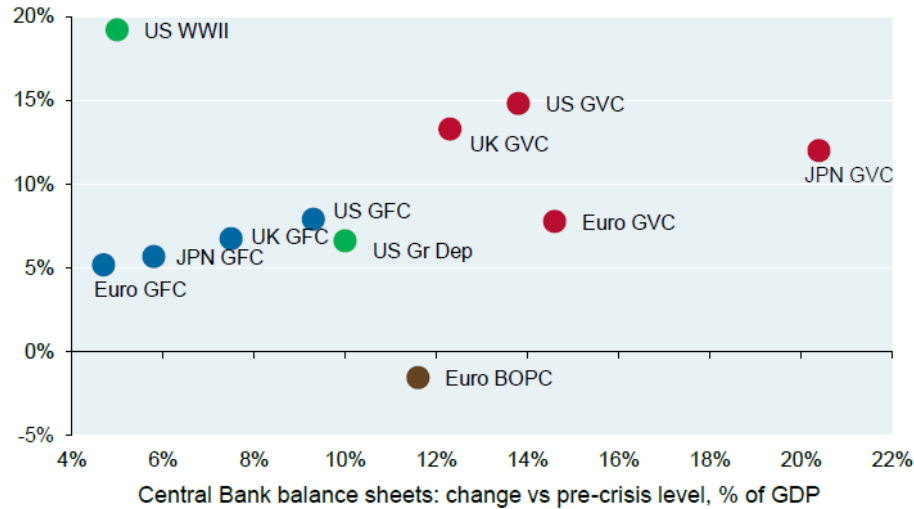
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On the positive side, there are a series of structurally and tactically healthy and supporting drivers for equities.

First, in the near-term, both the Fed and the Federal Government are committed to supporting the expansion by allowing inflation to run above long-term targets and by running unconstrained fiscal deficits, respectively, increasing the Fed's balance sheet and the fiscal deficit by record amounts.

**Debt monetization response to global virus crisis eclipses everything else**

Government fiscal deficits: change vs pre-crisis level, % of GDP



**Exhibit 22.** Fiscal Deficit and Central Bank Balance Sheet, Increase as a % of GDP, source JP Morgan.

It is important to note that monetary policy historically leads economic activity. Typically, a surge in coordinated central bank easing leads manufacturing expansion by seven to nine months.

**Central banks rate cuts lead global manufacturing**

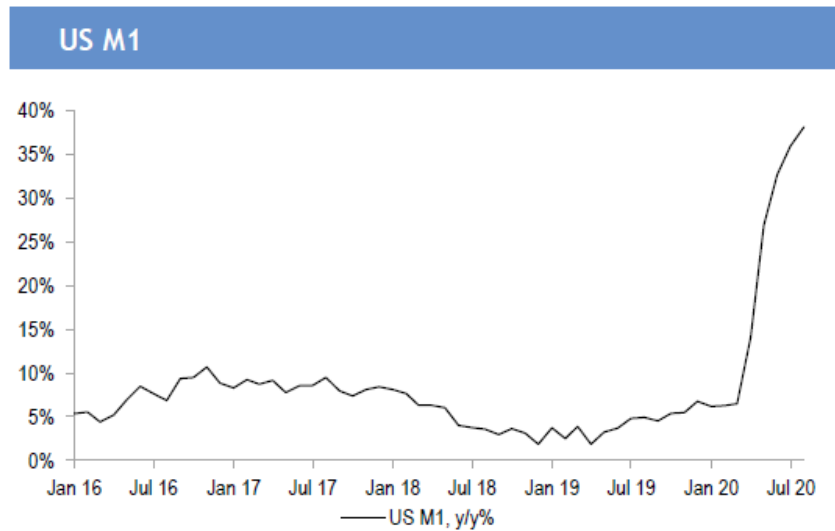
50+ = expansion

Central bank cuts, 8 month lead



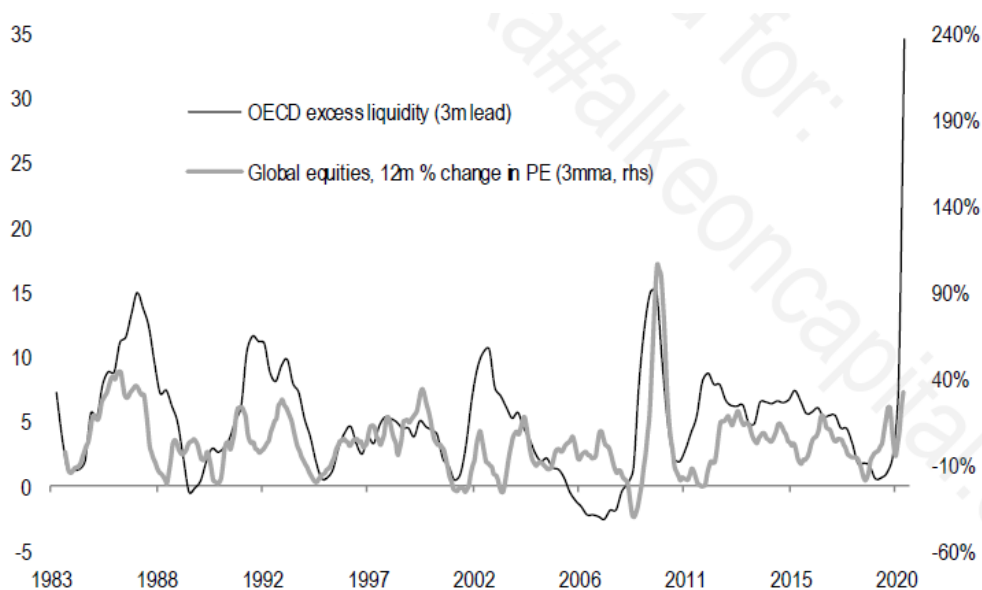
**Exhibit 23.** Central Banks Rate Cuts and Global Manufacturing Expansion, source JP Morgan.

Second, a tremendous amount of cash has been printed and will remain in the system. Slowly, this cash is finding its way into other assets, such as equities and real-estate. Certainly, we do believe that the recent unprecedented (in scale, velocity and scope) liquidity injection has not only supported asset prices but also is likely to have a more prolonged positive effect beyond the current crisis, as money will continue to be redeployed into real assets and liquid investments.



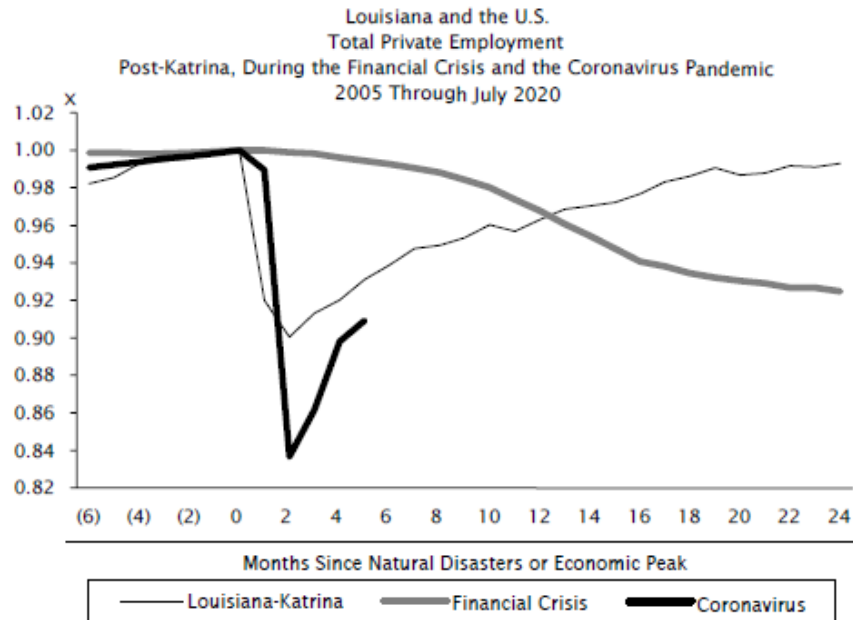
**Exhibit 24.** Growth in M1, source JP Morgan.

In particular excess liquidity is very supportive to global equities, as increases in excess liquidity, measured by the difference between M1 money supply growth and global GDP growth is positively correlated with an expansion of forward PEs for equities.



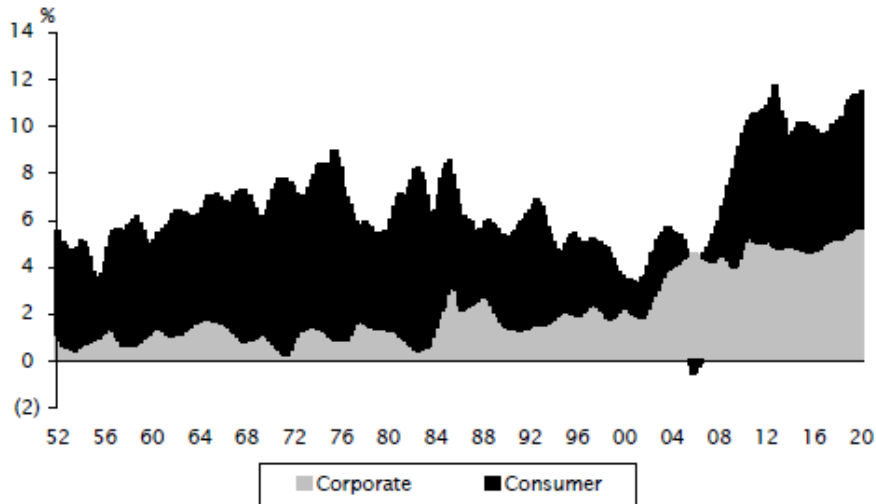
**Exhibit 25.** Increases in Excess Liquidity Imply Significant Year-over-Year Increases to Forward PEs, June 2020, source Credit Suisse.

Third, the market has generally viewed the impact of COVID as transitory and not structural. For example, using employment patterns as a guide, it is clear COVID looks more like an exogenous natural disaster event than a systemic endogenous structural imbalance such as the 2008 global financial crisis. We believe this has provided comfort to equity investors and has helped equity prices stay resilient.



**Exhibit 26.** Total Private Employment in Crisis, source Empirical Research.

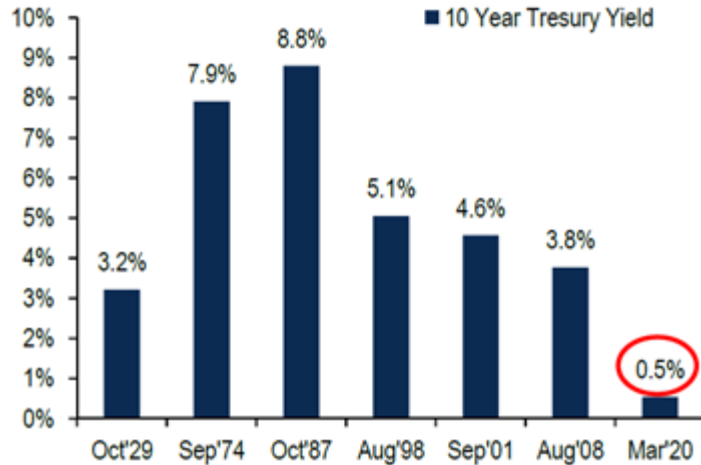
Fourth, the recent equity market strength has been further aided by a stable systemic backdrop with underlying characteristics that remain very healthy, if not enhanced, by the recent government stimulus.



**Exhibit 27.** US Consumer and Corporate Free Cash Flow as a Percentage of Nominal GDP, source Empirical Research.

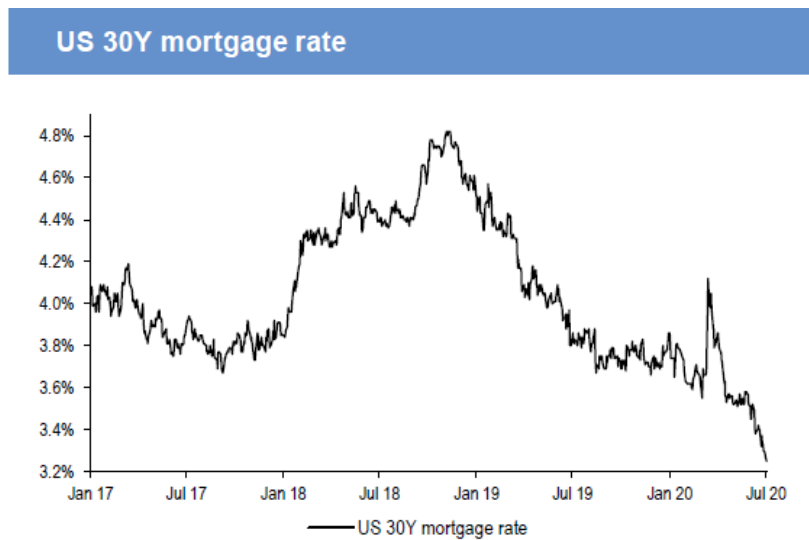
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Fifth, rates are likely to remain close to the zero-level “barrier” for the foreseeable future. This broad rate setting is indeed stimulative for housing and general economic activity.



**Exhibit 28.** "Safe Haven" Treasuries Now Yield Less Than Prior Crashes, source BofA Global Research.

Mortgage rates, for example, are already hitting new lows, at a time when consumer leverage is relatively benign.

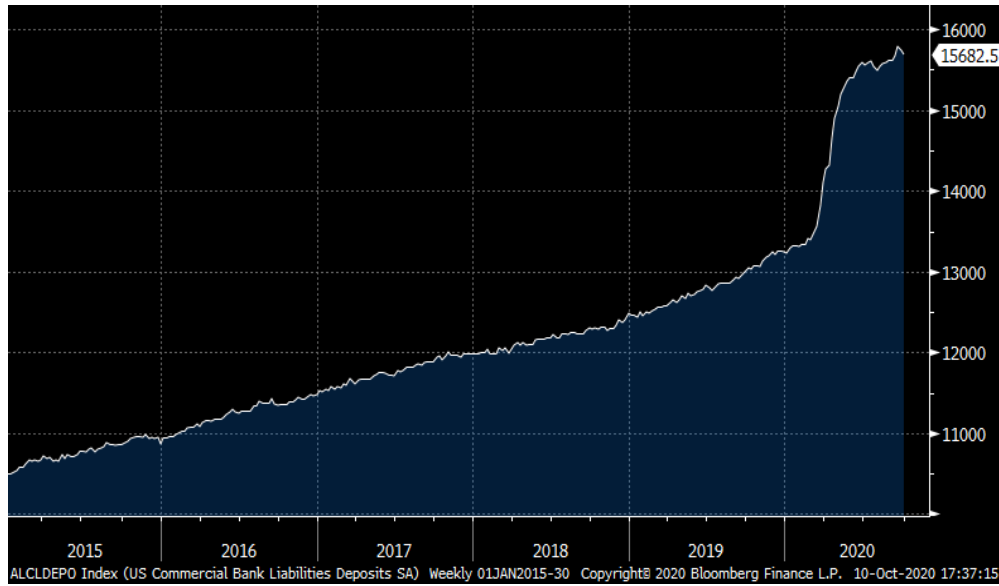


**Exhibit 29.** US 30-year Mortgage Rates, source JP Morgan.

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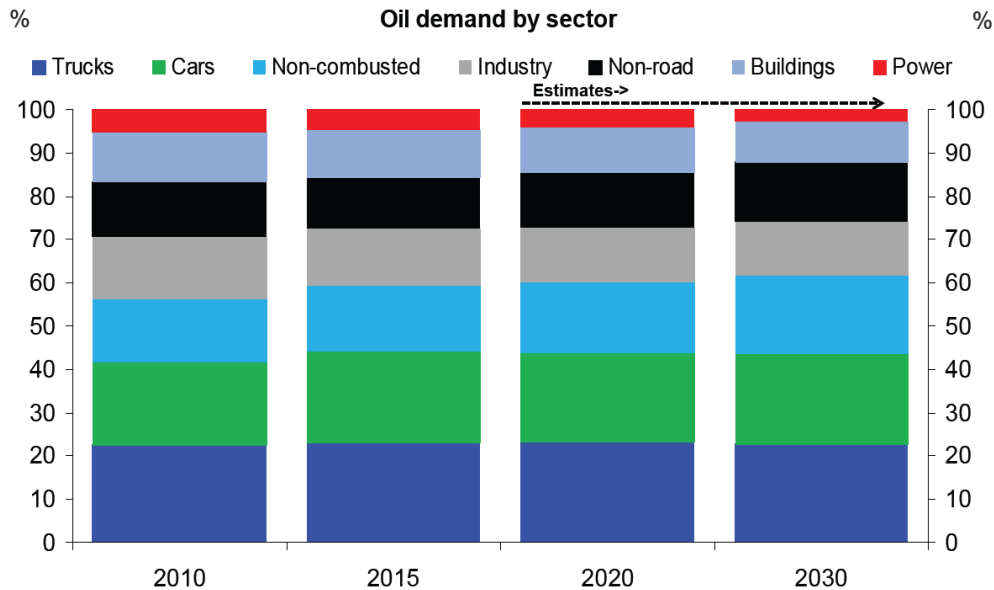
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Sixth, there is significant pent-up demand for goods and services, which eventually can boost economic activity rates in 2021, above even normalized levels for some time. Certainly, there is no shortage of dry powder for reallocation to equities if sentiment changes. Not only have money market fund assets reached a new multi-year high this year, US bank deposits have also surged sharply.



**Exhibit 30.** US Commercial Bank Deposits, source Bloomberg.

Seventh, secularly low oil prices can boost consumer spending.

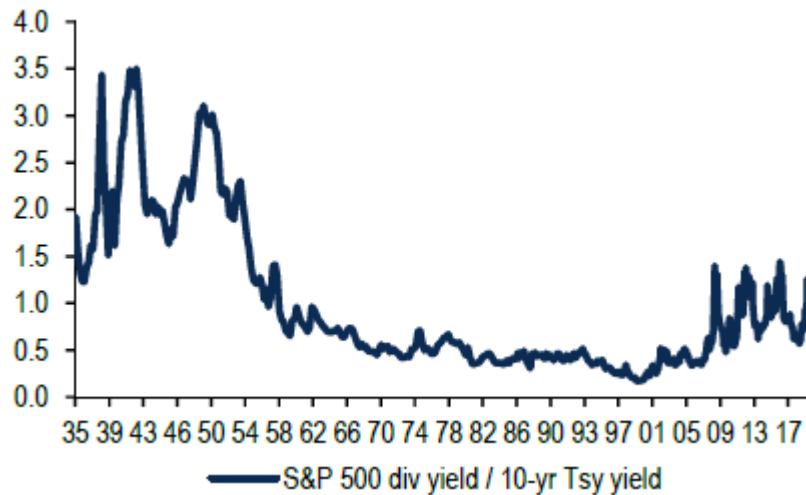


**Exhibit 31.** 40% of Oil Demand Goes to Cars and Trucks, source Deutsche Bank.

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And eighth, the equity market is strongly supported by not only strong liquidity but also by a scarcity of compelling asset allocation alternatives. In particular, from a relative value standpoint, record low interest rates are making stocks look increasingly attractive on a relative basis. Since 1951, the last time the ratio of S&P 500 yields to Treasury yields was at such a high level, equities delivered nineteen times outperformance over Treasuries.



**Exhibit 32.** *Stocks have not been this Attractive vs. Bonds since the 1940s, May 2020, source BofA US Equity & Quant Strategy.*

Furthermore, and as we explain in Section II of this letter, we believe current equity valuations are also attractive on a standalone basis from, one, a free cash flow standpoint and, two, a return on capital perspective. Specifically, and as one moves beyond a P/E approximation to assess the intrinsic value of an enterprise, we describe how companies have increasingly adopted asset-light models over the past decade and have been rewarded by the marketplace. The result has been almost doubling free cash flow generation as a percentage of sales to above 10% in recent years. This sizable decrease in capital intensity over the last decade, coupled with asset-light businesses becoming a larger percentage of broad equity indices, has led US equities to trade below historical average valuation levels on a price to free cash flow multiple basis, as depicted by Exhibit 39.

Moreover, and while a significant amount of capital remains sidelined, which could be reallocated to equities when sentiment changes, even without a broad change in sentiment, the current opportunity for alpha-generation through stock picking is most significant, in our view.

As we detail in Section II of this letter, we find remarkable cross-sector discrepancies between base sector valuations, on one hand, and underlying fundamentals as well as earnings growth rates, on the other hand. In particular, and given the data presented in Section II, we consider many high quality growth sectors, such as technology and healthcare, to be undervalued and attractive relative to the market, and even more conspicuously attractive relative to low-volatility, low-growth or no-growth ‘defensive’ equities. This is notable, as the latter group failed to act “defensively” during the recent deep correction, as evidenced by the performance of low-volatility ETFs.

In particular, the timing of this relative value opportunity is quite extraordinary and intriguing for the technology sector, as not only do underlying broad sector fundamentals remain robust, but also there is the potential for the sector's secular growth rate to accelerate meaningfully over the next several years —as we detail in Section III of this letter. This is especially likely for a group of companies that, as a result of the recent crisis, are seeing a re-acceleration in earnings growth rates from being in a position to increasingly benefit —on a secular basis— from recent trends towards distributed workloads, “work from everywhere”, and the cloud and SaaS/App ecosystem that supports this decentralized user architecture with security, redundancy and agility in its deployment and ease of infrastructure scaling.

In summary, we consider the current investment opportunity set to be attractive for both long and short investments globally. We reiterate the need to be highly selective in what we consider to be one of the best stock picking environments in years.

## II. Current Portfolio Opportunities and General Market Observations

As we look towards 2021/2022 and beyond, we see significant opportunities for both long and short investments. Overall, as detailed in Section I, we see a balanced backdrop for equities, supported by, one, stimulative monetary and fiscal policy, two, favorable relative valuations, and three elevated savings and cash balances. We also see substantial opportunities on the short side, particularly among companies that are unlikely to fully recover post-crisis.

The following section will focus on equity valuations and explain why we believe certain segments of the equity market are currently attractive on both a relative and absolute basis. In particular, we discuss how the events of the recent crisis are likely to continue to favor certain technology disruptors and innovators on a secular basis, beyond the inevitable recovery and for years to come.

### Attractive Valuations for Equities

On a long-term basis, we believe current equity valuations are broadly attractive, particularly on a relative basis against other asset classes, as global sovereign bond yields remain depressed, substantially lower than their historical average by nearly four times.<sup>3</sup>

Even though forward P/E multiples for the MSCI World are elevated relative to historical levels, bonds remain highly unattractive and overvalued relative to stocks, in our view.



**Exhibit 33.** MSCI World Index P/E and Global Sovereign Bond Yields since 1988, source JP Morgan.

Yet, year-to-date the spread between forward equity earnings yield and the 10-year Treasury has not worsened, implying that equities are as attractive relative to bonds as they were at the beginning of the year.



**Exhibit 34.** S&P 500 Index Earnings Yield minus Bond Yield, source JP Morgan.

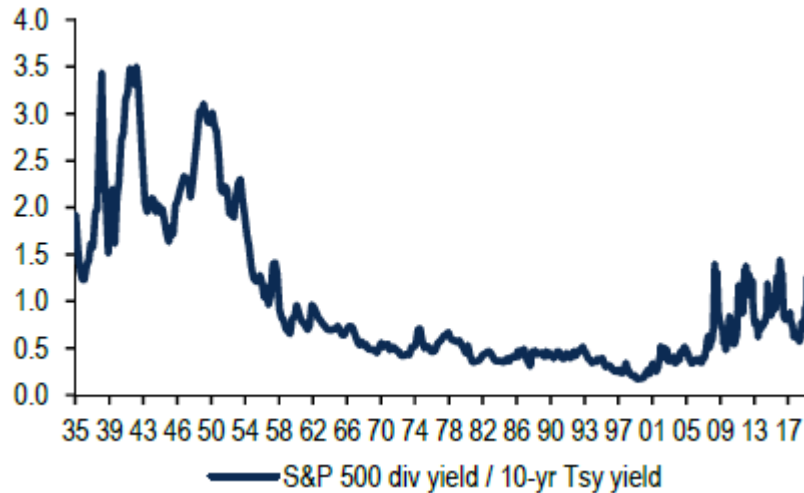
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Additionally, the spread between equity dividend yields and bond yields remains measurably elevated and highly favorable to equities across most developed markets, particularly in the Eurozone and the UK.

DM yield gap in the historical context					
	Dividend yield	10Y Bond yield	Dividend yield minus bond yield	Average since '00	Gap (bp)
US	1.6%	0.7%	0.9%	-1.4%	236
Japan	2.3%	0.0%	2.3%	0.7%	155
Eurozone	2.3%	0.0%	2.3%	0.3%	201
UK	3.9%	0.2%	3.6%	0.4%	321

**Exhibit 35.** *Developed Market Yield Gap, source JP Morgan.*

As noted above, since 1951, the last time the ratio of S&P 500 dividend yields to Treasury yields was at such a high level, equities delivered nineteen times outperformance over Treasuries.



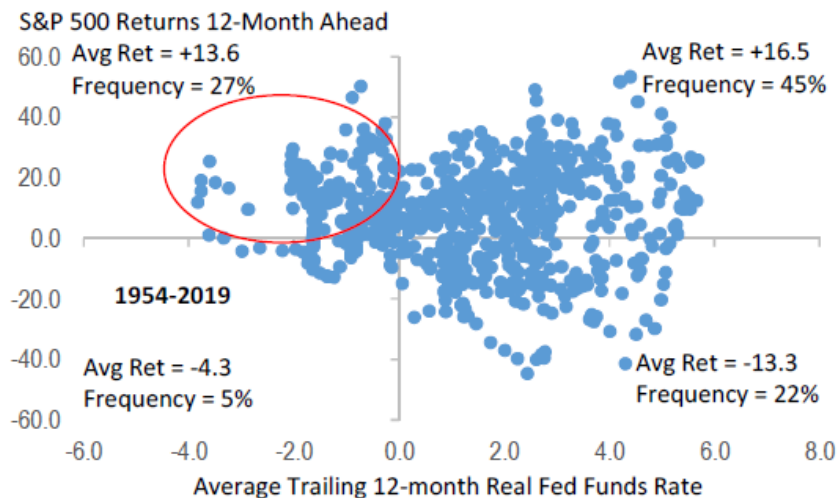
**Exhibit 36.** *Stocks have not been this Attractive vs. Bonds since the 1940s, May 2020, source BofA US Equity & Quant Strategy.*

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And it is not just Treasury yields that are low – real rates are actually negative. Historically, equity market returns have been positive 84% of the time when real rates (fed funds minus core inflation) are negative.

### Historically Negative Real Rates Are Positive for Equities

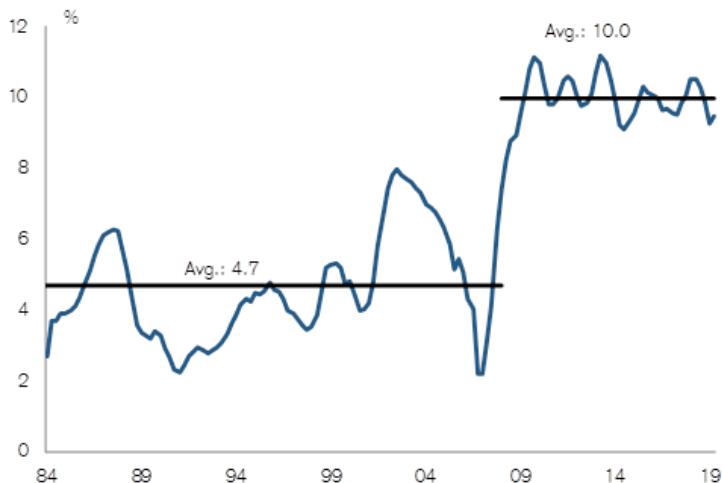
Likelihood of positive returns when real rate is negative, is  $27/(5+27) = 84\%$



**Exhibit 37.** Negative Real Rates have been Positive for Equities Historically, source JP Morgan.

Furthermore, we also believe current equity valuations are compelling on a standalone basis from both free cash flow and return on capital perspective. This analysis is important, as it uses a framework that moves beyond a P/E approximation as the main means to assess the intrinsic value of an enterprise, focusing instead on the underlying free cash generation as the most tangible measure of value creation for an enterprise.

To set this cash flow valuation framework, it is first important to note that companies have increasingly adopted asset-light models over the past decade. The result has been almost doubling of free cash flow generation as a percentage of sales to above 10% in recent years.

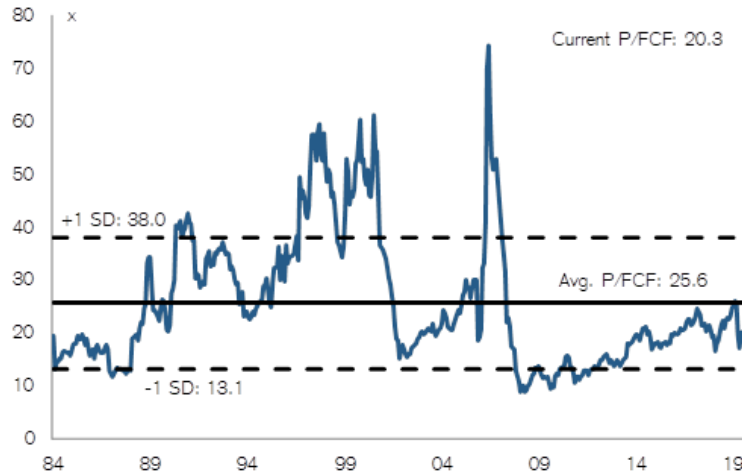


**Exhibit 38.** US Equities Free Cash Flow as a Percent of Sales since 1984, Russell 1000 Index (pre-1990) and S&P 500 Index (after 1990), source Credit Suisse.

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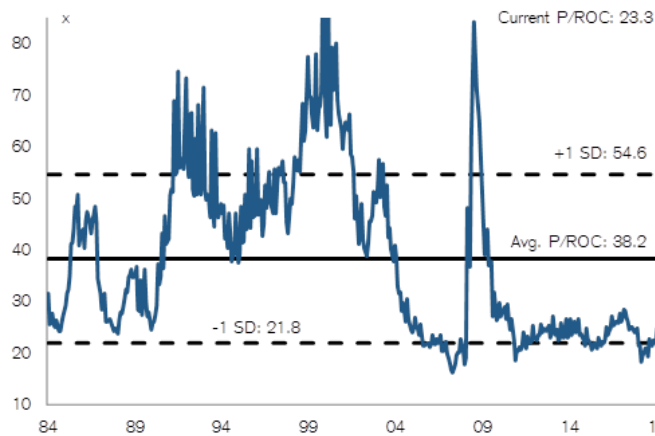
The significance of this cash flow valuation approach to a private owner of assets cannot be overstated. For example, a cyclical, capital-intensive business with large recurring maintenance costs may have the same P/E as an asset-light, high free cash flow generative business, yet it is measurably less valuable than the latter.

Remarkably, and as a result of this sizable decrease in capital intensity over the last decade (and, at the same time, as asset-light businesses have become a larger percentage of indices), the US last year was standing 20% below historical average levels on a price to free cash flow multiple basis. This reinforces our view that equities are significantly undervalued currently.



**Exhibit 39.** US Equities Price to Free Cash Flow Multiple since 1984, Russell 1000 Index (pre-1990) and S&P 500 Index (after 1990), source Credit Suisse.

Furthermore, asset-light businesses have increased the amount of capital returned to shareholders. As a result, from a price to return on capital (dividends plus buybacks) standpoint, equities last year traded at an astonishing 40% below historical levels! This is very significant and often ignored in a traditional P/E evaluation framework.



**Exhibit 40.** US Equities Price to Return of Capital Multiple since 1984, Russell 1000 Index (pre-1990) and S&P 500 Index (after 1990), source Credit Suisse.

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This relative value formation is very useful in highlighting substantial relative value opportunities in global equities, especially in classic high quality growth investments that trade at compelling valuation levels relative to global peers.

Country Name	Index	P/E 2022 Est
US	S&P 500	17.6
UK	FTSE 100	11.0
France	CAC 40	13.1
Germany	DAX	12.3
Japan	Nikkei 225	16.2
Hong Kong	Hang Seng	9.4
China	Shanghai Composite	11.2
South Korea	Kospi	10.2
Taiwan	Taiwan	14.4
India	Sensex	15.2

**Exhibit 41.** 2022 P/E Multiples by Country, October 2020, source Bloomberg.

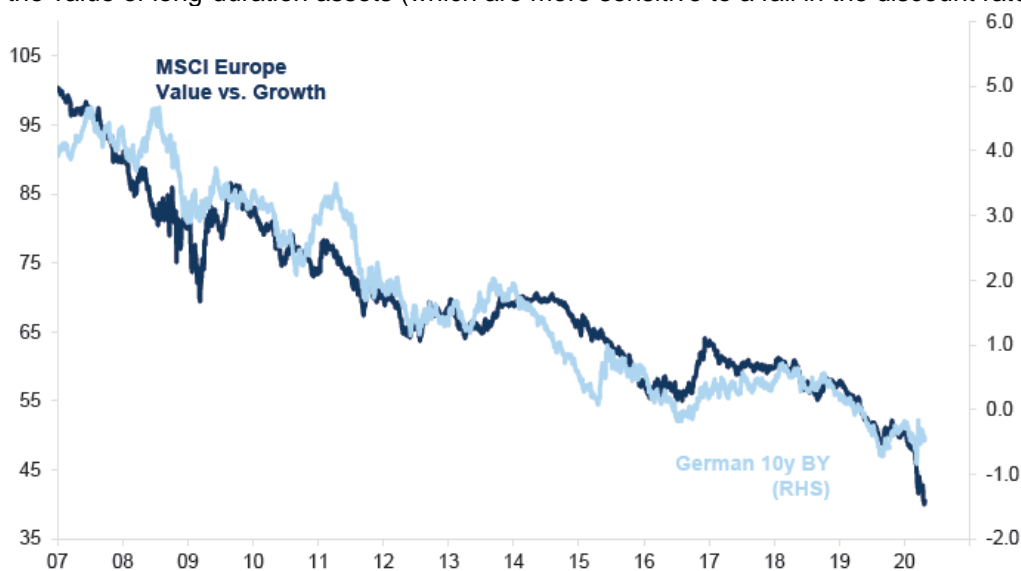
Overall, global multiples are broadly attractive on a relative basis, given the record-low level of interest rates and the increasing diminishing returns of attempting to diversify through bonds. This is particularly true as we approach the end of the year.

	S&P 500 Index Fwd P/E	Stoxx 600 Index 2022 P/E	MSCI EM Index 2022 P/E
Current Level	17.6	13.6	11.9

**Exhibit 42.** 2022 P/E Multiples by Index, October 2020, source Bloomberg.

*Attractive Opportunities in High Quality Growth Stocks with Strong Balance Sheets and Free Cash Flows*

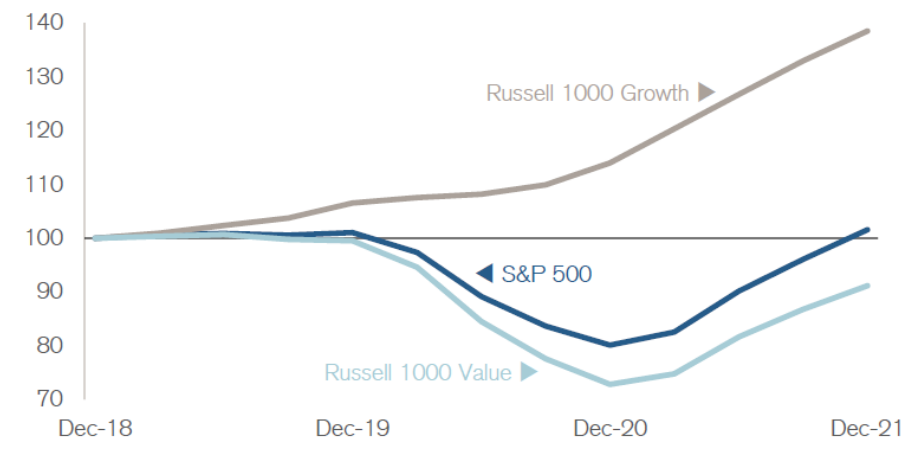
We continue to favor individual growth equity opportunities, especially in the US and emerging markets. Although growth has outperformed in recent years, almost all such relative outperformance is explainable by the drop in global bond yields that has elevated the value of long-duration assets (which are more sensitive to a fall in the discount rate).



**Exhibit 43.** Relative Performance of Growth vs Value Stocks Highly Correlated to Bond Yields, source Goldman Sachs.

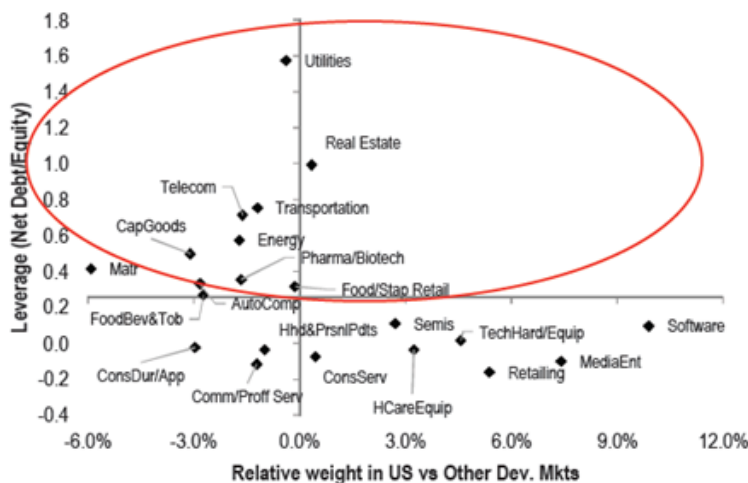
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Moreover, and importantly from our fundamental analysis perspective, the outperformance of growth stocks this year (as well as last year) has been earnings driven, as can be seen from the chart below that draws 12-month rolling earnings per share growth and includes forward estimates.



**Exhibit 44.** Twelve-Month Rolling EPS with Consensus Forecasts, source Credit Suisse.

We also continue to remain overweight in the US for a number of fundamental reasons. One, we favor companies that have strong balance sheets, and therefore we favor US equities. This is in line with our long-standing desire to maintain a high investment exposure to businesses with little to no debt – which we believe helped our portfolio in the recent crisis. As can be seen below, relative to other developed markets, the US has greater exposure to industries with low leverage.

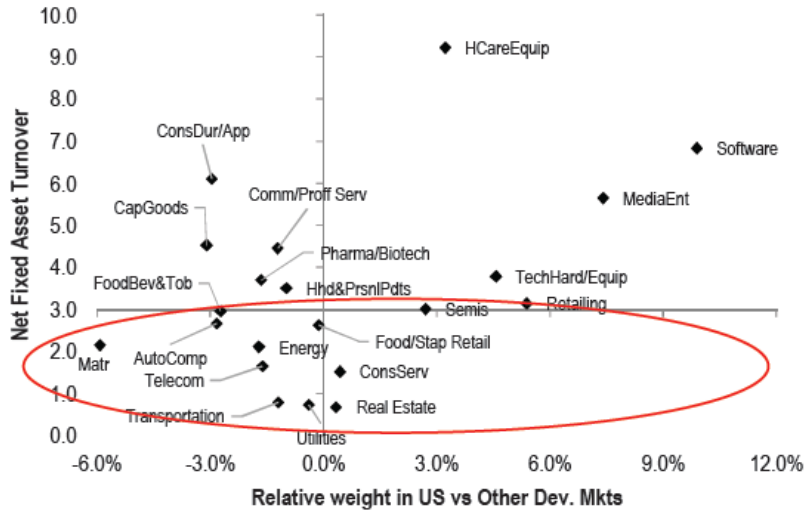


**Exhibit 45.** US has Higher Exposure to Low Leverage Industries, May 2020, source JP Morgan.

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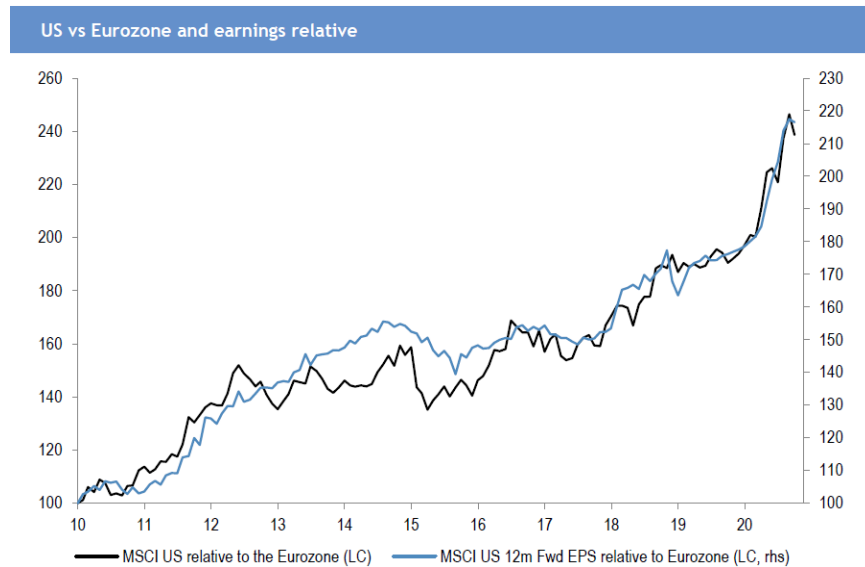
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Two, the US also stands out with respect to high exposure to asset-light (therefore high return on invested capital) industries, which, again, is consistent with our long bias towards that group.



**Exhibit 46.** US has Higher Exposure to Asset-Light Industries, May 2020, source JP Morgan.

Three, and again from our fundamental analysis perspective, we believe earnings growth in the US is likely to outperform other developed markets. US outperformance has closely tracked earnings growth in recent years.



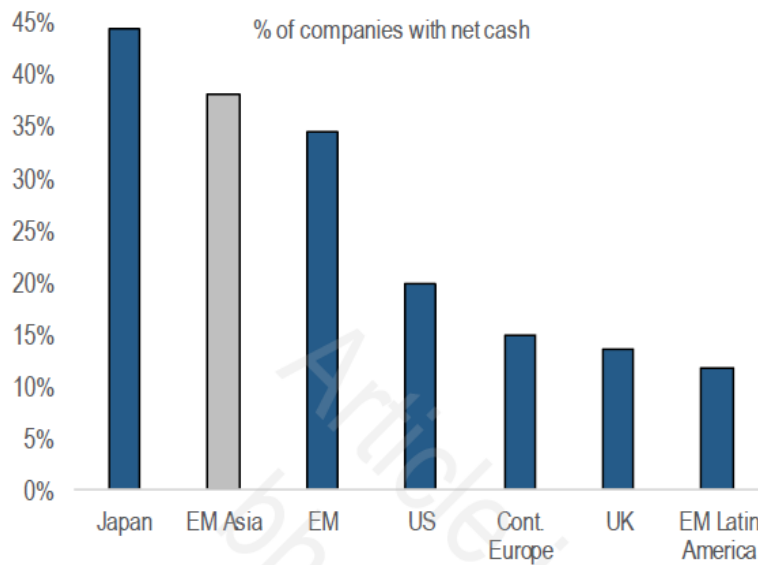
**Exhibit 47.** US vs Eurozone Performance and Relative Earnings Growth, source JP Morgan.

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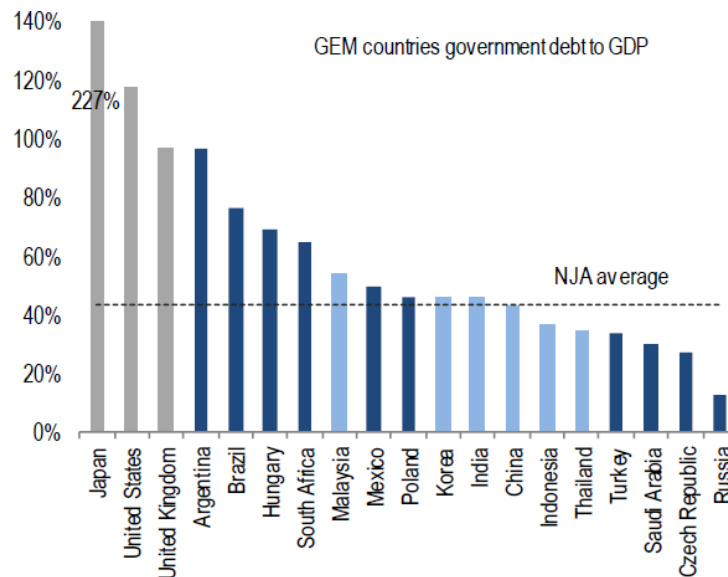


Outside the US, we also continue to find growth equity opportunities in emerging markets, particularly in Asia. We particularly favor Asia from a fundamental risk/reward standpoint, as relative multiples are attractive and companies in Asia typically maintain high cash levels on their balance sheets.



**Exhibit 48.** Percent of Companies with Net Cash, May 2020, source Credit Suisse.

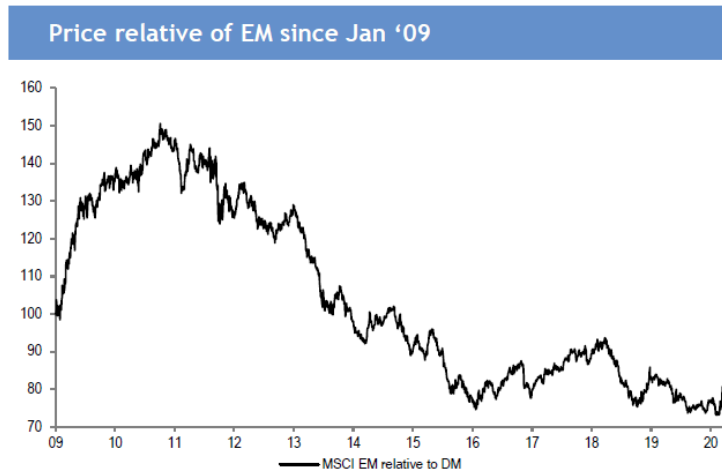
Moreover, and intriguingly in the current environment, Asia ex-Japan also has low levels of government debt! This is positive long-term, as we believe the recently elevated levels of debt in developed markets do impose structural long-term risks on their economies.



**Exhibit 49.** Government Debt to GDP, May 2020, source Credit Suisse.

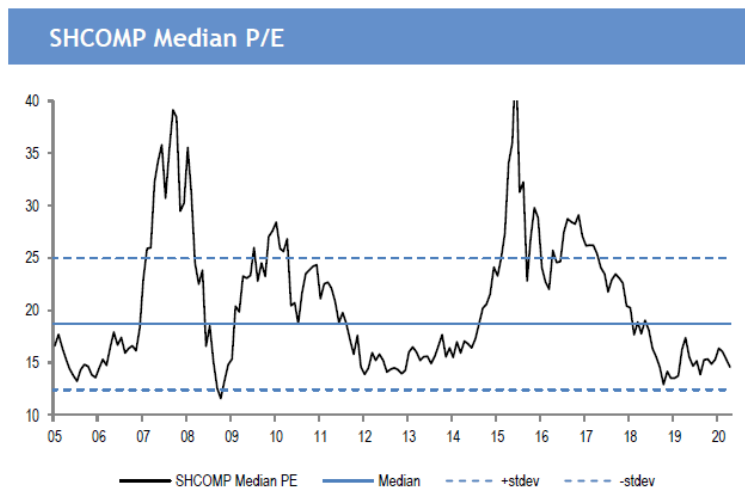
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In addition to the underlying balance sheet strength, multiples are also attractive. Emerging market equities have underperformed significantly over both the last two and the past ten years, with current relative prices at multi-year lows. This has created an array of attractive relative opportunities, in our view.



**Exhibit 50.** MSCI Emerging Market Index Relative to Developed Markets, Reverse Scale, source JP Morgan.

For example, in China, we believe the Shanghai Composite Index remains particularly attractive, as valuations are presently near fifteen-year lows and are among the least expensive in emerging markets.

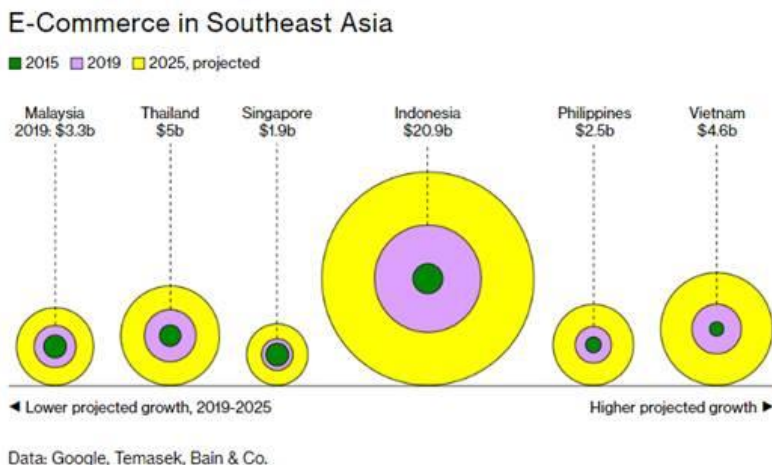


**Exhibit 51.** Shanghai Composite Index Forward P/E, source JP Morgan.

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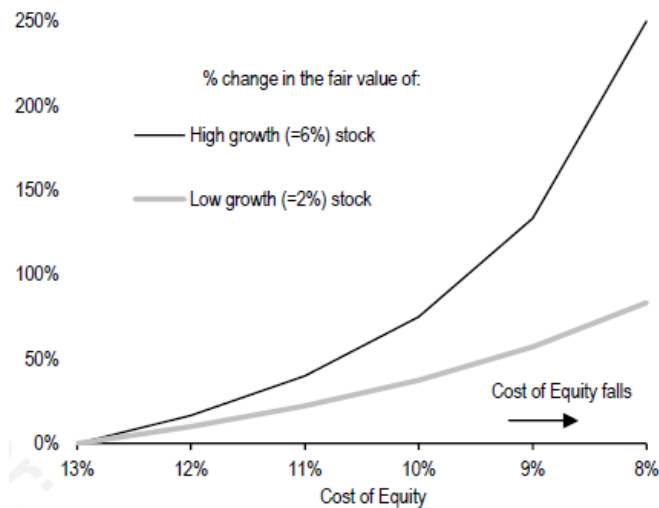
In this connection, our team has continued to dedicate substantial resources to fundamental research activities in Asia and emerging markets in general. Examples include investments in e-commerce businesses in Latin America as well as Southeast Asia.



**Exhibit 52.** E-Commerce in Southeast Asia, source Morgan Stanley, Google and Bain.

*Attractive Opportunities in Long-Duration Assets and Technology Stocks*

We continue to favor long duration sectors such as technology, communication services and ecommerce consumer discretionary, which we believe are supported by, one, superior fundamentals, e.g., stronger balance sheets, higher margins and stronger free cash flow generation; two, strong secular trends towards digital transformation, distributed workloads and distributed commerce, “work from everywhere” and the cloud and SaaS ecosystem that supports this decentralized user architecture with security, redundancy and agility in its deployment and elasticity in infrastructure scaling; three, and as shown below, the fall in the cost of equity (risk premia) due to record low interest rates; four, scarcity of growth assets; and, five, superior free cash flow valuations relative to the broader market.



**Exhibit 53.** High-Growth Stocks have Larger Upside from a Fall in the Cost of Equity, May 2020, source Credit Suisse Research.

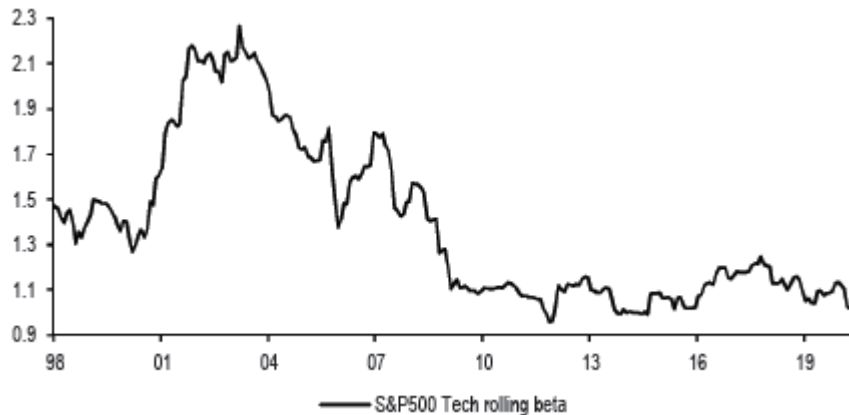
In particular, the scarcity of long-duration growth assets is remarkable. To illustrate how scarce growth assets have become, one need only look at global markets over the last twenty years, and, in particular, observe how slow-growing companies (i.e., those with top-line growth below 4%) have increasingly crowded out fast-growing companies (i.e., those with top-line growth above 8%), creating a severe scarcity of growth assets.



**Exhibit 54.** *High Growth Companies are Scarce, MSCI World Index, April 2020, source Goldman Sachs Global Investment Research.*

We also continue to favor investments in technology companies, which, year-to-date, have fared much better from an earnings reporting standpoint. As we have stated in previous investor communications, we consider technology to be not only a growth investment but also a defensive one due to its cost-cutting (high ROI) and productivity enhancing proposition to the end customer, superior balance sheet, strong free cash flow conversion, low labor cost to sales, ongoing industry consolidation, very low sensitivity to interest rates, and strong underlying secular innovation trends.

This defensive posture is also reflected in the steady decline in technology beta over the last two decades.



**Exhibit 55.** *US Tech Beta vs. S&P 500 Index, source JP Morgan.*

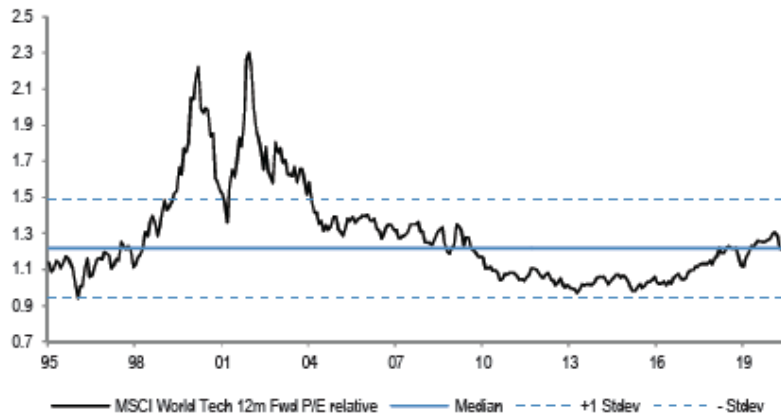
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Notably, the year-to-date outperformance of domestic technology stocks has been earnings driven, and not aided by relative multiple expansion. Therefore, on a relative forward PE basis, technology stocks are as attractive now as they were at the beginning of the year.

Year	Cap-Weighted			Equal-Weighted		
	Relative NTM Earnings Growth	Relative Multiple Expansion	Relative Performance	Relative NTM Earnings Growth	Relative Multiple Expansion	Relative Performance
2013	-3.2%	3.6%	0.0%	0.4%	1.8%	2.6%
2014	5.5%	-1.8%	3.7%	3.0%	-0.6%	2.2%
2015	2.1%	5.3%	7.5%	5.4%	-0.1%	5.2%
2016	3.9%	-2.3%	1.7%	4.6%	-3.6%	1.1%
2017	6.3%	7.0%	15.1%	10.1%	-1.7%	7.9%
2018	-1.9%	6.8%	6.6%	-4.2%	6.5%	4.9%
2019	0.3%	10.9%	11.6%	-8.9%	22.5%	9.2%
2020 H1	18.3%	-3.4%	21.8%	22.1%	-24.1%	15.3%

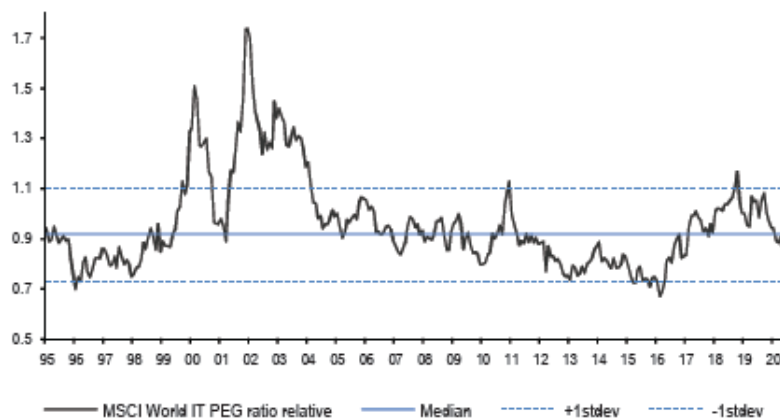
**Exhibit 56.** US Tech Sector Relative Outperformance, source Bernstein.

The picture is similar globally. As a result, on a relative forward P/E basis, global technology stocks are currently trading around their historical average levels, and similar levels to those at the very beginning of the year.



**Exhibit 57.** MSCI World Technology Forward 12-month PE, source JPM.

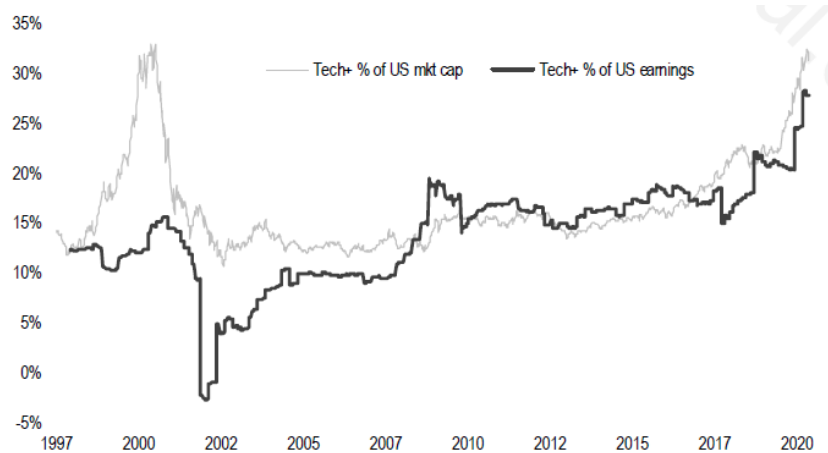
On a P/E to Growth basis, technology stocks also stand near average levels, and, on that basis, remain chronically undervalued in our view.



**Exhibit 58.** MSCI World Relative PEG, source JPM.

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Viewed in a different way, the technology sector market share of earnings has kept up with its share of market cap; this is unlike the tech bubble in the late nineties.



**Exhibit 59.** *Technology Share of US Market Cap and Earnings, source Credit Suisse.*

Technology stocks remain attractive both on a relative and absolute basis. Among the S&P 500 sectors, information technology, healthcare and communication services, all classic high quality growth sectors, are all currently trading at attractive multiples relative to the market on a forward free cash flow yield basis, despite having stronger revenue growth prospects, better balance sheets and high return on invested capital. In theory, and as multiples ultimately normalize against underlying fundamentals, one should expect a sector with high growth, a pristine balance sheet and high ROIC to trade at a significant valuation premium to the market.

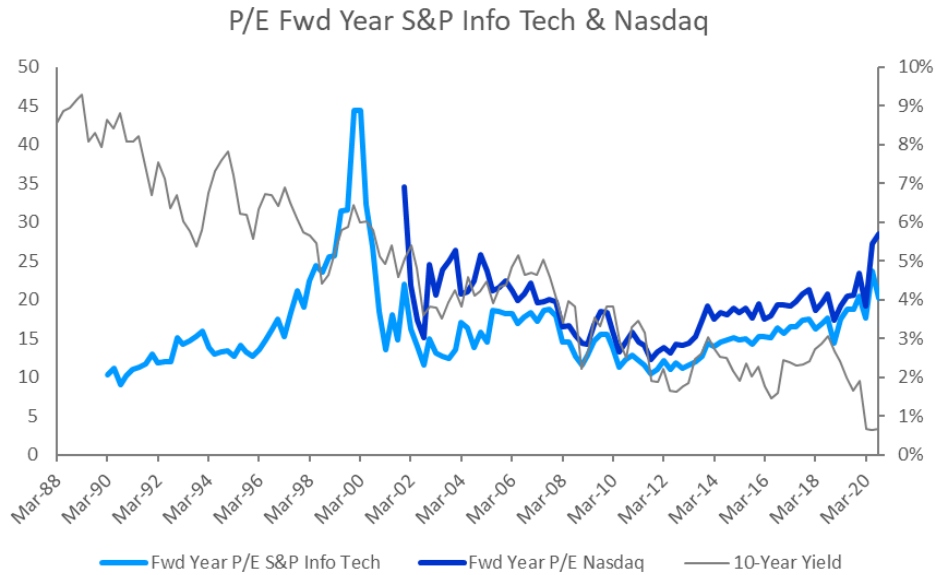
At the same time, on a free cash flow basis, low-growth sectors such as utilities and real estate continue to trade at a premium to the market. The utilities sector, for example, a “defensive” sector that exhibits anemic growth, has significant debt and generates negative free cash flow yield, trades at a large premium to communication services, healthcare and information technology on a forward free cash flow yield basis.

Sector	ROIC LTM	Net Cash % Mkt Cap	P/E 2022	FCF Yield 2022
Consumer Discretionary	7.8%	-16.6%	25.4x	4.7%
Consumer Staples	13.0%	-17.9%	19.4x	5.2%
Energy	-1.3%	-56.7%	13.2x	10.0%
Financials	3.9%	-87.2%	10.7x	
Health Care	10.8%	-14.1%	14.4x	6.8%
Industrials	7.4%	-23.5%	17.2x	5.8%
Information Technology	17.0%	-2.6%	23.5x	4.4%
Materials	5.5%	-21.6%	18.0x	5.0%
Real Estate	4.0%	-37.3%	18.2x	0.3%
Communication Services	7.4%	-14.2%	18.5x	7.5%
Utilities	4.1%	-66.4%	18.2x	-1.0%
<b>S&amp;P 500</b>	<b>7.0%</b>	<b>-22.8%</b>	<b>18.0x</b>	<b>4.8%</b>

**Exhibit 60.** *Valuation Metrics by Sector, October 2020, source Bloomberg and Alkeon Estimates.*

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Lastly, technology stocks remain very attractive relative to the level of interest rates. Not only are absolute forward P/E ratios substantially below the 1999-2000 technology bubble (and at very reasonable levels given their above market growth rates), but also, and notably, the 10-year Treasury yield has fallen from 6.44% at the end of 1999 to 0.68% at the end of the third quarter, making the earnings yield spread for technology stocks (against the Treasury yield) compelling by historical standards.



**Exhibit 61.** *Fwd Year P/E S&P Info Tech and Nasdaq through Q3 2020, source Bloomberg.*

To better understand how we reached this point of wide-scale sector valuation discrepancies, one has to first contemplate the unprecedented thirty-eight year super-cycle for interest rates (shown below) that began in 1982 when rates were around 14% and yielded remarkable returns for fixed-income investors.



**Exhibit 62.** *10-Year Treasury Yield, 1982 through October 2020, source Bloomberg.*

This multi-decade declining rate environment forced investors to seek defensive investments in “bond proxies” in the equity market in recent years, a behavior that particularly and disproportionately benefitted shares of low-volatility, interest-rate sensitive, low-growth stocks, such as utilities, REITs and consumer staples, elevating their relative multiples and, along the way, creating significant valuation dislocations compared to other sectors during this period.

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But now this super-cycle is ending as we approach the zero-level “barrier” that substantially inhibits the defensive nature of such investments, in our view. During the first quarter of 2020, the S&P 500 Low-Volatility Index failed to protect equity investors, realizing losses equal to the broader S&P 500, and, to add insult to injury, failed to fully participate in the subsequent recovery.



**Exhibit 63.** S&P 500 Low Volatility Index vs. S&P 500 Index, Year-to-Date through July 2020, source Bloomberg.

Simply stated, as low-volatility stocks have produced outsized returns for years, we believe their relative free cash flow yields are increasingly challenging to justify on fundamentals.

Supporting the formation of this low-volatility bubble in recent years, remarkably, and over the last decade, low-volatility stocks dramatically lagged the market from a free cash flow generation standpoint, showing little to no improvement. Specifically, while free cash flow as a percentage of sales almost doubled for the market as a whole during the 2009-2019 period, staples and utilities saw only much smaller improvements, and, in particular, REITs saw an outright deterioration.

	Financials	Technology	Communications	S&P 500	Discretionary	Industrials	Materials	Staples	Health Care	Utilities	Energy	REITs
2009-Current	23%	19%	13%	10%	5%	8%	6%	6%	10%	-1%	2%	29%
1990-2009	7%	8%	7%	5%	2%	5%	4%	5%	9%	-1%	4%	35%
Improvement	17%	12%	6%	6%	4%	3%	3%	1%	1%	1%	-2%	-6%

**Exhibit 64.** S&P 500 Index Sector Free Cash Flow Generation as a Percentage of Sales and Net Improvement, May 2019, source Credit Suisse.

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During the recent crisis, the market took corrective action, penalizing REITS for their high leverage, which led to widening credit spreads in the first quarter of the year. As a result, despite collapsing 10-year Treasury yields, REITS both failed to exhibit defensive behavior during the first quarter correction and failed to fully participate in the subsequent recovery.



**Exhibit 65.** Daily Price Movement S&P 500 REIT Index versus S&P 500 Index, Year-to-Date through July 2020, source Bloomberg.

In summary, we believe this multi-year, low-volatility and defensive stock bubble disproportionately benefitted low-volatility and defensive sectors at the expense of growth sectors, such as technology, communications and healthcare. We believe the on-going unwinding of the bubble is yielding a unique tactical opportunity on both sides of the investment universe, framing a particularly attractive fundamental backdrop for flexible long-short investors.

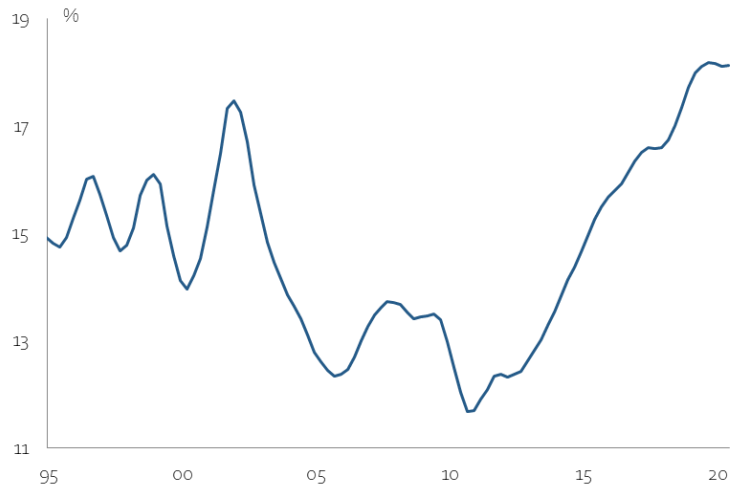
As a result, and as prices renormalize, not only can the opportunity set for alpha generation on the short side meaningfully improve, but also relative multiples for high quality growth compounders and high-quality long-duration assets may start to actually expand over time, framing a secular long-short, double-alpha-generation investment opportunity, which we believe has the potential to produce above-average returns.

### *Strong Fundamentals for Technology Stocks*

Beyond relative valuations, and looking at fundamentals, we continue to maintain a constructive view on the technology sector for ten reasons, which we detail below. Importantly, we consider technology to be not only a growth investment but also a defensive one due to its cost-cutting (high ROI) and productivity enhancing proposition to the end customer, superior balance sheet, strong free cash flow conversion, low labor cost to sales, ongoing industry consolidation, very low sensitivity to interest rates, and the secular benefit from “work-from-everywhere” trends.

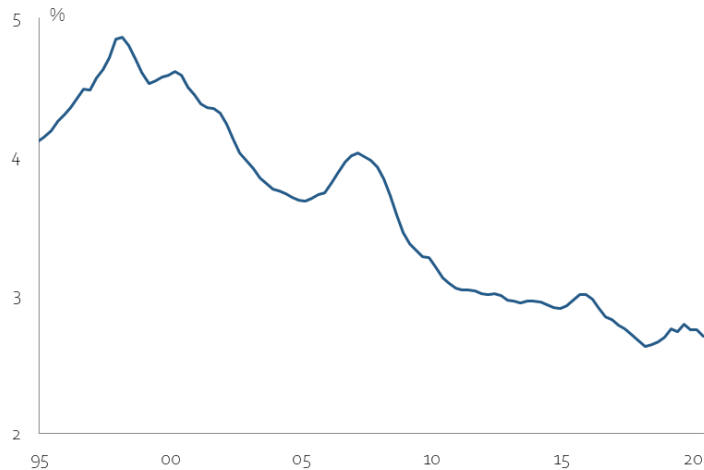
In recent communications, we have extensively discussed the driving elements behind such continued and persistent relative outperformance. In particular, when one carefully dissects underlying fundamental drivers of technology stocks, it becomes clear that chief among the reasons technology stocks have consistently grown earnings above market rates, and may continue to do so in the future, is their persistently high level of business reinvestment, measured as a percentage of sales – a high level that has allowed these companies to maintain a powerful combination of high barriers to entry and high margins.

This business model of high ROIC and high rate of reinvestment is an archetype of the high quality growth companies we seek to identify, analyze and invest. Furthermore, the level of business reinvestment by technology stocks has re-accelerated in recent years, approaching an all-time high level of 18% in 2018.



**Exhibit 66.** *Technology Capex plus R&D as a Percentage of Sales (Trailing 4Q Basis), 1996 to June 2020, source Credit Suisse.*

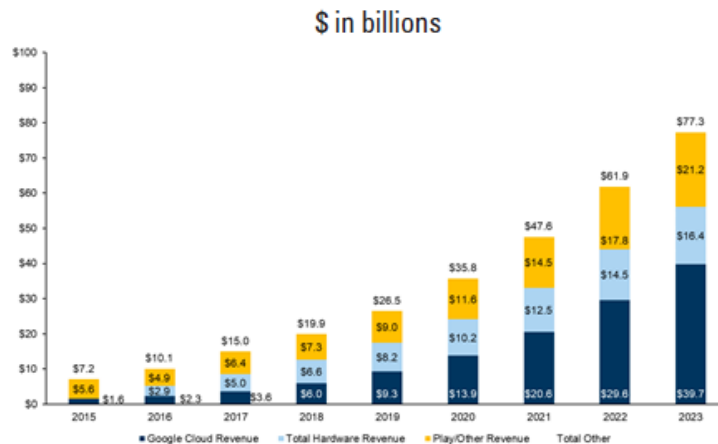
In contrast, the amount of business reinvestment for consumer staples has been disappointing and declining for over two decades, which has potentially grave implications for future earnings growth.



**Exhibit 67.** *Consumer Staples Capex plus R&D as a % of Sales (Trailing 4Q Basis), 1996 to June 2020, source Credit Suisse.*

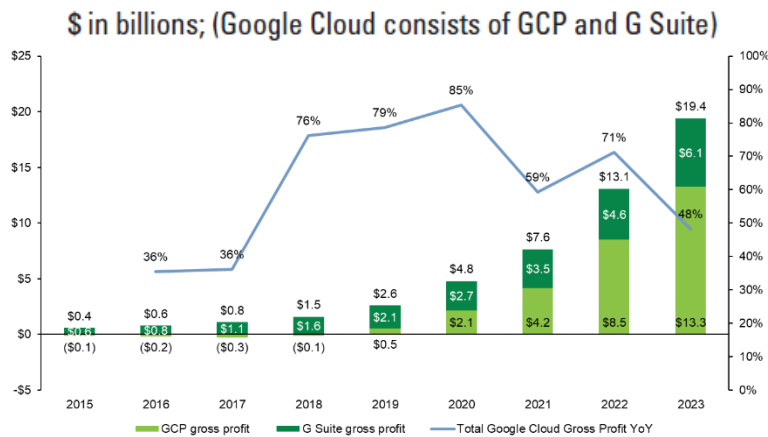
Not only does this high level of business reinvestment lead to an attractively high ROIC profile for technology companies, but also it provides fundamental investors with an additional benefit, namely an opportunity to research and evaluate newly emerging business units that are parts of these larger enterprises at an early stage. These promising, but early-stage growth business units often have the potential to contribute meaningfully to company revenues and earnings in future years, while they may remain a drag to profitability (and thus consensus expectations) in the near term. This gap between near-term earnings expectations and longer-term earnings realizations can provide a study framework to deeply analyze and invest in growth businesses early on, as they embark on a path of earnings acceleration, but before consensus expectations catch up to the real growth trajectory.

Take as an example Alphabet Inc., whose non-advertising revenues (“other revenues” that include apps and content, hardware such as Pixel phones and Google Home, and Google Cloud) were estimated to be approximately 20% of total revenues in 2019. From a profitability standpoint, these other businesses are expected to grow much faster than the company’s average, generating gross profit that is expected to grow from \$2.6 billion in 2019 to \$19.4 billion in 2023.



**Exhibit 68.** *Expected Revenue Contributions from Alphabet's "Other", source Goldman Sachs.*

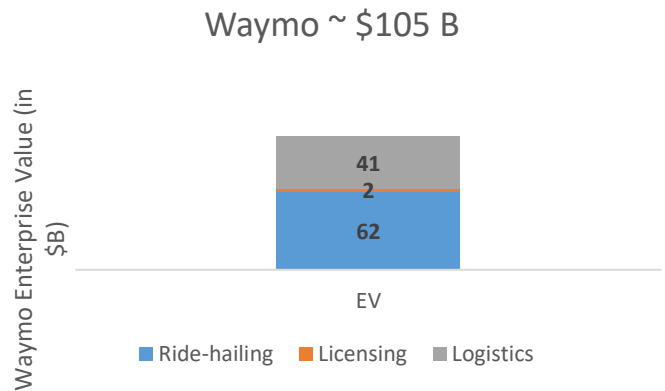
As the company makes heavy early investments in these businesses, their profit contribution can be most pronounced in future years. For example, the Google Cloud Platform, which has produced negative profits so far, is expected to contribute meaningfully in future years.



**Exhibit 69.** *Estimated Google Cloud Gross Profit Contribution, source Goldman Sachs.*

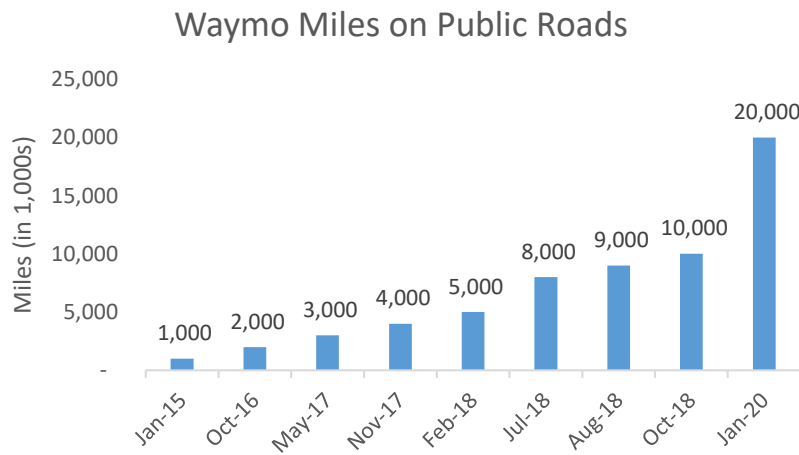
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Furthermore, these other businesses do not include other longer-duration investment projects, which themselves have the potential for meaningful revenue and earnings contributions in future years. For example, Waymo, which we consider the most advanced autonomous vehicle, has the potential to become a business worth \$105 billion.



**Exhibit 70.** *Estimated Waymo Enterprise Value, September 2019, source Morgan Stanley.*

To put this in perspective, Softbank's 2018 investment in GM's Cruise subsidiary valued the autonomous startup at \$11.5 billion. Meanwhile, Waymo has driven more miles than any other autonomous vehicle, which gives it an advantage in testing advanced machine learning algorithms, recently surpassing 20 million miles.

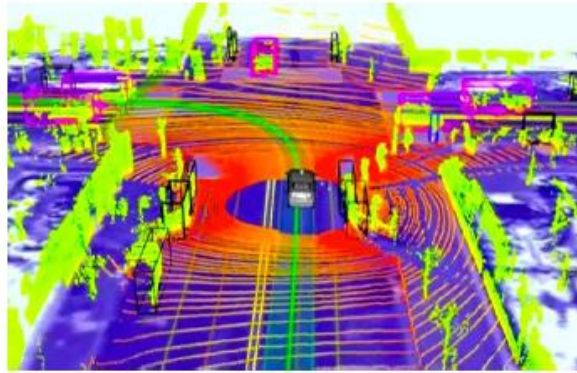


**Exhibit 71.** *Waymo Miles Driven, source Morgan Stanley.*

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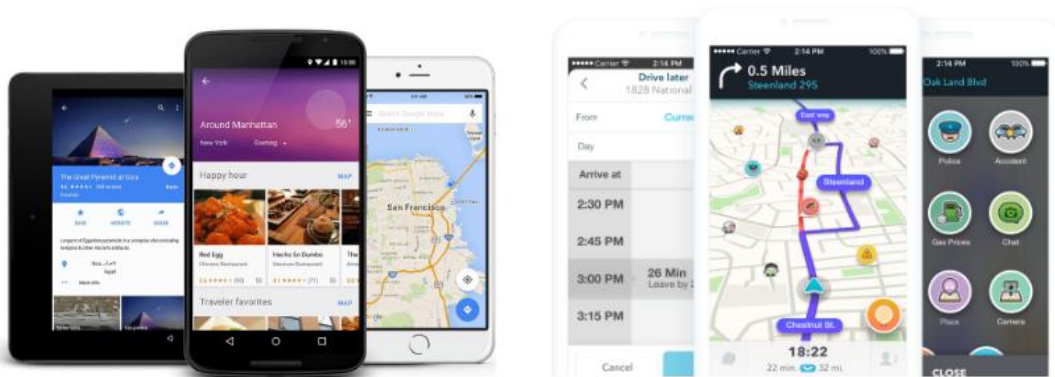
Waymo also has an incredible strategic advantage of leveraging Alphabet's advanced capabilities in machine learning, cloud compute power, computer vision and mapping.

**Waymo's sensor suite creates HD maps of road conditions**



**Exhibit 72.** *Waymo's Sensor Suite HD Road Maps, source Waymo and ISI Research.*

This advanced set of technologies materially extends the core capabilities of Google Maps and Waze, which in and of themselves represent another strategic advantage in a different direction, namely the consumer evolution of Waymo in the ride hailing market.



**Exhibit 73.** *Google Maps and Waze, source Alphabet and Merrill Lynch.*

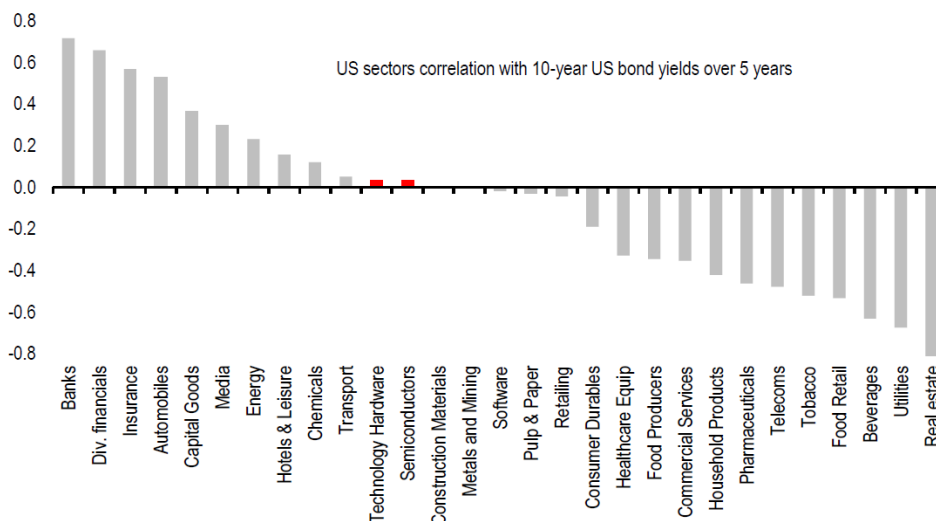
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## Ten Fundamental Reasons Why Technology Stocks Remain Attractive

One of the main reasons why technology investments have been attractive and generally resilient in most market environments is the presence of strong underlying secular growth-driving product cycles, which are company-specific, are fueled by innovation and, as such, have historically been largely decoupled from the economic cycle.

This yields an additional benefit to investing in technology secularly, or even counter-cyclically, namely low correlation to interest rates. Specifically, technology investment performance has historically been largely yield-agnostic, as statistically there has been almost zero correlation between the performance of technology subsectors and bond yields.



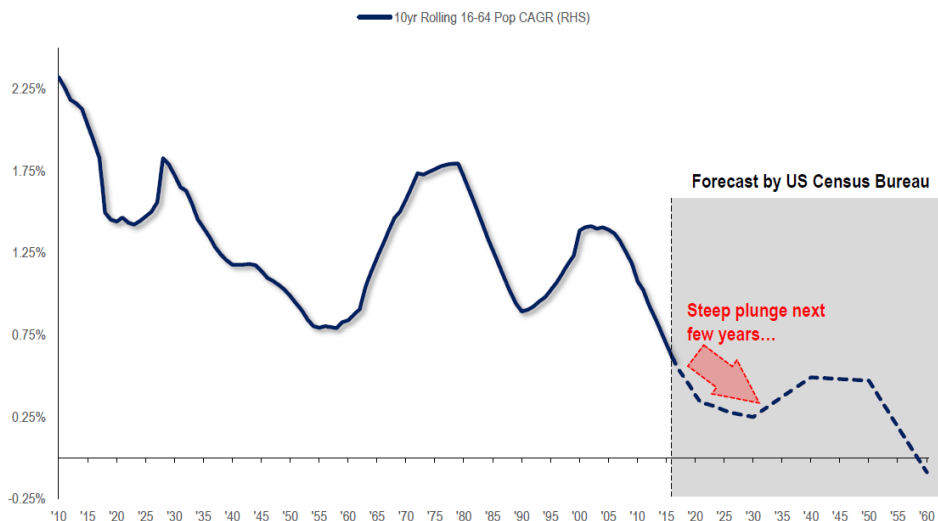
**Exhibit 74.** US Sector Correlation with 10-Year Treasury Yields, over Five-Year Period, April 2018, source Credit Suisse.

As a result, historically technology has been able to outperform in environments of both falling and rising bond yields, as shown below. In our view, this is reflective of the product-specific nature of the underlying earnings growth drivers for technology stocks, which, often remain largely independent of the economic cycle, particularly for cutting-edge technology disruptors and innovators.

Major peak	Bond yields		US Tech relative performance		Bond yields		US Tech relative performance	
	Major trough	Change in yields	Peak to trough performance	Major trough	Major peak	Change in yields	Trough to peak performance	
Apr-10	Oct-10	-161	0.0%	Oct-10	Feb-11	134	4.0%	
Feb-11	Sep-11	-201	1.6%	Sep-11	Mar-12	66	3.8%	
Mar-12	Jul-12	-97	-5.1%	Jul-12	Mar-13	66	-10.1%	
Mar-13	May-13	-43	-1.7%	May-13	Sep-13	134	1.8%	
Sep-13	Oct-13	-48	-0.9%	Oct-13	Dec-13	52	2.6%	
Dec-13	Jan-15	-137	5.1%	Jan-15	Jun-15	85	2.4%	
Jun-15	Sep-15	-45	0.8%	Sep-15	Nov-15	29	3.1%	
Nov-15	Jul-16	-96	-5.3%	Jul-16	Dec-16	122	7.2%	
Dec-16	Today	-40	11.2%					
Average		-96	0.6%	Average		86	1.9%	
% of times positive			44%	% of times positive			88%	

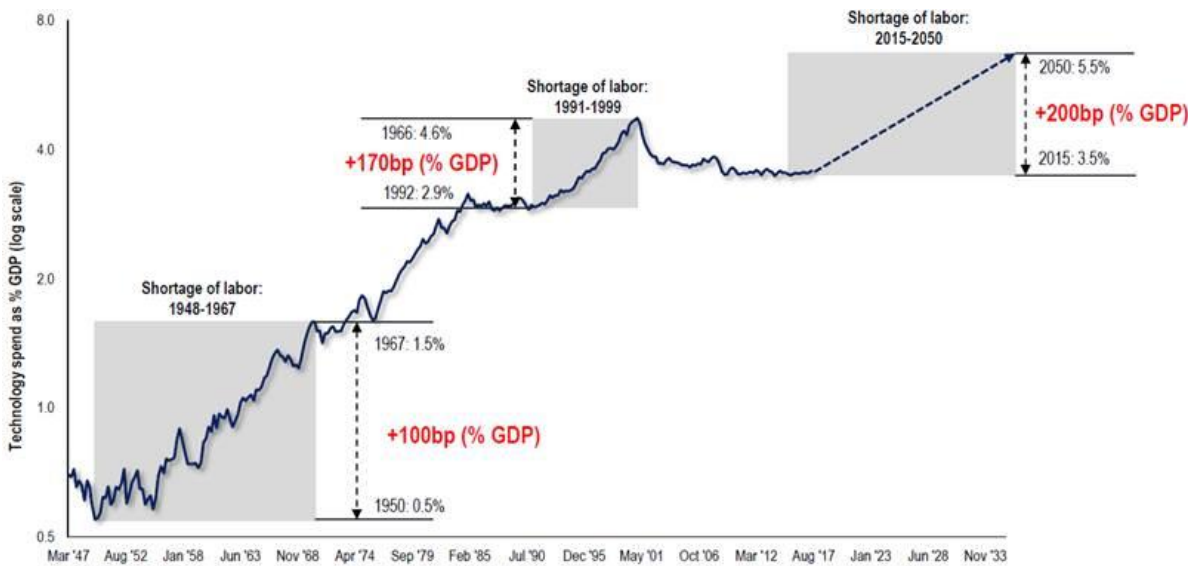
**Exhibit 75.** US Technology Sector Performance in Periods of Rising and Falling Bond Yields, source Credit Suisse.

Secularly, the technology sector also stands likely to benefit for years to come from increased spending due to an emerging long-term labor shortage in the US over the next fifteen to twenty years. Specifically, the growth rate of the US population working pool (ages 16-64) is set for a steep decline within the next few years and is expected to turn negative by late 2060, something our country has never seen before.<sup>4</sup>



**Exhibit 76.** 10-Year Rolling Change of US Worker Population Pool, source Fundstrat.

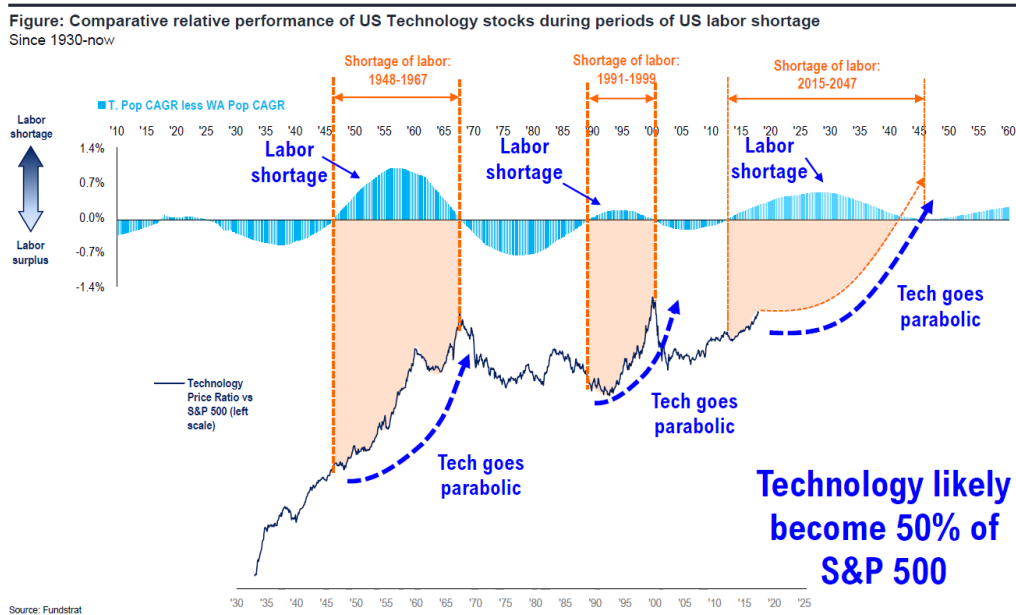
In past labor shortages, technology spending spiked, and it was estimated to rise to 5.5% of GDP (an all-time high) from 3.5% at the beginning of 2018.<sup>5</sup> Remarkably, this incredibly strong demographic tailwind is independent of and incremental to the upcoming wave of technological innovation, which is in itself transformative and represents a sea-change event. The result is a potentially powerful dual engine of secular growth for technology stocks that can lift consensus expectations meaningfully on a secular basis over a multi-year period.



**Exhibit 77.** Technology Spending as a Percentage of GDP, source Fundstrat.

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Historically, the outperformance of technology stocks against the S&P 500 during periods of labor shortage has indeed been dramatic and, according to Fundstrat, has the potential to lift the technology sector to a 50% weight in the S&P 500 during this upcoming long-term labor shortage cycle over the next two decades.



**Exhibit 78.** Technology Price Ratio vs. S&P 500 Index and US Labor Shortage/Surplus, source Fundstrat.

Staying with demographics, another important tailwind for technology investments in the US is the mere presence of Millennials, who represent the largest population cohort ever, and are entering their prime working years. From a broader economic cycle standpoint, this is an important group to watch, as Millennials –who have helped the auto market in recent years and are already having a positive impact on the housing market– are still early in their investment activities, and therefore their full impact on the stock market has yet to be seen.<sup>6</sup>

Generation	Years of birth	Statistics @ 2017			Peak size of generation (includes immigration)
		# in cohort	As % Pop	Avg age	
Greatest Generation	1910-1927	2.6	1%	92.9	43.2
Silent Generation	1928-1945	25.8	8%	78.5	44.1
Baby Boomers	1946-1964	73.8	23%	61.3	79.5
Generation X	1965-1980	65.8	20%	44.5	65.8
Millennials	1981-2000	89.2	27%	26.5	95.8

**Exhibit 79.** Comparative Size of US Generations (in millions), source Fundstrat.



More specifically, Millennials are the first truly all-digital generation. Every large generation group has embraced innovation and supported disruptive emerging companies that have challenged the status quo, and we expect Millennials, whose experiences are built on digital data, to be no different, as they fully endorse and accelerate this upcoming technological revolution, an innovation cycle that has the potential to fundamentally and structurally alter the way we work and interact with each other.



**Exhibit 80.** *Innovations Seen When Each Generation was in Their 20's, source Fundstrat.*

Despite such powerful fundamental tailwinds, technology is remarkably trading attractively relative to the market, on a FCF yield basis, at the exact time when the long-term secular growth outlook for the sector is improving, in our view. This, we believe, creates a compelling risk/reward opportunity ahead of a potential large-scale, broadly impactful wave of technological innovation, similar to the internet wave of the 1990s. But, unlike that last innovation cycle, technology stocks now are highly profitable and among the most attractive in the S&P 500.

In summary, even though the underlying superior revenue and earnings growth for technology companies relative to other sectors has been well documented, it is in fact the current, forward-looking risk/reward opportunity –ahead of a disruptive cycle of innovation– that is perhaps the most underappreciated aspect of investing in technology, especially considering how early we are in the innovation cycle, in our view. This is something we will fundamentally examine in detail in Section III of this letter. But first, we summarize ten principal reasons why we believe the current risk/reward opportunity for technology stocks is unique.

One, information technology and communication services are currently trading attractively relative to the market, on a forward-free-cash-flow yield basis (see Exhibit 60). Two, in our view, analyst long-term consensus expectations are not fully incorporating the secular multi-year wave and growth upside of the upcoming technological revolution, and therefore what looks cheap or reasonably priced today may look even cheaper two to three years from now. Three, technology stocks have historically been largely uncorrelated to interest rates (see Exhibit 74), and therefore they are more insulated against inflation or disinflation risks. Four, we expect this technological revolution to be fully embraced by Millennials –a generation raised on digital data– who represent the largest population cohort ever, all at a time when they are just entering their prime working and spending years.

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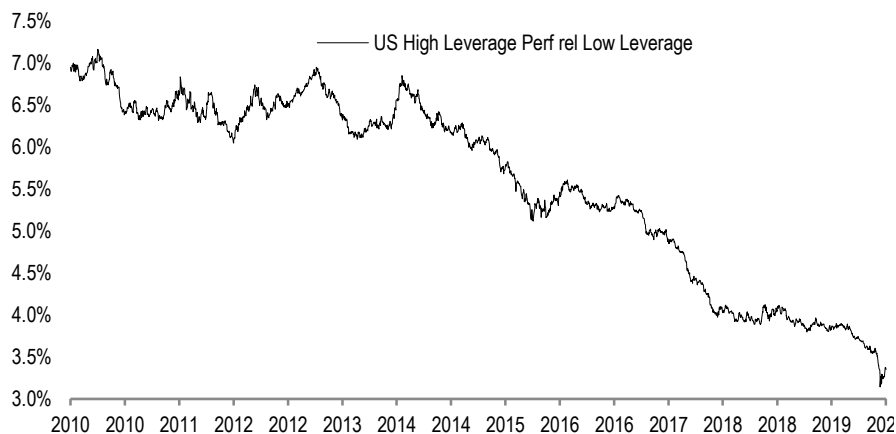
Five, in a low-growth economic environment, there is a real scarcity of growth assets. For example, the percentage of companies globally expected to grow more than 8% has almost been cut in half since 2000.



**Exhibit 81.** Percentage of MSCI AC World Companies with Expected Sales Growth Higher than 8% Over the Next 3 Years, source Goldman Sachs.

Six, we believe multiple sectors of the value complex face major fundamental disruption. For example, auto manufacturers are threatened by autonomous driving, car sharing and electric vehicles. Large pharmaceuticals face government pricing pressure and disruption by biosimilars and personalized medicine. And key segments of the banking sector are being increasingly disrupted (e.g., in the Netherlands, 40% of new mortgages come from non-banks).<sup>7</sup>

Seven, commonly members of the value complex have high leverage. Recently, leverage as a style has structurally underperformed – the relative index level of high leverage to low leverage has halved in the last 10 years, indicating underperformance of approximately 50%.



**Exhibit 82.** US High Leverage relative to Low Leverage Performance, source Credit Suisse.

Eight, in addition to –and independent from– the secular wave of innovation, a projected upcoming severe and secular labor shortage in the US should dramatically boost technology spending in the next decade.

Nine, technology companies, because of recent events during the Coronavirus Crisis, are likely to increasingly benefit, permanently and secularly, from strong trends towards distributed workloads, “work from everywhere”, and the cloud and SaaS/App ecosystem that supports this decentralized user architecture, with security, redundancy and agility in its deployment and ease of infrastructure scaling.

And lastly, ten, as it relates to our portfolio’s technology investing activities, our team has not only invested in long-short technology equities at scale for more than two decades, it also brings deep domain expertise and a strong global network of industry contacts to the alpha-generation and value creation process for our technology investments.

In summary, our current positive outlook on technology stocks is based on a combination of strong underlying fundamentals, multiple macro and demographic tailwinds and a strong superior risk/reward relative opportunity.

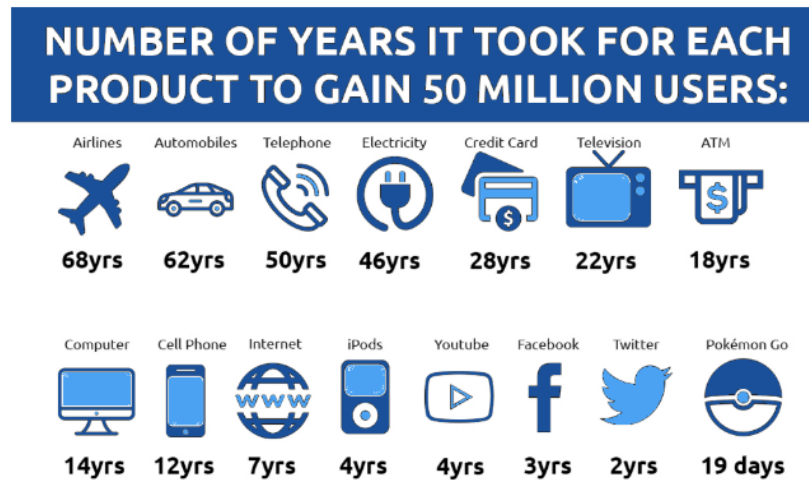
Remarkably, this is all happening at a time when we believe the technology sector is on the precipice of a large-scale wave of innovation, the likes of which has not been seen in decades. This powerful innovation cycle is discussed in detail in the following section.

### III. Secular Outlook for Technology

*“There have been four major historical eras defined by the way we work. The Hunter-Gatherer Age lasted **several million years**. And then the Agricultural Age lasted **several thousand years**. The Industrial Age lasted **a couple of centuries**. And now the Information Age has lasted just **a few decades**. And now today, **we’re on the cusp of our next great era as a species.**” Maurice Conti, Director of Applied Research & Innovation, Autodesk*

In recent communications, we have extensively detailed our view on the emerging wave of technological innovation which we expect to be wide in scope, transformative and highly disruptive. Additionally, we have also discussed why we believe investment implications of this upcoming wave of disruption are likely to be dramatic and, as a result, favor flexible, long-short strategies that can benefit not only from long investments in companies that innovate but also from short investments in companies trapped in an equally powerful cycle of technological obsolescence.

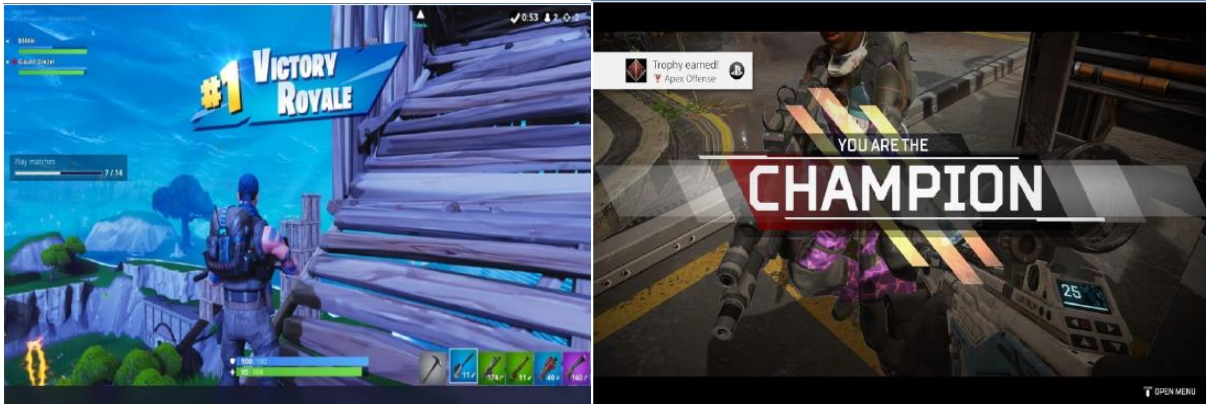
As the digital foundation of the global economy expands rapidly, it is enabling disruption in a matter of months, as, now, businesses can reach millions of users in the shortest time ever. Disruption can affect businesses almost overnight.



**Exhibit 83.** Number of Years for a Product to Reach 50 Million Users, source Morgan Stanley.

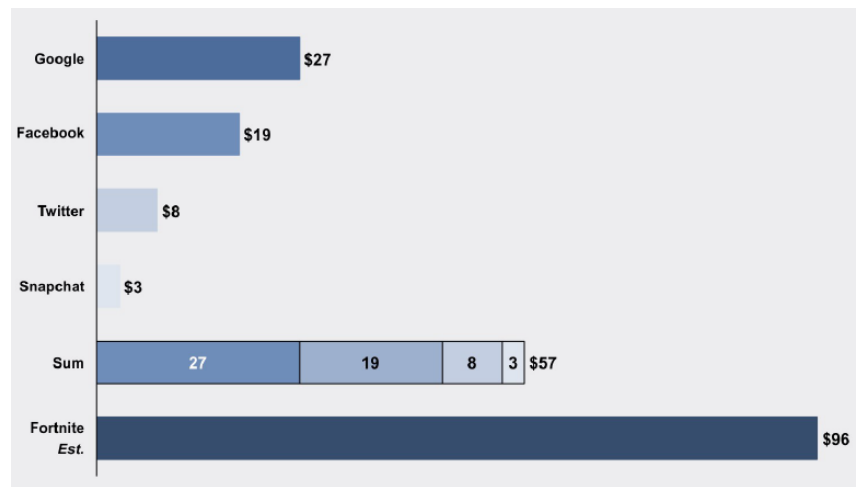
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This new digital world's reach to consumers is almost immediate. For example in digital gaming, last year Call of Duty racked up 100 million downloads in its first week, dwarfing the debuts of previous smashes including Fortnite and PlayerUnknown's Battlegrounds (PUBG).<sup>8</sup> "This is by far the largest mobile game launch in history in terms of the player base that's been built in the first week," according to Randy Nelson, Head of Mobile Insights at Sensor Tower. PUBG, Fortnite and EA's Apex Legends respectively scored 26.3M, 22.5M and 25M in their first week of release.<sup>9</sup>



**Exhibit 84.** Battle Royale Games, source Merrill Lynch.

The above is an example of the dramatic changes in the digital media landscape, a result of technological disruption. For years, as an example, the CEO of Epic Games (creator of Fortnite) Tim Sweeney has espoused the inevitability of "metaverse", an open 3D virtual world that will disrupt the traditional 2D social media world.<sup>10</sup> A sample of this transformation was given last year, when Epic staged an in-game Marshmello EDM concert within Fortnite Battle Royale, arguably the biggest concert in history, with attendance estimates reaching 10 million and estimates of merchandise sales reaching \$30 million. And according to 13D research, Fortnite makes twice as much in revenues per user per year than Google, Facebook, Twitter and Snapchat combined.

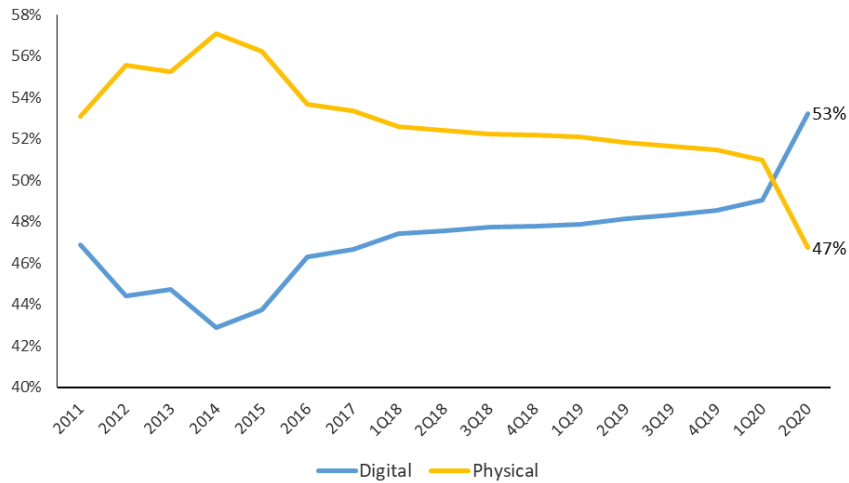


**Exhibit 85.** Annual Revenue per User per Year, source 13D and MediaRedef.

These explosive consumer community formations have certainly been well-documented in recent years. But this year, something remarkable took place, a tectonic shift in user behavior, which we believe will accelerate digital transformation and advance the broader cycle of innovation beyond consumer applications and deep into the business domain.

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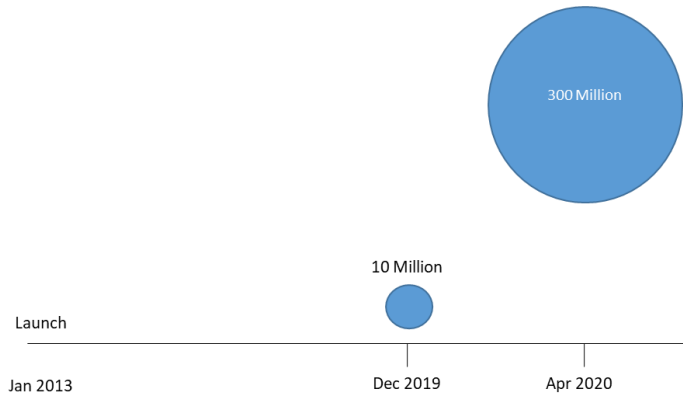
For the first time, digital investment surpassed physical investment and is accelerating rapidly.



**Exhibit 86.** Share of US Business Investment, source U.S. Bureau of Economic Analysis.

*“We’re in a new digital world, in an all-digital world. The past is gone, it’s not coming back . . . . We need to rebuild our companies, our organizations, and ultimately we need to rebuild ourselves to be successful in this new digital future.”*  
 Marc Benioff, Salesforce CEO

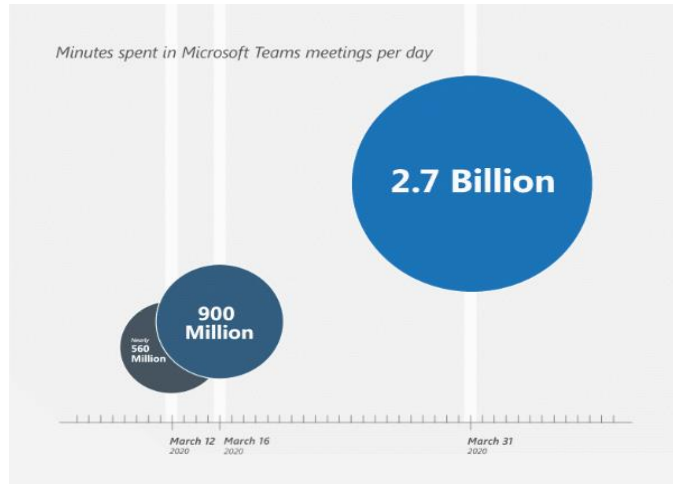
This inflection point of the pace of digital transformation is dramatically accelerating application adoption. Business applications, such as Zoom, for example, are seeing their number of daily participants explode, from 10 million to 300 million in four months.



**Exhibit 87.** Zoom Global Daily Meeting Participants, source Zoom.

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Levels of engagement for business users are growing equally exponentially. Microsoft Teams saw a 200 percent increase in meeting minutes, from 900 million to 2.7 billion in two weeks.

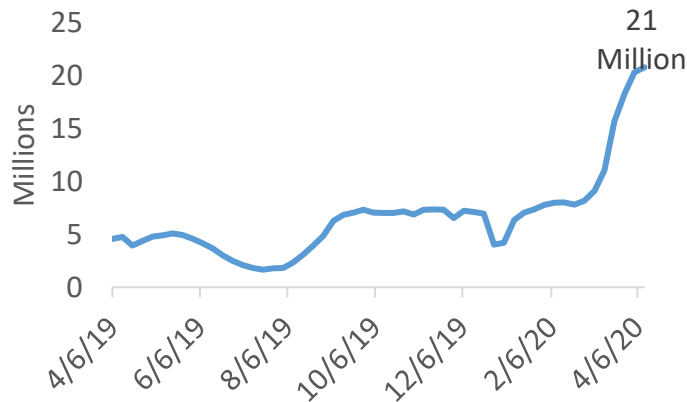


**Exhibit 88.** Microsoft Teams Meetings per Day, source Microsoft.

*"We are seeing businesses accelerate the digitization of every part of their operations, from manufacturing to sales and customer service, to reimagine how they meet customer needs from curbside pickup and contactless shopping in retail to telemedicine in health care." Satya Nadella, Microsoft CEO*

This paradigm change in user behavior, we believe, is likely not only to sustain momentum post the Coronavirus Crisis, but fundamentally change human to business interaction in a secular matter, and transform business collaboration, learning and training as well as the entire sales activity cycle.

As students quickly shift from physical to virtual classes, for example, they are likely to immediately appreciate the long-term comparative benefits in convenience, cost, flexibility/customization and the magnitude of choices that can advance personalization.



**Exhibit 89.** Google Classroom Worldwide Weekly Active Users on iOS, source AppAnnie.

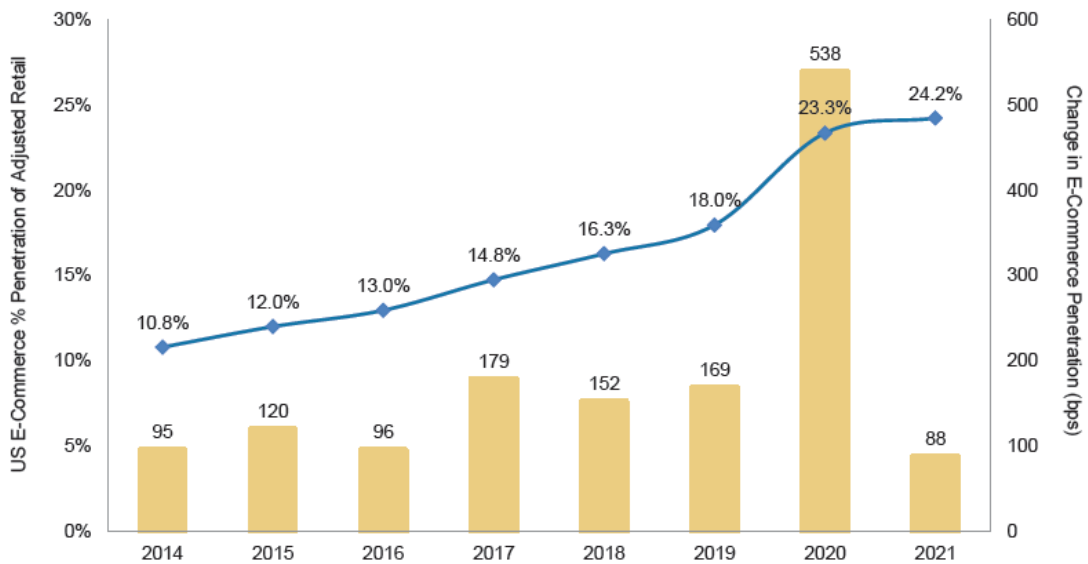
As such user habits grow secularly, and as businesses exhibit receptivity to such changes, we are likely going to find ourselves at the very early stages of a multi-year evolution in user mobility with increased productivity and work-life rebalancing.



**Exhibit 90.** *Do Your Life’s Work from Everywhere*, source Nvidia.

*“We’ve seen two years’ worth of digital transformation in two months. From remote teamwork and learning, to sales and customer service, to critical cloud infrastructure and security – we are working alongside customers every day to help them adapt and stay open for business in a world of remote everything” Satya Nadella, Microsoft CEO*

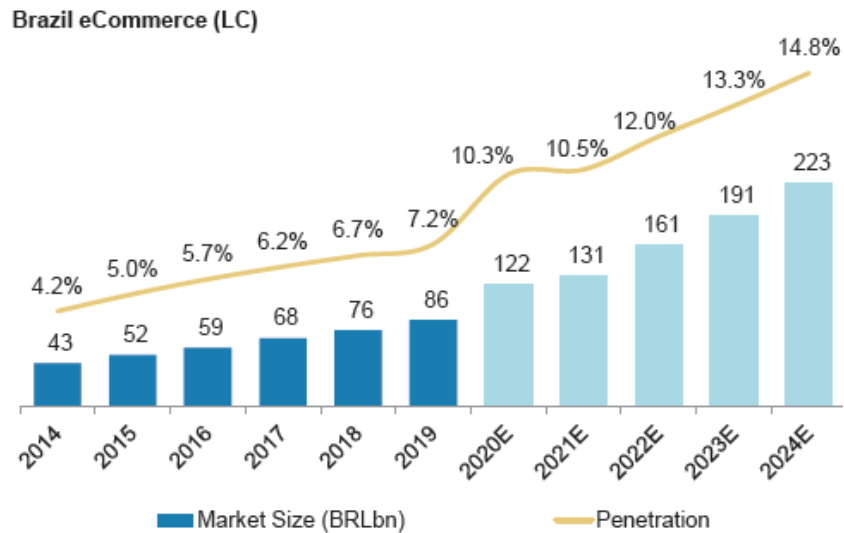
For example, in the US it is estimated that approximately two years of ecommerce adoption has been pulled forward.



**Exhibit 91.** *US E-Commerce Penetration*, source Morgan Stanley.

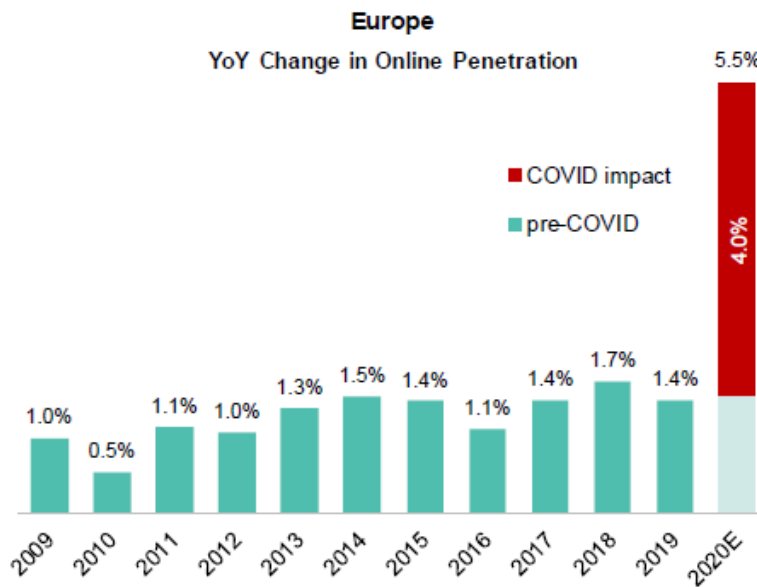
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We have seen similar permanent step-ups in other parts of the world, such as South America.



**Exhibit 92.** Brazil E-Commerce Market Size and Penetration, source Morgan Stanley.

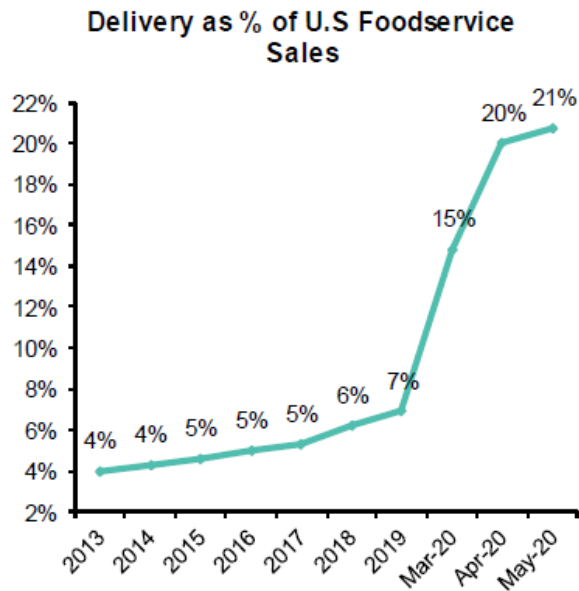
In Europe, it is estimated that the residual effect of COVID will be five years of ecommerce growth.



**Exhibit 93.** Year over Year Change in E-Commerce Penetration, source Bernstein.



In another dramatic, demand pull-forward example, online food delivery share of sales has tripled.

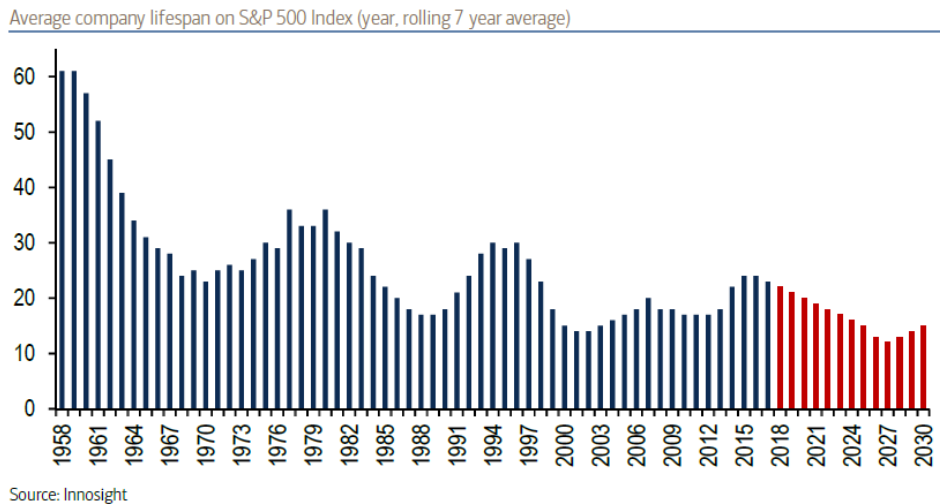


**Exhibit 94.** Delivery Share of Foodservice Industry, source Bernstein.

It is becoming increasingly evident to us that this upcoming cycle of technological innovation and associated disruption is likely to affect all sectors of the economy. This is a disruptive revolution at its earliest stages, in our view.

*“We are just scratching the surface of this huge opportunity as companies around the world reimagine their customer engagement in a digital world.” Jeff Lawson, Twilio CEO*

Merrill Lynch has predicted that 50% of S&P 500 companies could be replaced over the next 10 years, as the average tenure of an S&P 500 company is forecast to contract from its high of nearly 40 years in 1977 to nearly 12 years by 2027, supporting our view of a highly favorable environment for stock picking and highlighting the need for investors to remain exceedingly selective.



**Exhibit 95.** Average Lifespan of S&P 500 Index Companies on the Decline, October 2019, source Merrill Lynch.

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*Businesses Embrace the AI Revolution*

AI is, of course, at the very heart of this rapid pace of fundamental secular change. As a result, business leaders are rapidly abandoning legacy business models, as multi-trillion dollar industries are now turning to AI to accelerate their digital transformation and enhance their chances of survival.



**Exhibit 96.** *AI is Fueling Global Industries, source Nvidia.*

Changes are profound, even at a personal level. This emerging historic and deeply transformative wave of innovation, this upcoming Fourth Industrial Revolution, is indeed a beautiful "fusion of technologies that is blurring the lines between the physical, digital and the biological", "a technological revolution that will fundamentally alter the way we live, work and relate to one another".<sup>11</sup>

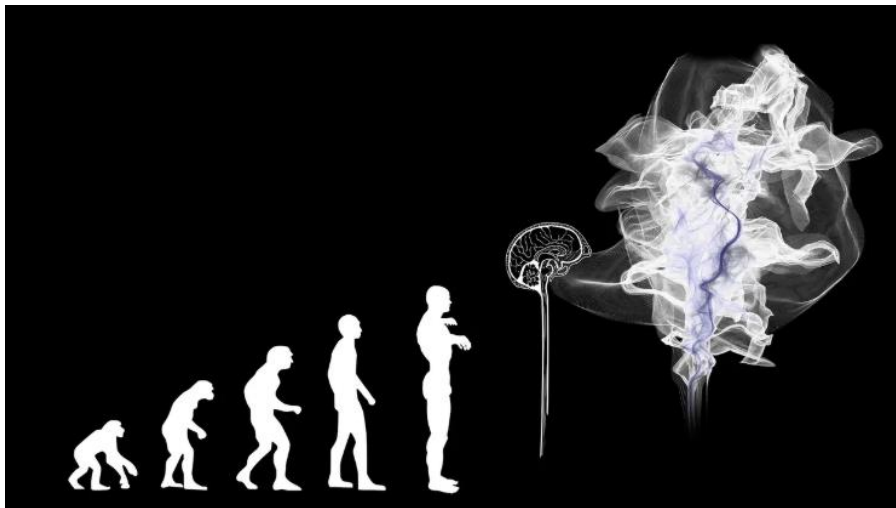
It is an era that Jen-Hsun Huang, visionary CEO of Nvidia, described as "one of the most important revolutions ever, whereas computer scientists used to specify every single instruction one line at a time, now algorithms write algorithms, software writes software, computers are learning by themselves, the era of machine learning", a historic time when "serendipity meets destiny".<sup>12</sup>

*"We always overestimate the change that will occur in the next two years, and we underestimate the change that will occur in the next ten years" Bill Gates*

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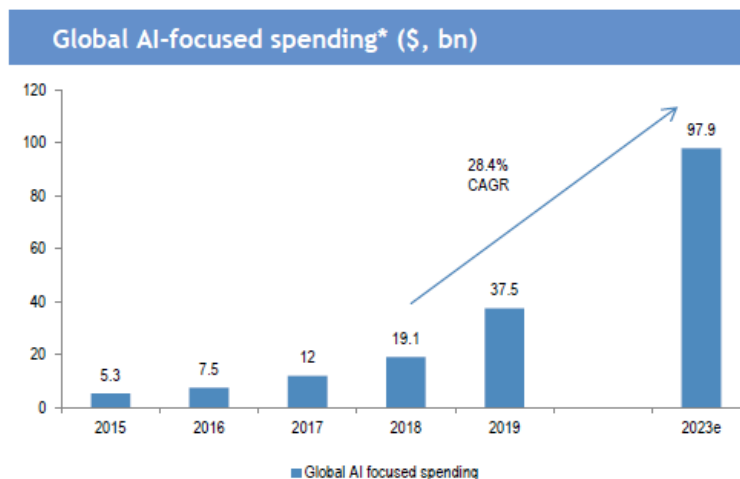
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ML automation is a critical step towards conquering cognitive, human level AI. It is only most recently, in 2020, that AutoML Zero, developed by scientists at Google, elevated the idea of automatic machine learning algorithms that are machine-created and can automatically improve themselves through Darwinian style evolution. This approach elevates machine learning innovation to a different level by un-constraining the hand-designed machine learning algorithm building and discovery process that biases searches in favor of human-designed algorithms that are inherently limiting in the number of options they consider – as “you cannot search for what you cannot discover”.



**Exhibit 97.** *AutoML-Zero: Evolving Machine Learning Algorithms from Scratch, source Bigthink.*

The investment implications are staggering and secular in nature. Against this backdrop of significant disruption, companies are rushing to invest, not to seize the opportunity, but simply to survive the rapidly changing landscape of the fully-connected economy. As a result, AI spending alone is projected to grow at 28% annually, approaching \$100 billion by 2023.



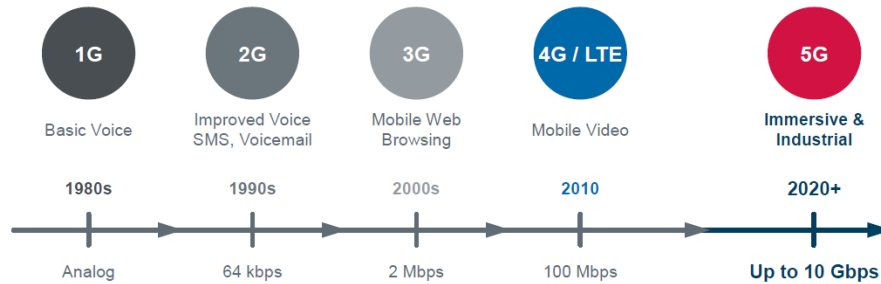
**Exhibit 98.** *Global AI-Focused Spending in Billions, source JP Morgan.*

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Importantly, we are just at the early and beginning stages of this technological revolution, as we continue to develop the physical, compute and application layers of this new digital world. For example, even 5G, a critical infrastructure layer underneath the compute and application layers, will take years to deploy fully. In particular, 5G is not a single innovation, but rather a set of advances in spectrum usage.

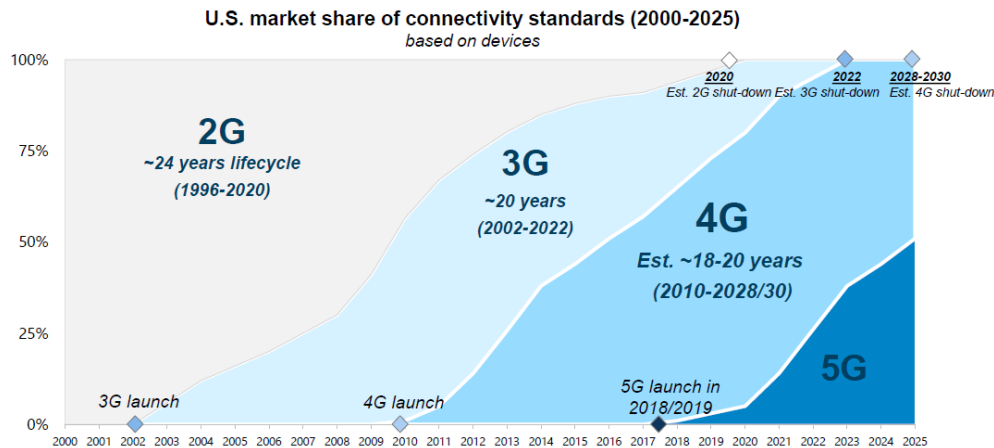
### What is 5G?

*5G is not a single innovation, but rather a set of advancements in spectrum usage*



**Exhibit 99.** *What is 5G?, source American Tower.*

Indeed, the network evolution towards 5G is at its early stages. This creates an exciting, multi-year, secular investment cycle that is largely independent, and can at times be countercyclical to the economic cycle (e.g., currently in China).



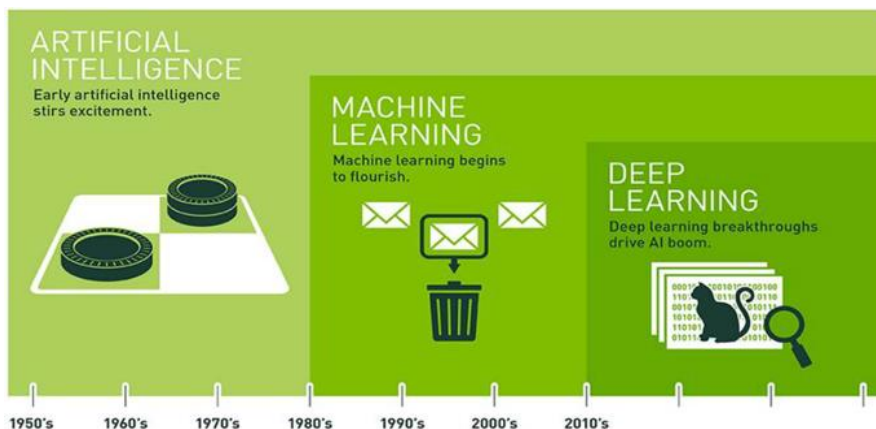
**Exhibit 100.** *The Evolution Towards 5G, source American Tower.*

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## Recent AI Breakthroughs Accelerate Disruption

This incredible wave of technological disruption is enabled and accelerated by "Deep Learning", the most advanced AI state in which machines can learn unsupervised by sifting through vast amounts of data, often unstructured.

As we will detail later, this AI revolution has been decades in the making. For years the compute power needed to handle AI models with tremendous complexity was simply not there.



**Exhibit 101.** *The Era of Deep Learning, source Nvidia and JP Morgan.*

Only in the last five years have advances in computing power (30,000-fold increase in the last five years) enabled a new era of AI training.



**Exhibit 102.** *GPU Computing Powers AI Advances, source Nvidia.*

And most recently, as the cost of compute and memory came down dramatically, Deep Learning breakthroughs advanced machine sensing (natural character recognition, speech recognition, image recognition, data discovery and extraction, and predictive analytics) to new levels of machine cognition, and accelerated the feedback loop between data and algorithms.

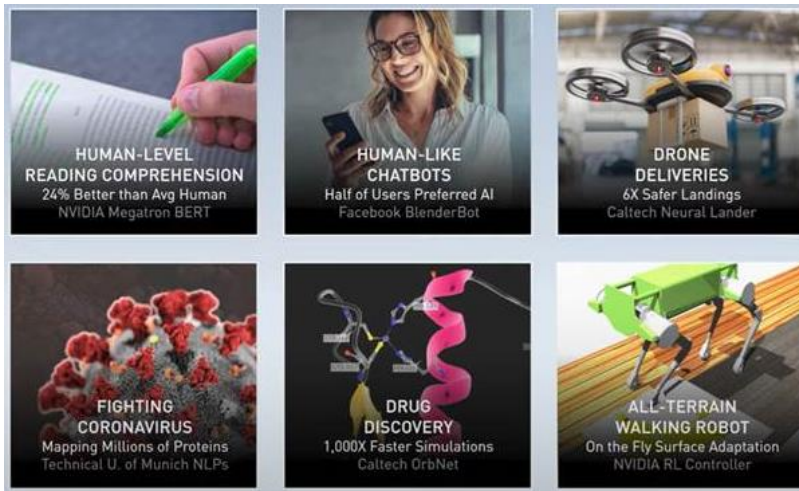
As a result, and building on top of this incredible compute power, only most recently we have advanced algorithmically to solving major problems that were unsolvable for decades. This phase is enabling breakthroughs in advanced machine sensing (such as natural character recognition, speech recognition, image recognition, data discovery and extraction, and predictive analytics), which elevates machine learning to new levels of machine cognition, and accelerates the feedback loop between data and algorithms.

One of the simplest and yet most impressive examples of these recent advances in machine learning is Alpha Zero, developed within the DeepMind division of Alphabet, that most recently obliterated the highest-ranked chess program

(Stockfish)<sup>13</sup> and achieved superhuman performance in the game of chess by tabula rasa reinforcement learning from games of self-play! Given only the rules of the game, Alpha Zero learned how to play chess within four hours by playing against itself and convincingly defeated a world champion program.<sup>14</sup> No domain knowledge, no specialized search engines, no handcrafted evaluation functions, no move ordering heuristics, just a beautifully simple, general-purpose reinforcement learning algorithm!

The same DeepMind team at Alphabet recently attacked another major challenge for current deep learning algorithms, namely the tendency to forget things previously learned upon receiving new information, what is known as "catastrophic forgetting".<sup>15</sup> As Irina Higgins, senior research scientist at DeepMind, explained, "The capacity for life-long learning, the ability to acquire new knowledge from a sequence of experiences to solve progressively more tasks, an essential feature of biological intelligence, has indeed been a hurdle in our efforts to develop Artificial General Intelligence (AGI), the type of AI that is all-encompassing, empathetic and imaginative, such as the one we see on TV and in movies".<sup>16</sup> Catastrophic forgetting has been one of the top reasons researchers have not been able to achieve human-level AI.

All this brings us closer to the type of AI one sees in movies – human-level AI that rivals the efficacy of human models.



**Exhibit 103.** *Machines Rival Humans, source Nvidia.*

Incredibly, and as we were marking an inflection point of change in the last two years, advancing algorithmically closer to cognitive AI, the hardware needed to optimally process huge quantities of data and train these advanced AI models also advanced exponentially, reaching new milestones at the same time. In particular, to enable AI models with billions of parameters, AI chips are becoming larger and larger, with designers now embedding significant amounts of fast memory on the chip to handle the demands of AI training algorithms that require a huge amount of communication and a modest amount of relatively easy compute.

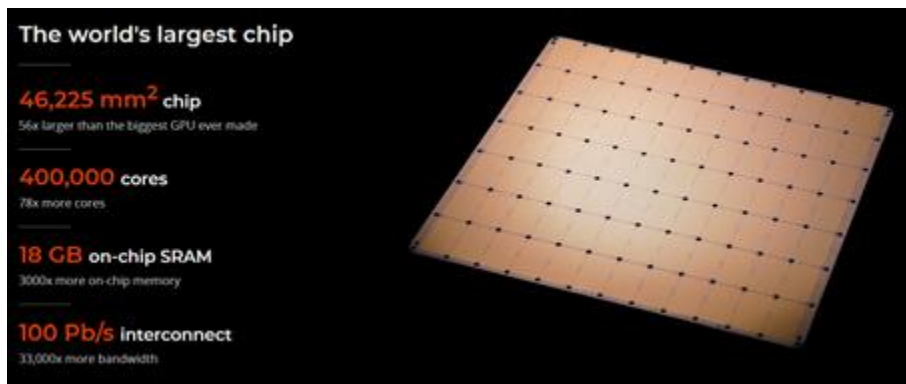
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For example, Xilinx has recently announced the world's largest FPGA featuring 9 million system logic cells and 35 billion transistors. This provides the highest logic density on a single device ever built, enabling the development of complex algorithms used for artificial intelligence, machine learning, video processing and sensor fusion.<sup>17</sup>



**Exhibit 104.** *The World's Largest FPGA, source Design & Reuse.*

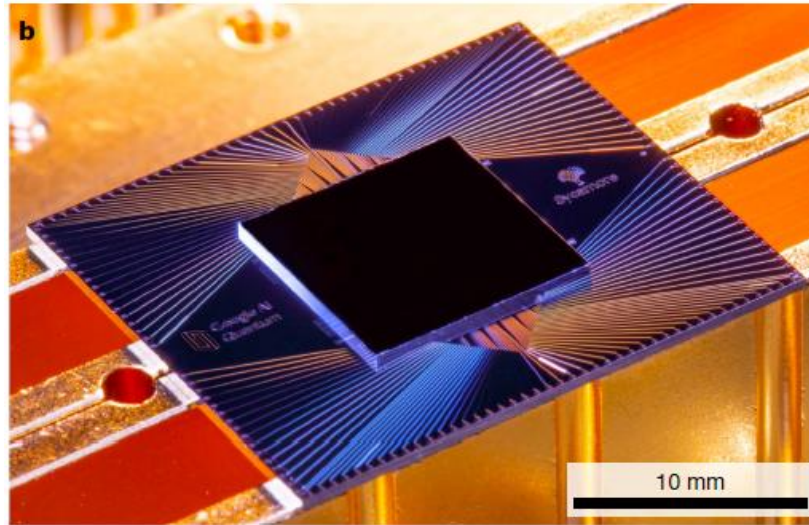
And private startup Cerebras most recently showcased the largest chip ever built. This wafer-scale chip has 1.2 trillion transistors and embeds 400,000 AI-optimized cores.



**Exhibit 105.** *The World's Largest Chip, source Cerebras.*

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And in a paper published late in 2019, Alphabet announced a major breakthrough in quantum computing, claiming quantum supremacy using a programmable supercomputing processor. This processor, named "Sycamore" uses programmable superconducting qubits to create quantum states on 52 qubits, corresponding to a computational state-space of dimension 2 to the power of 53 (approximately 10 to the power of 16). The published benchmarking example reported that Sycamore took about 200 seconds to complete a task that would take a state-of-the-art supercomputer approximately 10,000 years!<sup>18</sup>

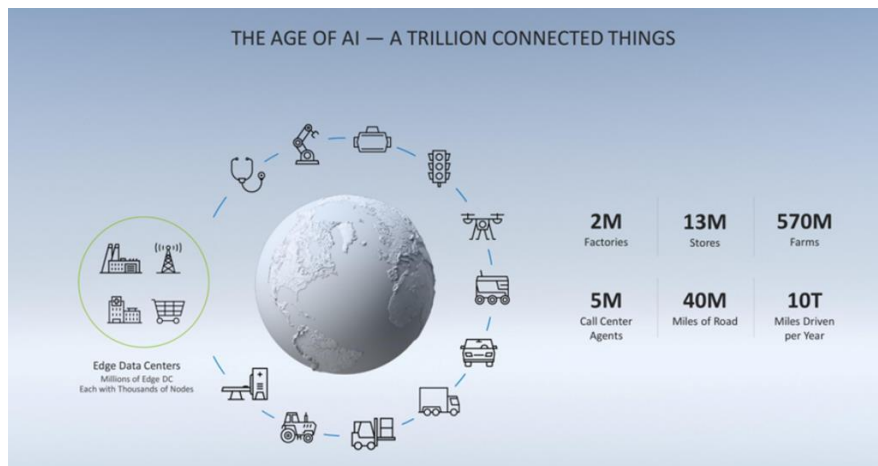


**Exhibit 106.** *The Sycamore Processor, October 2019, source Nature.*

#### 5G and IoT Build a Powerful Infrastructure Layer

This upcoming wave of disruption is broad-based and large in scale. As such, it is important to note that we do not view this upcoming cycle of innovation as another mini-cycle, such as the 2007 smart-phone cycle, but rather as a broad-based cycle of innovation driven by a unique set of new technologies, including, one, next-gen broadband mobility (5G and the Internet of Things (IoT)), two, on the consumer side, significant advances in display technologies (high-definition CMOS image sensors, OLED, 3D sensing and Virtual and Augmented Reality – VR/AR), the combination of which can provide a sizable uplift to the mobile video experience making it more pleasant and immersive, and, three, AI and autonomous driving (ADAS – Advanced Driver Assistance Systems, which is effectively a subset of AI).

This is a set of technologies that is highly synergistic and mutually reinforcing. And although AI is attracting most of the media headline attention, the underlying foundational components of this upcoming Fourth Industrial Revolution, such as 5G and IoT applications, are equally important.

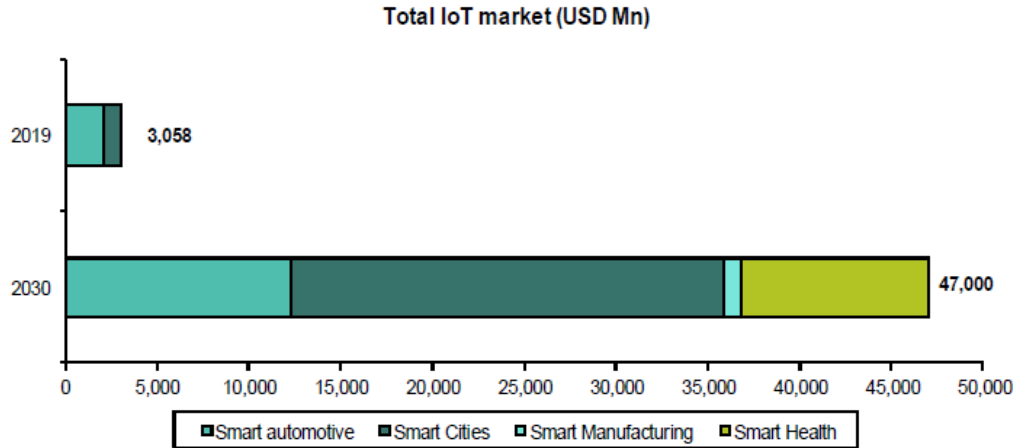


**Exhibit 107.** *The Age of AI, a Trillion Connected Objects, source Nvidia.*

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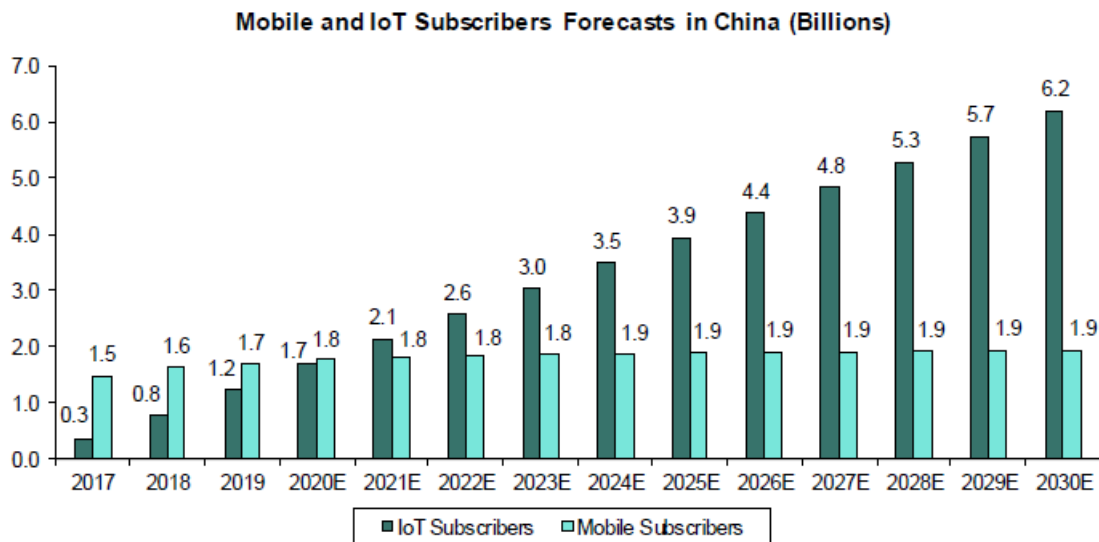
As such, newly formed applications on top of this new powerful physical layer will be sizable – and are growing rapidly. For example, by 2030, the size of the US IoT market is expected to grow fifteen-fold relative to 2019.



**Exhibit 108.** *Estimated US IoT Market Growth, July 2020, source Bernstein.*

One can certainly think of AI as the compute layer of the Fourth Industrial Revolution, with advances in silicon technology and wireless connectivity being represented in the infrastructure layer.

Indeed, one of the most important components of this innovation wave is 5G, the most critical enabling block of full connectivity and not just among humans, but also among machines and devices. For example, in China it is expected that the number of connected machines will surpass the number of connected humans in 2021.



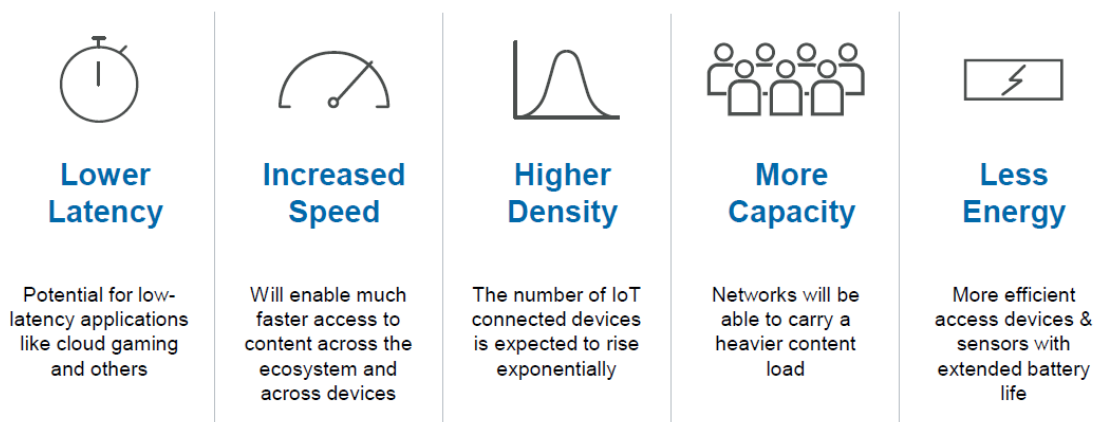
**Exhibit 109.** *China Mobile and IoT Subscribers, July 2020, source Bernstein.*

In particular, 5G represents a significant advancement over 4G, as it will ultimately offer a “fiber-like” experience at speeds up to one hundred times faster than 4G.

Technology Characteristic	5G vs. 4G	Implications
Average Download Speeds	<b>10-100x</b>	Drastic performance improvement for high bandwidth applications (e.g. high resolution video)
Average Roundtrip Latency	<b>5-10x lower</b>	Supports applications requiring low latency
Spectral Efficiency b/s/hz	<b>&gt;3x</b>	Provides carriers more “bang for buck” per unit of spectrum holdings
Max Simultaneous Connections per Cell	<b>300x</b>	Supports many more densely packed IoT connections than today

**Exhibit 110. 5G Capabilities, source American Tower.**

As network performance improves dramatically over time, the benefits to users ultimately create a superior, highly immersive experience.

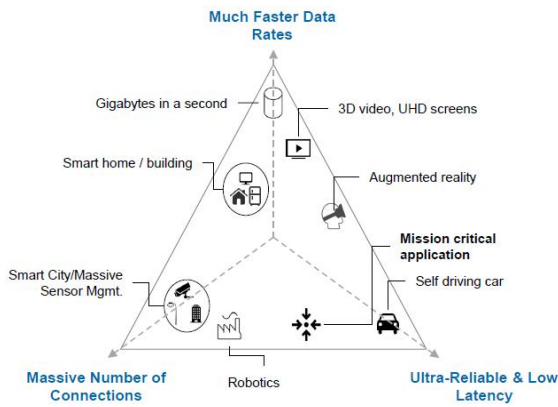


**Exhibit 111. What Does 5G Mean for Users, source American Tower.**

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The result is the emergence of a next-generation infrastructure layer that will enable a wide variety of new use cases and advanced applications and will set the foundation of the new wireless web with a massive number of connections, offering much faster and ultra-reliable data rates with low latency.

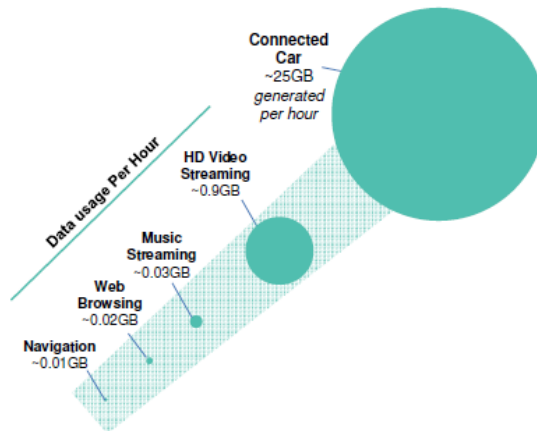
*5G has a wide variety of potential applications*



**Exhibit 112.** *What Use Cases can 5G Transform, source American Tower.*

In summary, 5G is becoming the enabling infrastructure foundational layer to a variety of advanced commercial applications rapidly emerging in a fully-connected economy, where bandwidth requirements are most demanding. For example, a fully connected car is expected to generate 25GB of data from its sensors (for comparison, an hour of HD video streaming currently generates less than 1GB of data).

**Connected Car data generation vs. common activity data usage**



**Exhibit 113.** *Connected Car Data Generation vs. Common Activity Data Usage, source Bernstein.*

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This is unsurprising, as a fully autonomous car is essentially becoming a computer server on wheels. Furthermore, the autonomous car market will ultimately grow to an order of magnitude bigger than the server AI market (as currently there are approximately 80 million cars sold annually versus 10 million servers). 5G will provide ubiquitous connectivity to this network of transportable car servers, with the underlying data network growing exponentially as cars become fully connected. As an example, the ride-hailing industry alone is expected to grow eightfold to \$285 billion by 2030.<sup>19</sup>

## ALL VEHICLES WILL BE AUTONOMOUS



**Exhibit 114.** *Future Vehicles Will All be Autonomous, source Nvidia.*

All these critical end-applications require advanced connectivity with high throughput and very low latency. Consider, for instance, a fully connected car ecosystem with three main technologies to transmit data to and from autonomous vehicles: one, vehicle-to-infrastructure, a technology that connects cars with urban infrastructure (such as roads, traffic lights and signs), two, vehicle-to-vehicle, a technology that allows cars to "talk" to each other, and, three, vehicle-to-network, a technology that connects vehicles with the rest of the world and the cloud using the 5G network.<sup>20</sup>

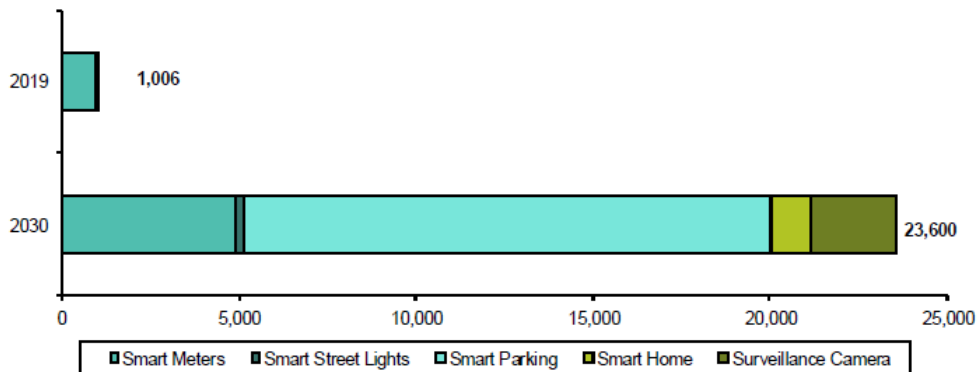
Vehicle to everything (V2X) communication is expected to be one of the key applications of 5G. In China, the government has already designated V2X as an important part of its Intelligent and Connected Vehicle (ICV) strategy, with dozens of regional pilot zones and nine national intelligent highways already established.



**Exhibit 115.** *Overview of Connected Car Ecosystem, source Morgan Stanley and Qualcomm.*

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Importantly, carriers, which are now aggressively building 5G networks, have a strong economic incentive to support and promote advanced commercial applications. For example, smart city projects can allow carriers in the US to increase revenues almost twenty-four times over the next ten years.



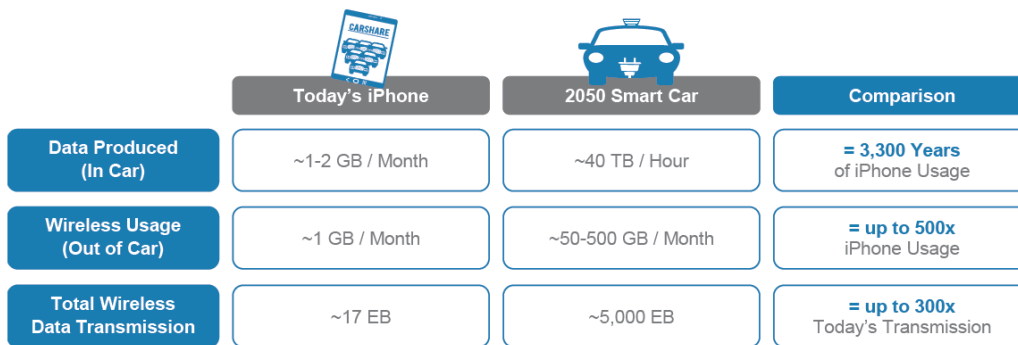
**Exhibit 116.** *Estimated Smart City Revenue Contribution, Millions, July 2020, source Bernstein.*

5G is expected to also transform another huge end market, namely logistics, from driverless long-haul transportation, to last-mile delivery robots, to smart delivery boxes, to IoT-5G-assisted sorting centers and fully automated warehouses. In China, companies like Alibaba and JD Logistics are already building intelligent 5G-enabled logistics parks.



**Exhibit 117.** *JD Logistics using 5G in Warehousing and Last-Mile Logistics, source Bernstein.*

This important application ecosystem is extremely data hungry. Connected cars, for example, need mobile networks and the pace of data generated by autonomous vehicles is likely to be unprecedented. Morgan Stanley estimates that the massive amounts of data autonomous vehicles will generate will require data links ranging from 3 gigabytes per hour for Level 1 vehicles to 50 gigabytes per hour for Level 5 vehicles. Until now, autonomous vehicle platforms have involved cars that work with little network connectivity (e.g., Tesla’s AutoPilot and Alphabet’s Waymo). But in the future, local processing within vehicles will not be sufficient, and therefore a fully-connected ecosystem and continuous access to the cloud will become essential.<sup>21</sup>

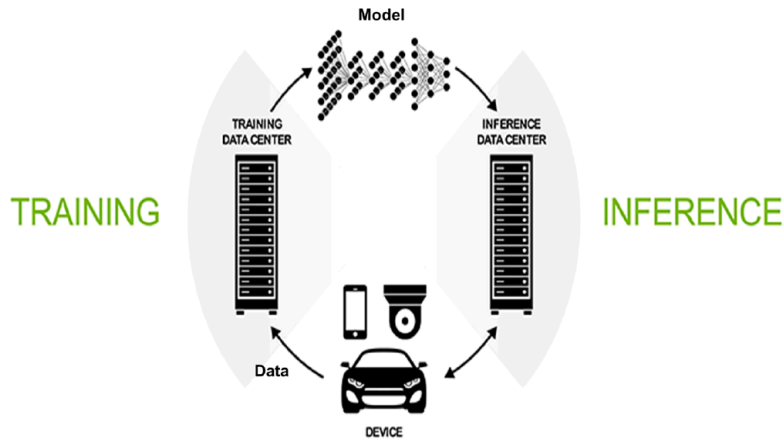


**Exhibit 118.** *Data Comparison, Today's iPhone vs. 2050 Autonomous Vehicle, source Morgan Stanley.*

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This insatiable need for bandwidth and low latency connectivity feeds the emergence of a variety of end applications, which in turn increases the need for more bandwidth, processing power and instant connectivity. And as this fully-connected ecosystem develops, access to the cloud via the wireless network will ultimately bring real-time intelligent decision-making to the edge of the network.

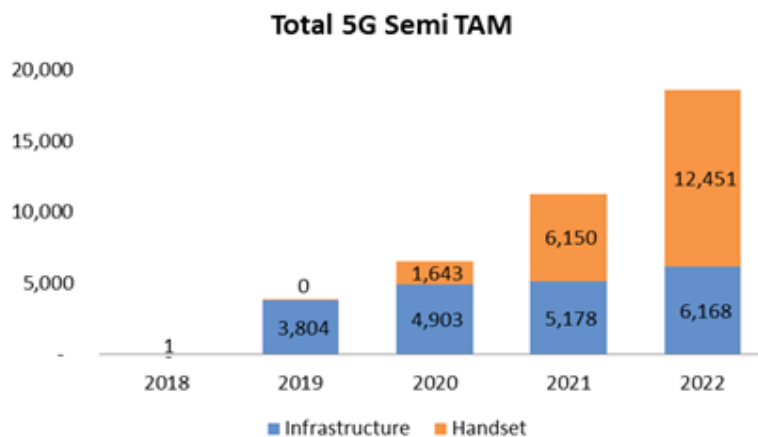
There is a virtuous cycle here, as the emergence of AI applications and use cases will incentivize the crowd sourcing of data and induce a massive installment of IoT access points and devices for machine learning. We believe we are at the very early stages of this massive endpoint built-out.



**Exhibit 119.** *Virtuous Circle of IoT Devices and Deep Learning, source JP Morgan.*

As a result, the amount of silicon investment required to build this 5G infrastructure and enable access points such as mobile devices, cars, IoT devices and sensors cannot be overstated. 5G will enable an incredible collection of data via sensors. This will require significant investments in hardware content. For example, at least 10 cameras and 32 sensors per car will be needed for Level 5 autonomous driving.

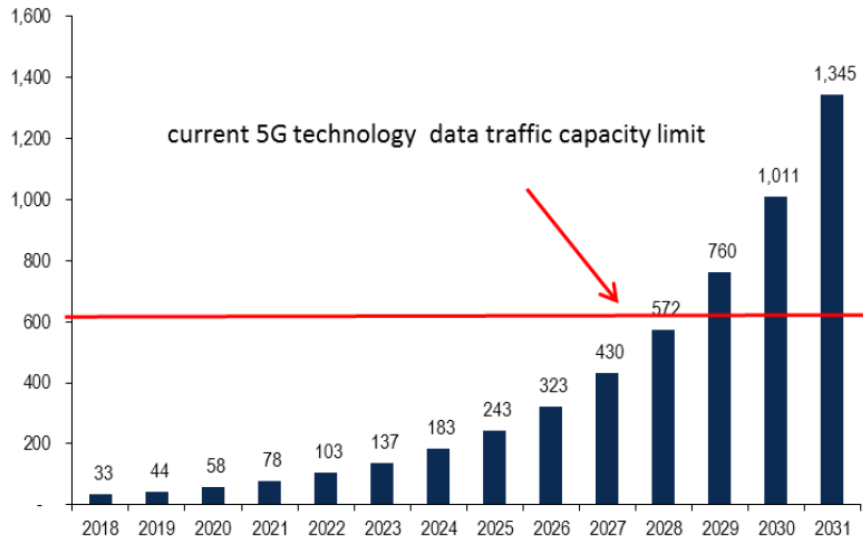
Similar to the AI data-application virtuous cycle, the innovation we are seeing in 5G is creating its own virtuous cycle where hardware is enabling software that, in turn, requires more and more hardware to accommodate more advanced software applications for the fully-connected economy.



**Exhibit 120.** *Total 5G Semi TAM (\$M), source Merrill Lynch.*

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Given this expected long-duration bandwidth demand cycle, it is actually not too early to talk about 6G, even as 5G networks will not be fully operational for a few more years. This is due to the explosive growth in data creation. Currently 5G networks can handle total traffic of 600 Zettabytes per year and given the expected growth in data, 5G networks will reach capacity around 2028, and given anticipated performance enhancements like prior generations most likely sometime around 2030, around the time we enter the Yottabyte era for total global data generation.



**Exhibit 121.** Total Global Data Generation (Zettabytes per year), source Merrill Lynch.

In summary, this confluence of expanded 5G connectivity, IoT, and advances in AI presents a new chapter in industrial automation and machine learning, a world in which robots, drones, cell phones, cars and millions of devices are all fully connected. This is a potentially massive opportunity for the technology sector.<sup>22</sup>

And any single subset of this connected world, commercial drones for example, will eventually have its own universe of widespread applications, such as precision agriculture, search and rescue, transportation (package delivery and even human transport), inspection, 3D measurement and mapping, smart factories, surveillance, data connectivity and research, and so on.<sup>23</sup> The demand cycle for the Industrial Internet of Things (IIoT) is just beginning.

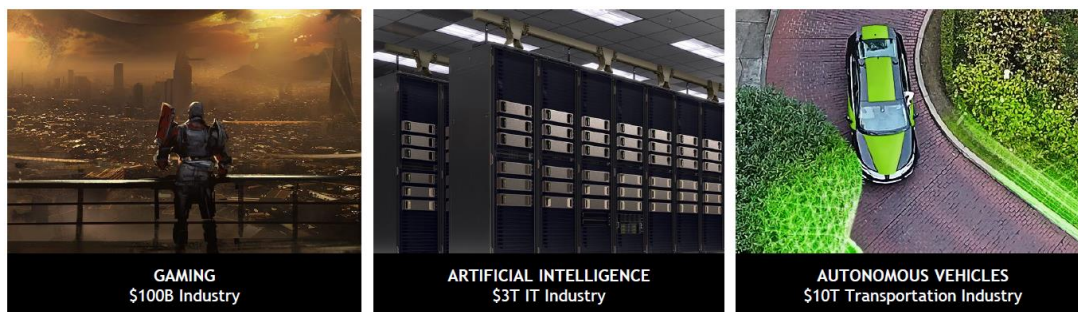


**Exhibit 122.** Deep Learning and Inference Everywhere, source Arm Limited.

## Early Stages of Technological Innovation

As one contemplates how early we are in this wave of technological innovation, it is instructive to step back and review the incredible progress that has been made in AI in the last few years. For example, only in the last few years have machines begun to recognize images and words better than people. This is despite the fact that the general theory behind parallel processing and computation, which is the foundation of machine learning, had been fully developed and taught in graduate schools for decades. During that time, it was well known that there was somewhat little algorithmic differentiation in AI, i.e., the value in AI was not in the algorithm. Instead, and what had been the hurdle for AI until recently, was the inability to cost-effectively deploy the incredible amounts of processing power necessary to solve complex problems with billions of parameters using relatively simple algorithms.

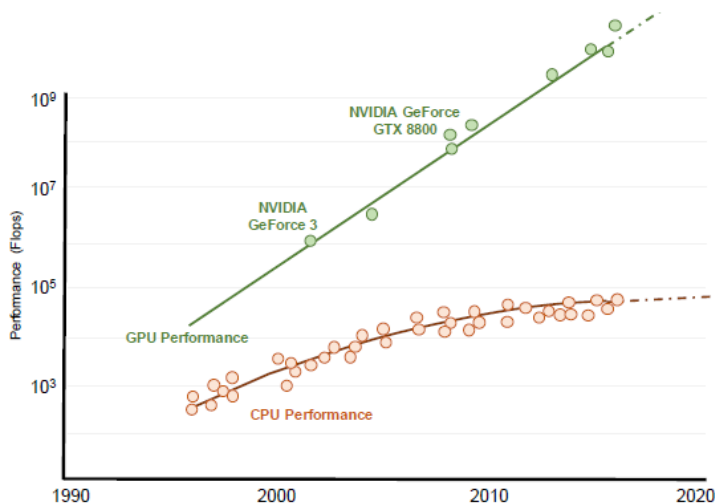
In other words, AI needed a tremendous amount of silicon optimized for machine learning. Enter the recent era of massive parallel processing graphic processing units (GPUs), which, in recent years, have emerged as the dominant computing platform for AI and machine learning. As AI applications demanded massive amounts of computational power, high-performance GPUs emerged as the de-facto tool to meet such demand and solve major AI problems.



**Exhibit 123.** *The Most Exciting Time in Tech History, source Nvidia.*

The result has been a classic innovation cycle, the network effect and the dynamic of an unstoppable wave. More and more data feed AI platforms of massive processing power, which in turn enable major AI applications that consume more and more data and require increasingly more processing power.

It took decades to reach this inflection point of change. Looking at the history of commercial AI, it is important to note that it was only in 2007 when Nvidia first introduced its famous CUDA platform that included both the software and the GPU and only in the 2010s that AI researchers started to use GPUs for machine learning. In 2012, Alex Krizhevsky from the University of Toronto won the annual ImageNet computer image recognition competition (the Super Bowl of computer imaging) using GPUs for machine learning, beating the foremost computer vision experts by a wide margin, and since that moment the use of GPUs for AI training and highly parallel workloads in high performance surged, as scaling of CPU computing reached its limits.

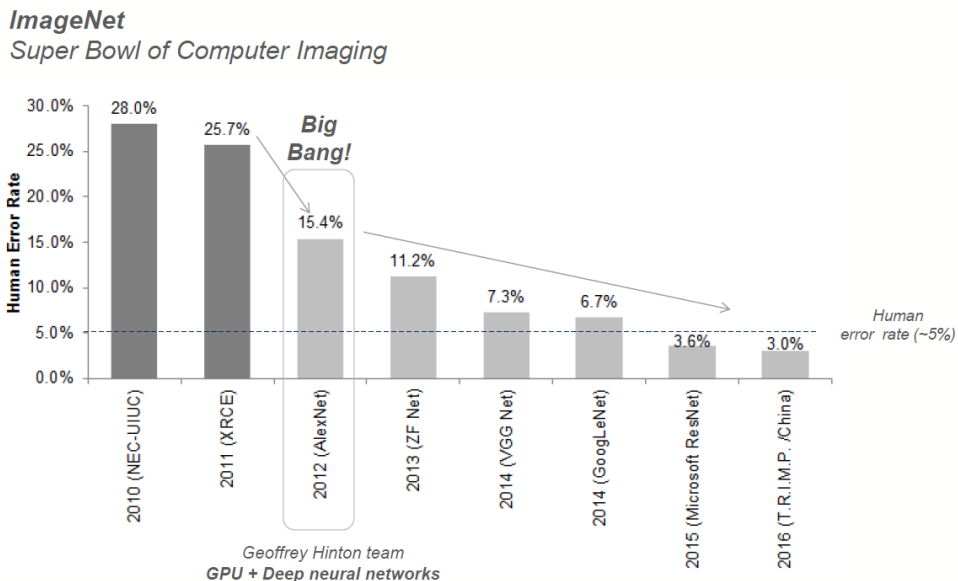


**Exhibit 124.** *GPU vs. CPU Performance, source Nvidia and Wells Fargo.*

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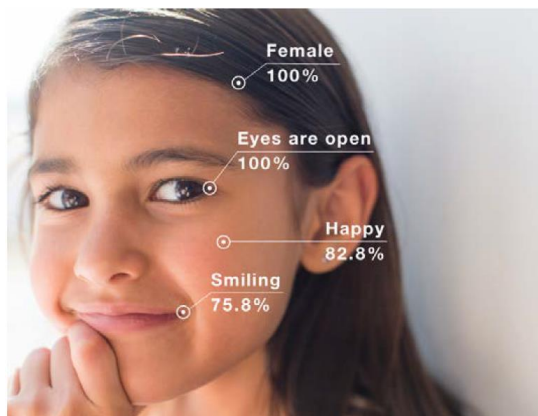


And then, just a few years ago, another major milestone was reached: Using GPUs, both Alphabet and Microsoft beat the best human score in the ImageNet challenge. Officially now, computers can recognize images better than people can. This is a technological revolution, decades in the making, which, in our view, is now enabling an accelerated pace of growth and adoption of AI at a time when major milestones in image recognition, natural character recognition, natural language processing and speech recognition are regularly being reached.



**Exhibit 125.** ImageNet Competition, source KeyBanc.

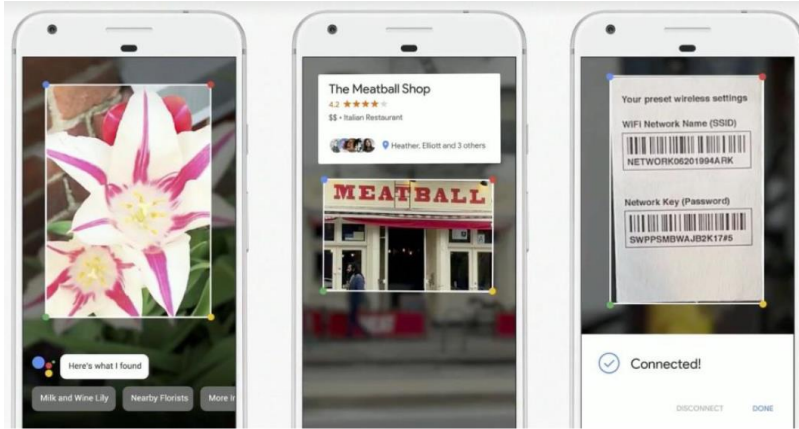
For an AI system, being able to recognize images at a low error rate was a major step towards machine cognition and ultimately relational reasoning. Technology disruptors were quick to embrace the revolution and provide the tools to enable others to do the same. For example, Amazon introduced its AI image recognition tool, Amazon Rekognition, which can detect objects, scenes and faces in images. Using Rekognition, one can locate faces within images and analyze face attributes, such as whether or not the face is smiling or the eyes are open.



**Exhibit 126.** Example of Facial Recognition, Facial Analysis, source Amazon.

As AI models can now better understand visual information, computers can consequently rely heavily on machine vision to process information. For humans, 80% of our information is derived by vision, far outweighing all other senses.<sup>24</sup> And now computers can read images better than we can!

Capitalizing on this important trend, Alphabet introduced Google Lens that uses AI to let cameras understand what they see. For instance, pointing your phone camera at a flower will tell you exactly what species the flower is and pointing your phone camera at a restaurant will tell you what restaurant it is and provide reviews.



**Exhibit 127.** *Example of AI in Image Recognition, Google Lens, source Alphabet.*

Simply stated, computer vision is a major enabler of machine cognition and a fundamental component of AI sensing, giving machines the power to extract and intelligently process unstructured data to drive advanced decision-making. The potential commercial implications of this power are dramatic, impacting everything from how we drive to how we shop at the grocery store.



Source: Nvidia.



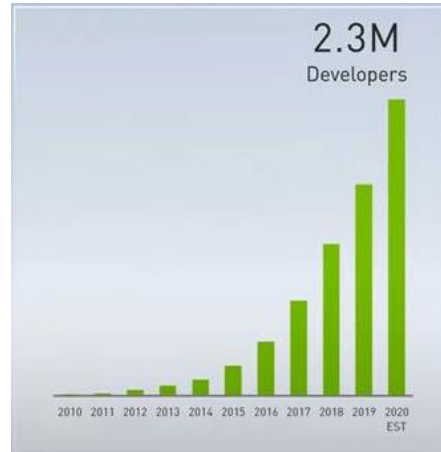
Source: Simbe Robotics.

**Exhibit 128.** *Object Identification & Classification and Retail Shelf Auditing, source Nvidia, Simbe Robotics and JP Morgan.*

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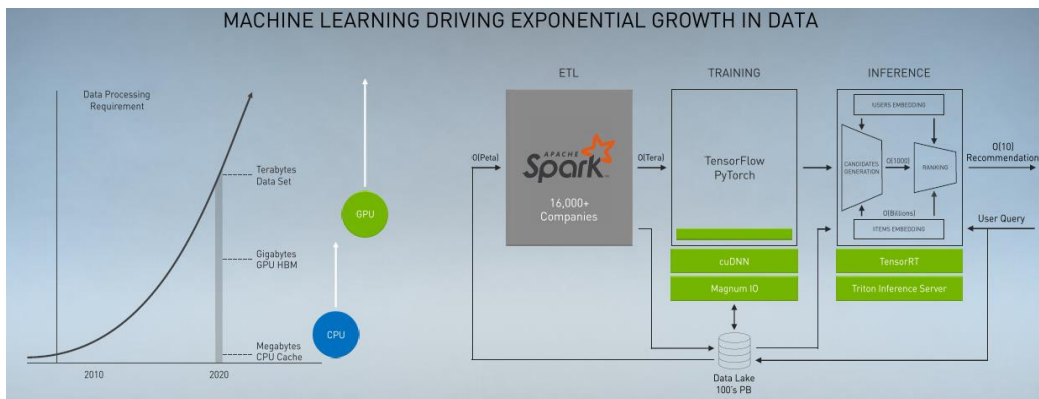
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Following the algorithmic breakthroughs in recent years, the ecosystem of software developers that use GPUs exploded, advancing computing applications that use millions and eventually billions of parameters and require more and more processing power.



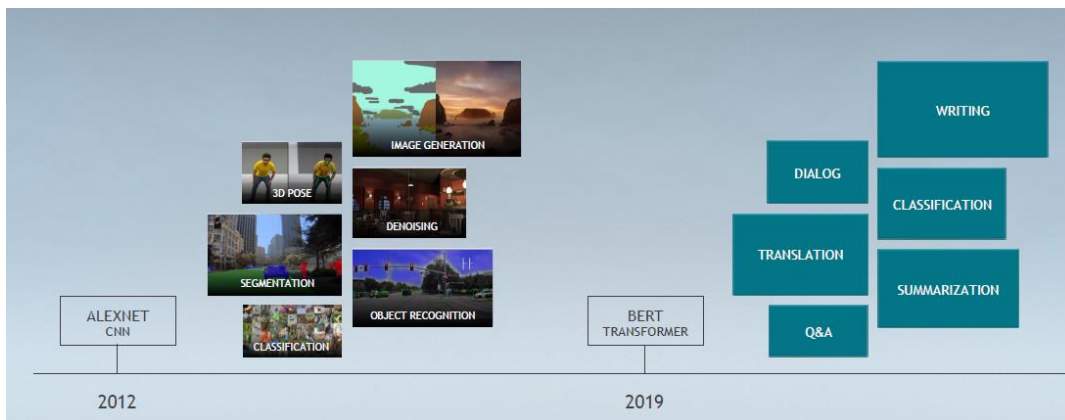
**Exhibit 129.** Nvidia Software Developer Ecosystem, source Nvidia.

And as machine learning drove exponential growth in data, cognitive problems with enormous complexity were attacked for the first time only recently. An example is the ability to analytically process in real-time huge amounts of unstructured data residing in data lakes.



**Exhibit 130.** GPUs Handle Complex AI Problems and Huge Data Lakes, source Nvidia.

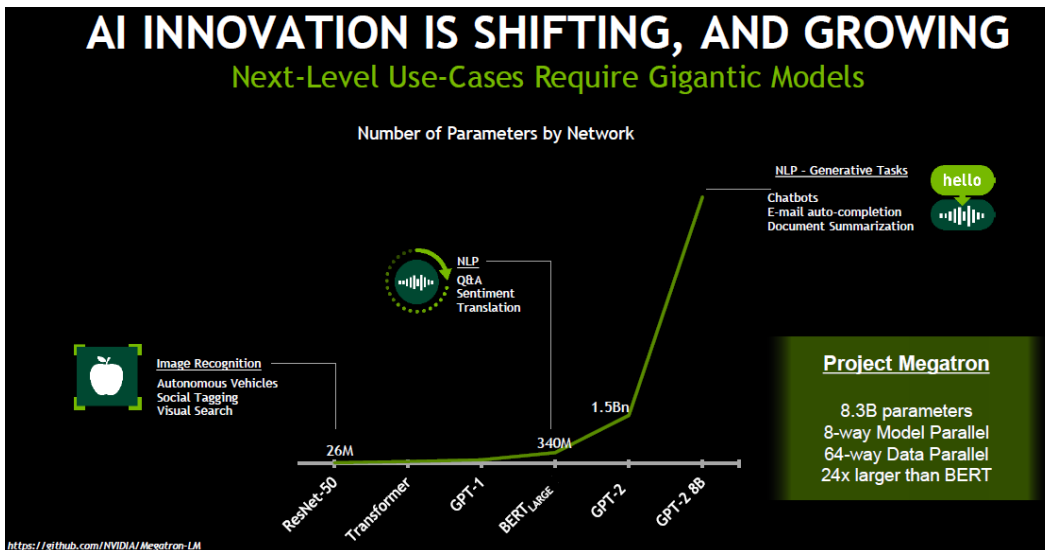
In summary, recent application advances in AI that were only reached in the last few years are now providing us with confidence that AI is rapidly approaching the cognitive era.



**Exhibit 131.** Incredible Advances in AI, source Nvidia.

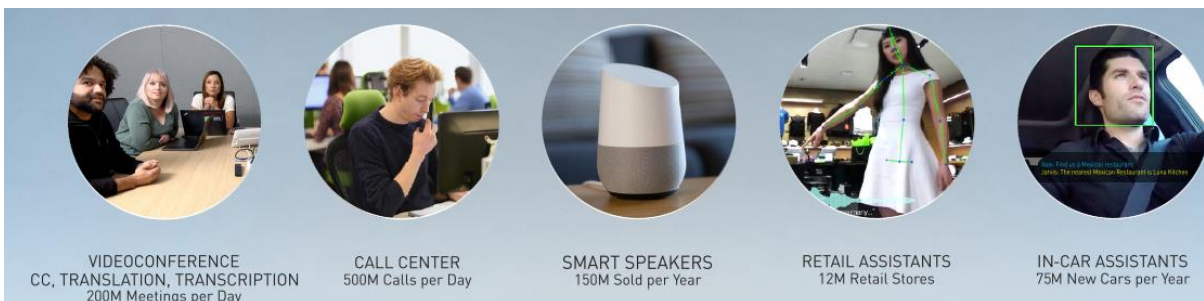
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As AI begins to handle models with tremendous complexity, AI innovation is shifting and growing, becoming more “human-like”, as next-level use cases require gigantic models. Advanced AI models are becoming massive and highly complex, which is the only way to approach models of human intelligence.



**Exhibit 132.** AI Innovation is Growing, source Nvidia.

For example, Nvidia recently discussed breakthroughs in language understanding, as recent advances in training, inference and model size of Natural Language Processing are bringing the world one step closer to Conversational AI. True conversational AI can now “engage in human like dialogue, capturing context and providing intelligent responses”.<sup>25</sup> These high quality AI conversational tools can enable a level of intelligence in human-machine interaction that was simply unattainable before.

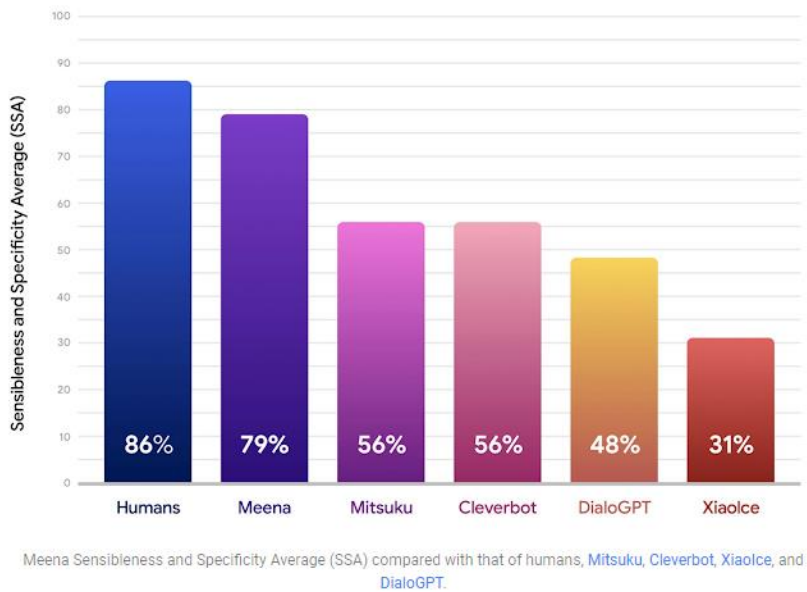


**Exhibit 133.** Breakthroughs in Conversational AI, source Nvidia.

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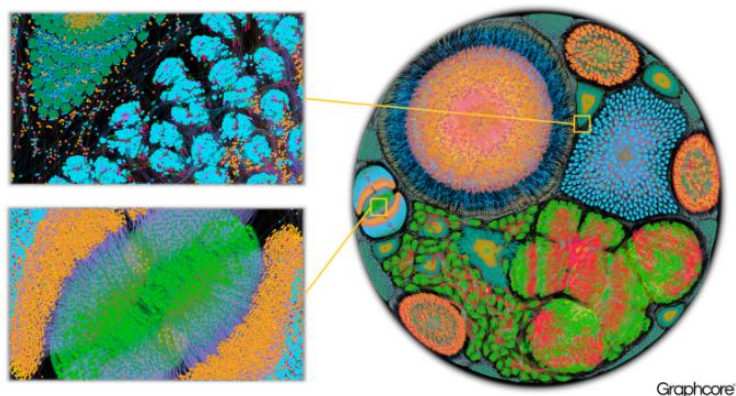
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Just in 2020, Google introduced Meena, an end-to-end neural conversational model that learns to respond sensibly to questions. The Meena model is another example of the complexity of next generation models we discussed above, embedding 2.6 billion parameters and trained on 341 GB of text, filtered from public domain social media conversations. Google claimed a sensibleness score for Meena that is not only above all other advanced agents (chatbots) but also in close reach to human performance.



**Exhibit 134.** Meena Sensibleness and Specificity Average (SSA) vs. Humans and Other Agents, source Alphabet.

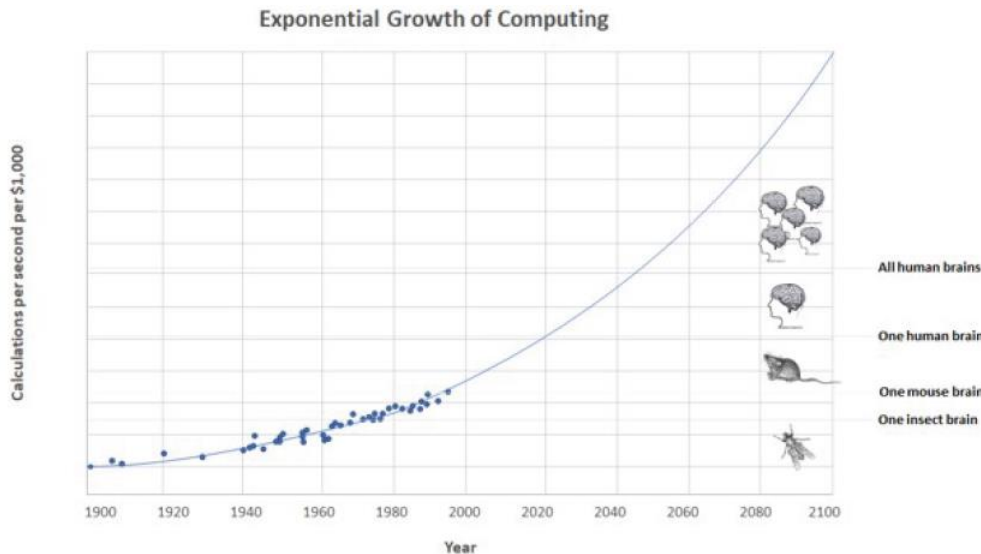
To visualize the incredible potential of next generation AI applications, it is instructive to look at the computational graph of a machine learning system – this is a representation of the model the system builds. AI startup Graphcore has published an amazing set of images of the computational graphs mapped to its machine learning system, which strikingly look much like a brain scan.<sup>26</sup>



**Exhibit 135.** Example of a Machine Learning Model Used in Data Analysis, source Graphcore.

This is not a futuristic reflection of theoretical vision but rather a model visualization of future developments. Only in the last few years, GPUs have been able to handle such advanced problems. In March 2017, SpaceX and Tesla CEO Elon Musk backed Neuralink, a startup that attempts to connect brains to computers.<sup>27</sup> And in April 2017, Regina Dugan, head of Facebook’s R&D division Building 8, describing how we have only begun to scratch the surface of what is possible, revealed that it has a team of engineers working on building a brain-computer interface that will allow people to type up to 100 words per minute, five times faster than typing on a phone, by just using their minds.<sup>28</sup>

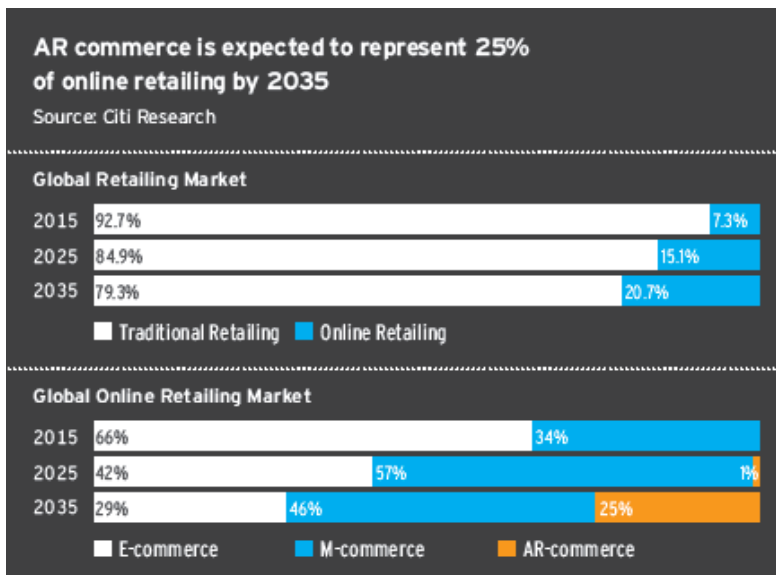
These breakthrough developments in image and speech recognition, conversational AI and AutoML –over just the last couple of years–, are now about to fundamentally change our relationship with machines and computers forever, as computers begin to learn our language and understand what we see and hear.



**Exhibit 136.** *Computing Power Roadmap, source Ray Kurzweil and Morgan Stanley.*

“As that happens the human-computer interface [will] no longer exist. We will become the interface. We will talk to computers and they will talk back. We [will] see information directly in our eyes. The new form factor is VR/AR.”<sup>29</sup>

This will also advance a new type of direct human-computer interaction, especially as VR/AR becomes an integral part of the knowledge economy, ultimately driving a new frontier market that can reach \$692 billion by 2025. The potential for growth in this AR/VR market is difficult to overstate. AR Commerce alone is expected to represent 25% of online retailing by 2035, as shown below.



**Exhibit 137.** *AR Commerce Table, source Citi Research.*

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In summary, we are still at the early stages of this technological revolution, as major milestones in AI applications such as image recognition, natural character recognition and speech recognition were reached only in the last few years. We do not yet have 5G broadly and fully deployed, Level 5 autonomous cars roaming our streets, self-taught robots stocking our supermarket shelves, full vehicle to everywhere connectivity, and 5G enabled logistics for Smart Cities. But we believe all this will change in the next few years, as 5G and IoT become the enabling physical layer of the Fourth Industrial Revolution. The world will never look the same.



**Exhibit 138.** Sotheby's AR Home Staging Application, Utilizing Google ARCore, source Merrill Lynch.

#### *The Future of Business Automation*

Businesses are already rushing to invest in and capitalize on these emerging technologies, aiming to offer a differentiated customer experience. For example, Volvo has teamed up with Microsoft to bring AR to car showrooms, creating models of the cars in virtual reality, using Microsoft's HoloLens technology, which displays virtual objects as holograms. In particular, the cars' sensor fields (which are invisible) are envisioned as colorful waves. This allows customers to see sensors that cannot be seen in a regular car showroom.<sup>30</sup>



**Exhibit 139.** Microsoft and Volvo Bringing Augmented Reality to Car Shopping, source Morgan Stanley.

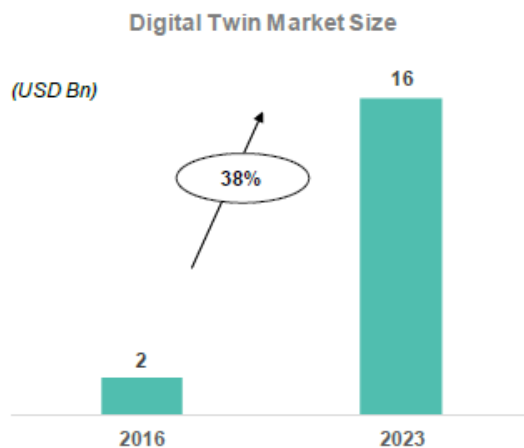
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This Fourth Industrial Revolution is also creating a fusion of physical and virtual systems. The IIoT is pioneering building an entire manufacturing process in a virtual world, what Siemens calls a "digital twin" that links physical product and production to their digital copies and enables lifecycle management of physical assets and processes. The power of a digital twin –a digital representation of real-world products and systems in a software object that mirrors a physical object– is the linkage to the real-world counterparts, which allows real time synchronization of the model and real time recalculation of expected outcomes, enabling rapid and advanced cycles decision making, all within an intuitive visual representation. With increasingly sophisticated digital twins, product cycles can be shortened substantially, creating an integrated engineering process environment and workflow.



**Exhibit 140.** An Example of a Digital Twin, source Siemens and Bernstein.

This digital twin market is expected to reach \$16 billion by 2023.

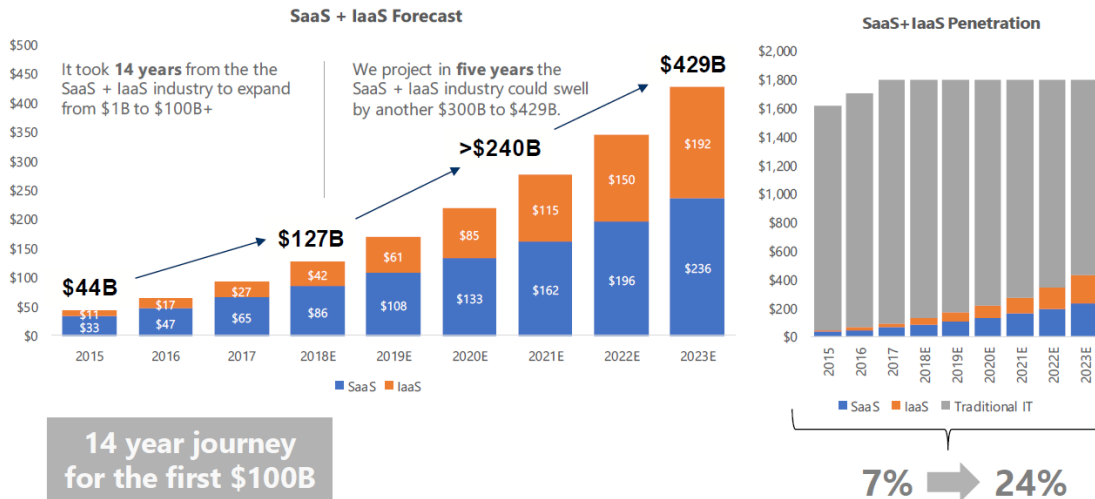


**Exhibit 141.** Digital Twin Market Size, source Bernstein.



This upcoming technological revolution is also rapidly impacting enterprise software applications. Cloud software platforms, for example, are applying powerful AI and machine learning capabilities to massive data sets, unlocking tremendous value. The cloud industry includes software-as-a service as well as infrastructure-as-a-service (following the launch of AWS around 2006) and currently represents approximately a \$127 billion part of a \$1.8 trillion enterprise IT industry. Growth is projected to remain strong over the next five years as cloud occupies a larger portion of IT budgets, taking overall cloud penetration from 7% to 24%.

### The next \$100B+ could occur within 2.5 years (vs. 14 years)



**Exhibit 142.** Cloud Growth and Penetration, source KeyBanc.

This ability to now handle huge amounts of structured and unstructured data in real time, allows the modern enterprise software ecosystems to become seamlessly interconnected, creating a beautiful software mesh that is powered by expansive API libraries and massive application/ISV exchanges. A rapidly growing ecosystem of APIs is making the enterprise rapidly intelligent and scalable, turning simple software tools into enterprise platforms. Once niche, these software solutions are now becoming critical infrastructure enterprise rails.

This is putting extraordinary demands on application development teams, which are now struggling to meet the growing demands for new IT and business applications. As the need to meet a wide array of business goals within tight deadlines increases, there is a growing demand for collaboration between lines of business and IT. The rapid emergence of low code/no code platforms addresses this need and expands the pool of developer talent by making application development capabilities accessible to a broader audience of knowledge workers.

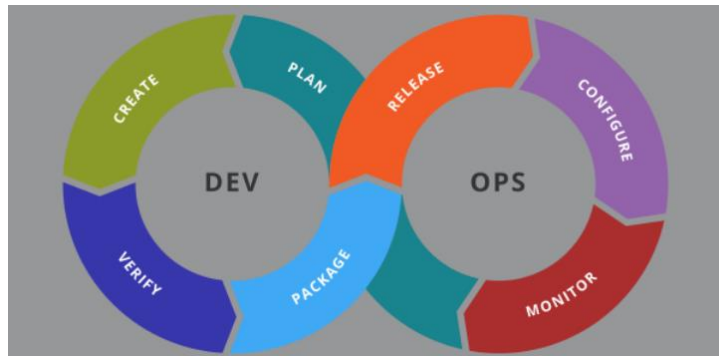
These types of low code/no code platforms empower non-developers to accomplish tasks that previously required coding skills and were generally built bespoke. This speeds up the overall development cycles of the customer of the platform – as a business user without technology knowledge can iterate without waiting for developers to get involved. As the world is becoming more programmable, configurable and able-to-be-integrated, it requires an unprecedented pace of product innovation and integration for best-of-breed companies to keep pace. Building everything in-house is no longer feasible for most organizations.



**Exhibit 143.** No-Code and Low-Code, source Moveoapps.

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DevOps technologies (technologies designed to speed up the process of developing and deploying new IT applications) also play a critical role in enabling developers to develop quickly business applications in entirely new ways, allowing them to bring products to market much faster. Developers often follow consumer models, empowering the user to use affordably a product or service until it becomes mission critical. Software vendors in the DevOps and low code/no-code ecosystem benefit from bottoms up adoption and receive real time feedback on developers' blogs and other channels to gain a sense for how users feel about the product.



**Exhibit 144.** *DevOps Cycle Overview, source RedmineUP.*

As this new development paradigm hits the tipping point, even laggard technology adopters such as construction and agriculture businesses are being disrupted by third-generation software-as-a-service (SaaS) solutions. Construction, for example, is one of the last frontiers of software. Historically, the category has been plagued by laggard worker adoption, on-site bandwidth constraints and clunky software. As a result, construction productivity has been flat and has not scaled to meet demand. A new generation of mobile-enabled software and technology-solution providers are enabling cloud based workflows, better on-site data visibility and improved planning solutions. As today's software and technology is narrowing the productivity gap, tomorrow's frontier technology may close it.

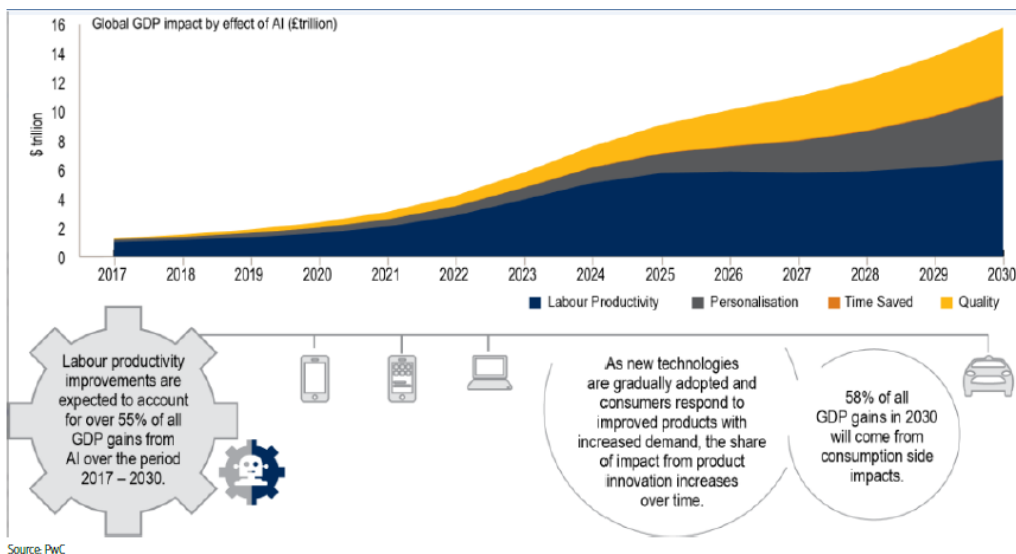


**Exhibit 145.** *Narrowing the Productivity Gap in the Construction Industry, source Alkeon.*

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In summary, we believe we are at the early stages of potentially the most disruptive innovation cycle in technology ever: An AI-driven revolution that by 2030 has the potential to contribute up to \$15.7 trillion to the global economy.



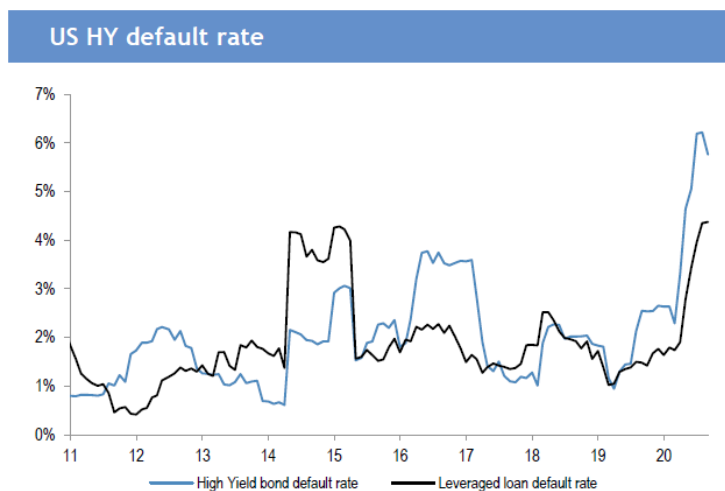
**Exhibit 146.** Gains in AI, source PwC and Merrill Lynch.

As a result, we are dedicating significant research resources to both fully evaluate and position our strategy to try to exploit this massive innovation wave. We believe implications for technology investments are most pronounced, as this cycle of innovation accelerates growth for the sector, which along with the technology sector’s low recent relative valuation multiple, high profitability and free cash flow conversion, make the current risk/reward proposition for the technology sector far superior to that of the internet wave of the mid 90’s —the last broad-scale wave of innovation we have witnessed—, in our view.

**IV. Broad Market Observations**

Our current view on the global equity market is broadly balanced. Overall risk/reward for equities appears attractive relative to fixed-income investments, as we will explain in this section.

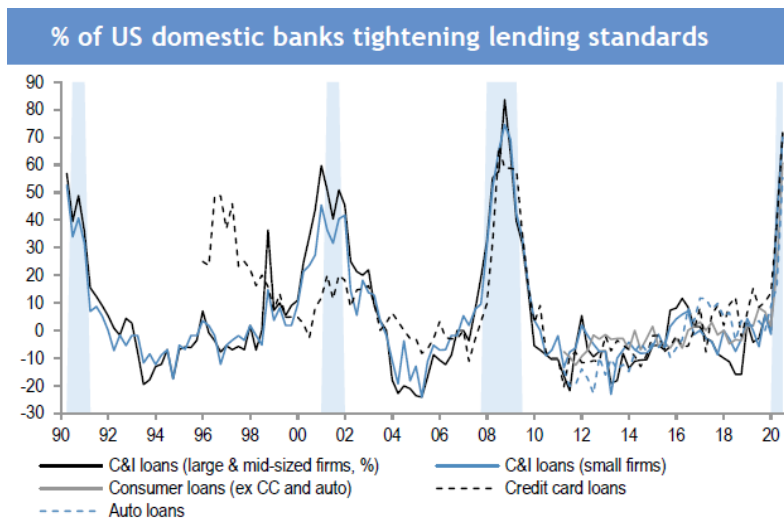
Yet, uncertainty is likely to persist as broad macroeconomic signals such as rising default rates and a deteriorating labor market have quickly turned recessionary after global PMI quickly fell as much as it did during the global financial crisis.



**Exhibit 147.** US High-Yield Default Rates, source JP Morgan.

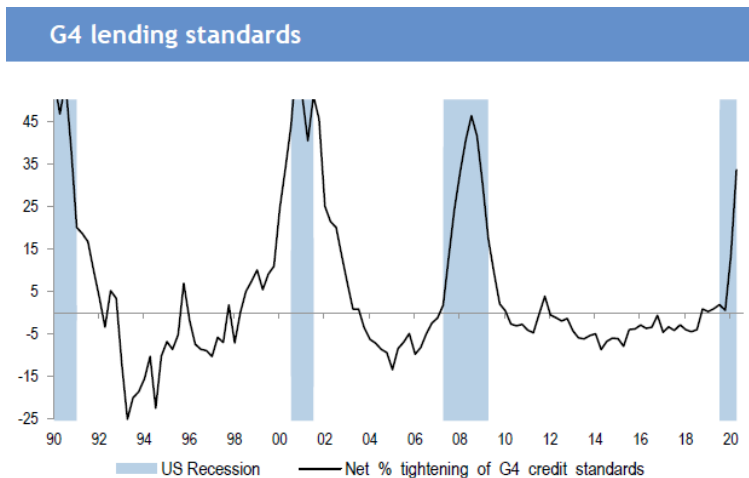
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This is worrisome, particularly in the face of tightening US bank lending standards.



**Exhibit 148.** US Bank Lending Standards, Percentage of Banks Tightening, source JP Morgan.

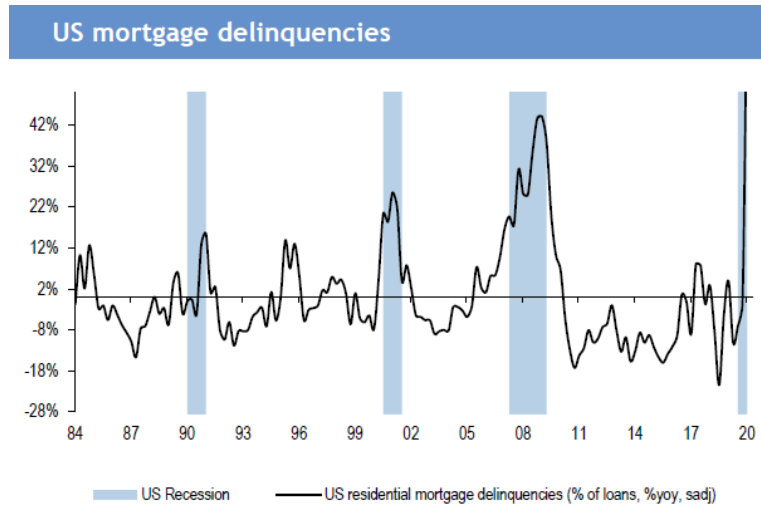
The picture is similar globally, as G4 lending standards continue to tighten.



**Exhibit 149.** G4 Lending Standards, source JP Morgan.

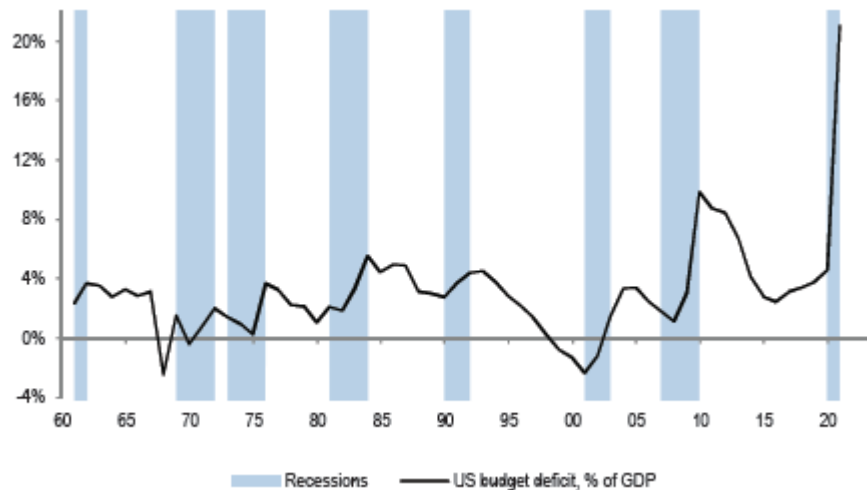
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Lastly, the consumer market is deteriorating, as consumer confidence has not recovered and mortgage delinquencies are rising.



**Exhibit 150.** *US Mortgage Delinquencies, source JP Morgan.*

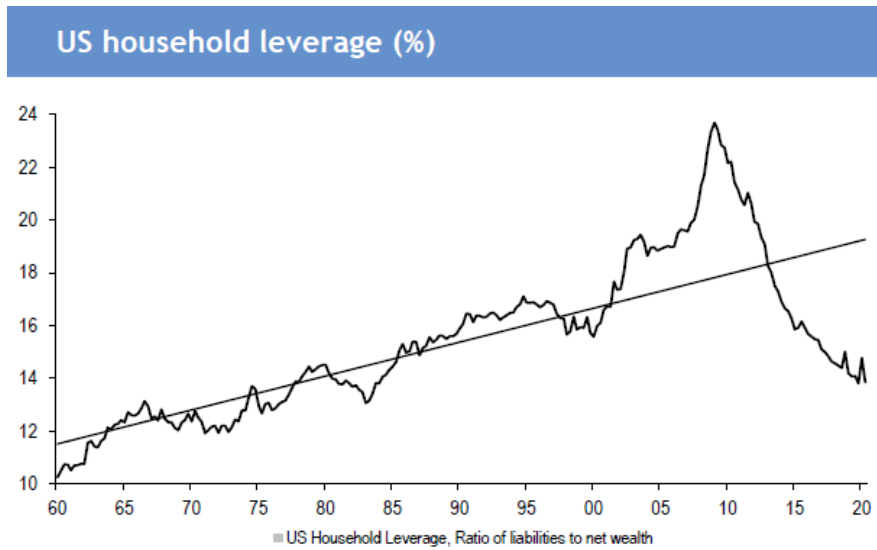
Mitigating this weak consumer picture is, of course, an unprecedented level of fiscal and monetary support. But this has increased deficits at levels higher than any other prior recession, with significant implications for rates and long-term GDP growth.



**Exhibit 151.** *US Budget Deficit, source JP Morgan.*

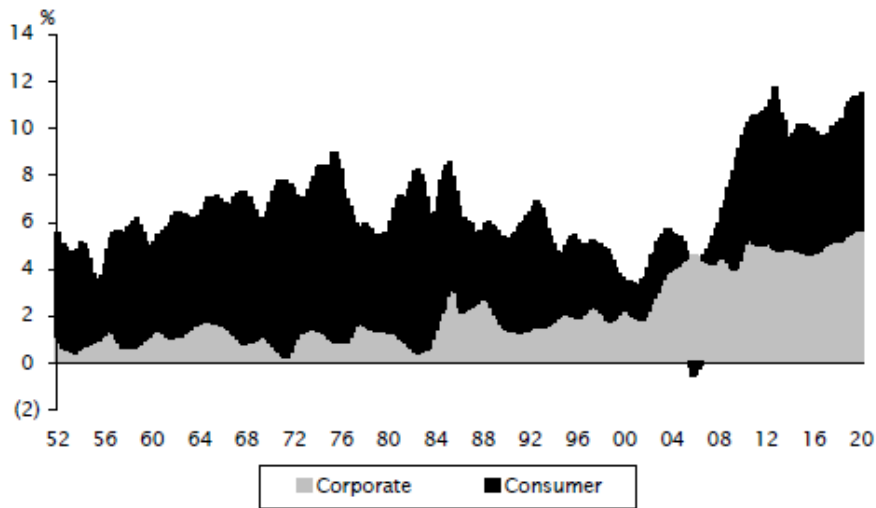
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On the positive side, consumer leverage remains low.



**Exhibit 152.** US Consumer Leverage, Ratio of Liabilities to Net Worth, source JP Morgan.

Systemically, the overall economic backdrop is healthy, aided by strong liquidity injections and fiscal support.



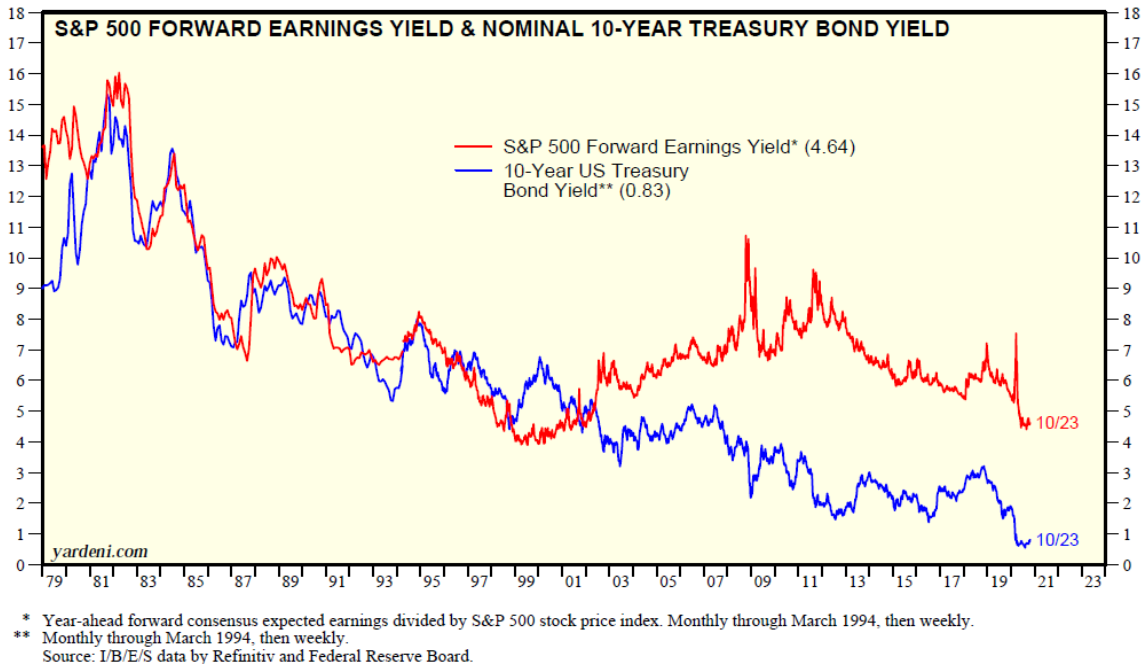
**Exhibit 153.** US Consumer and Corporate Free Cash Flow as a Percentage of Nominal GDP, source Empirical Research.

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*Broadly Attractive Equity Valuations*

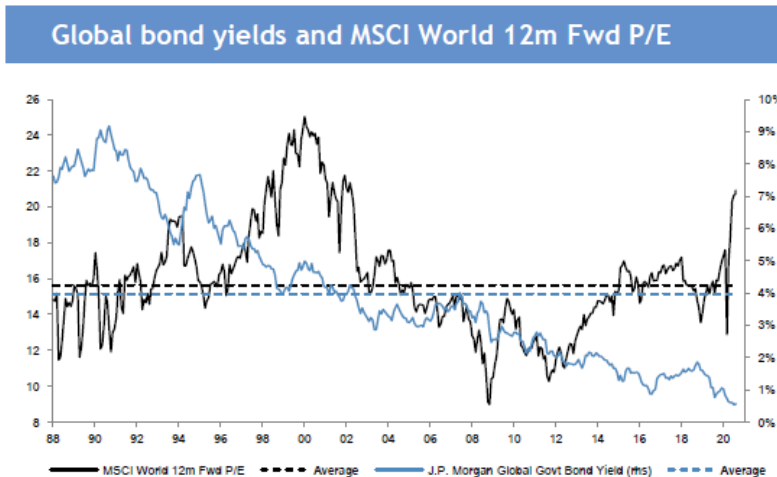
Despite macroeconomic uncertainty, we believe equities currently remain undervalued relative to bonds. Comparing the forward earnings yield on the S&P 500 against the 10-year Treasury yield is a highly instructive exercise and a simple way to measure relative value between two major asset classes. While the two have been tracking close to each other for decades, recently they have diverged significantly, as monetary stimulus policies depressed bond yields.

A review of the Fed stock valuation model is particularly revealing, unveiling a picture which is the opposite of the end of 1999 when rates were at 6.44%: bonds are currently in as much of a bubble formation (i.e., overpriced relative to stocks) as stocks were in 1999 (i.e., overpriced relative to bonds)!



**Exhibit 154.** *Fed Stock Valuation Model, source Yardeni.com.*

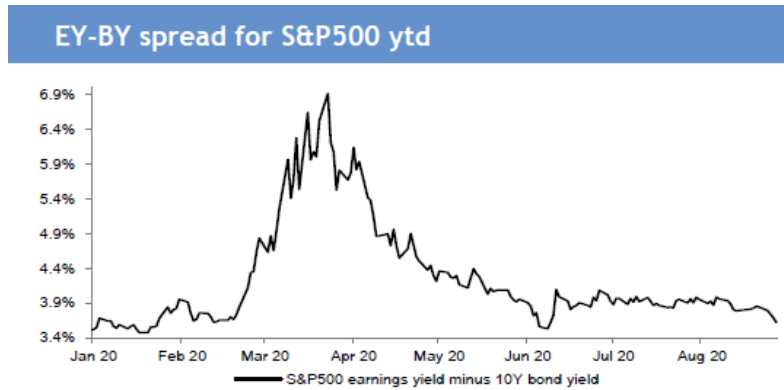
Even though forward P/E multiples for the MSCI World are elevated relative to historical levels, bonds remain highly unattractive and overvalued relative to equities, in our view.



**Exhibit 155.** *MSCI World Index P/E and Global Sovereign Bond Yields since 1988, source JP Morgan.*

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In particular, year-to-date, the spread between forward equity earnings yield and the 10-year Treasury has not worsened, implying that equities are as attractive relative to bonds as they were at the beginning of the year.



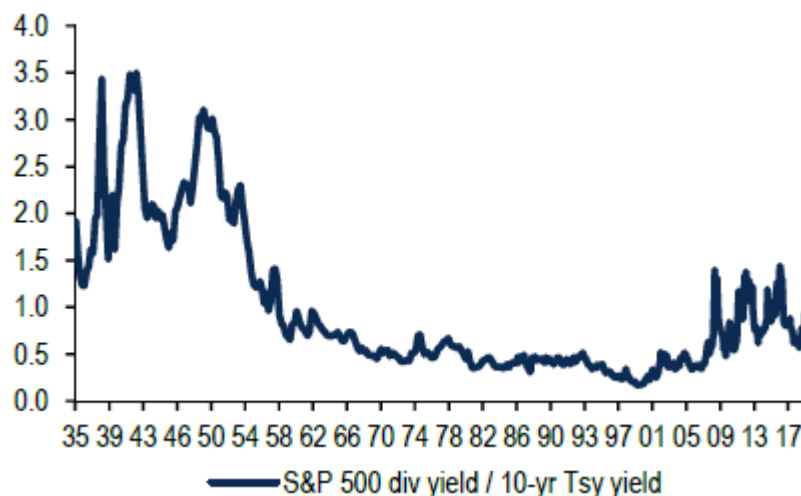
**Exhibit 156.** S&P 500 Index Earnings Yield minus Bond Yield, source JP Morgan.

Additionally, the spread between equity dividend yields and bond yields remains measurably elevated and highly favorable to equities across most developed markets, particularly in the Eurozone and the UK.

	Dividend yield	10Y Bond yield	Dividend yield minus bond yield	Average since '00	Gap (bp)
US	1.6%	0.7%	0.9%	-1.4%	236
Japan	2.3%	0.0%	2.3%	0.7%	155
Eurozone	2.3%	0.0%	2.3%	0.3%	201
UK	3.9%	0.2%	3.6%	0.4%	321

**Exhibit 157.** Developed Market Yield Gap, source JP Morgan.

Notably, since 1951, the last time the ratio of S&P 500 dividend yields to Treasury yields was at such a high level, equities delivered nineteen times outperformance over Treasuries.



**Exhibit 158.** Stocks have not been this Attractive vs. Bonds since the 1940s, May 2020, source BofA US Equity & Quant Strategy.

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*Attractive Long-term US Fundamentals*

We remain overweight in the US for a number of reasons.

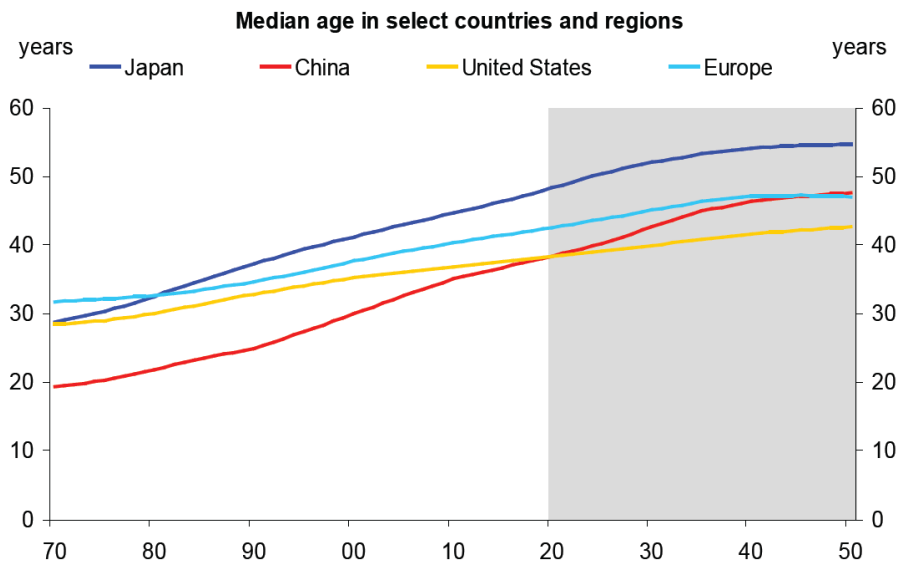
First, from a demographic standpoint, the underlying fundamental backdrop seems very favorable. Using data from Fundstrat, it is clear the US is decoupling from the rest of the world in a positive way due to various factors. In particular, the US is expected to be the only region with population growth over the next 20 years, as shown below. This is very positive for a demand cycle in the US, and can drive a credit cycle similar to the early 80's.

Figure: Total Population Growth — 2019 to 2039  
Per UN DESA

	Population explained last 20 years...		Next 20 years...	
	Population CAGR 1999 - 2019	Population (in mm) 2019	Population CAGR 2019 - 2039	Population Delta (in mm) 2019 - 2039
US	0.8%	329.1	0.6%	43.3
Europe	0.1%	743.1	-0.1%	-13.1
Germany	0.1%	82.4	-0.1%	-1.2
Japan	-0.0%	126.9	-0.5%	-11.0
China	0.5%	1,420.1	0.0%	1.2
Russia	-0.1%	143.9	-0.3%	-7.7

**Exhibit 159.** US Population Growth vs. Rest of the World, source Fundstrat.

Importantly, the median age for the US population will soon be lower than China.



**Exhibit 160.** Median Age in Select Regions, source Deutsche Bank.

Second, compared to other major countries, the US has the highest share of "high value" sectors, i.e., technology and healthcare and the lowest share of deep cyclicals (traditionally, low-volatility stocks).

Third, according to the World Bank, the US now has the most business friendly regulatory regime compared to other major economies such as China and Japan.

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Fourth, the US's "cash return" measured by dividends plus buybacks as a percentage of market cap is the highest among major countries.

And finally, fifth, the US remains the most liquid market globally.<sup>31</sup> The US remains by far the largest market of global equity indices. In fact, as of 2018, roughly 49% of global wealth was controlled by the US and China, making these two countries the most important drivers of global economic growth going forward.

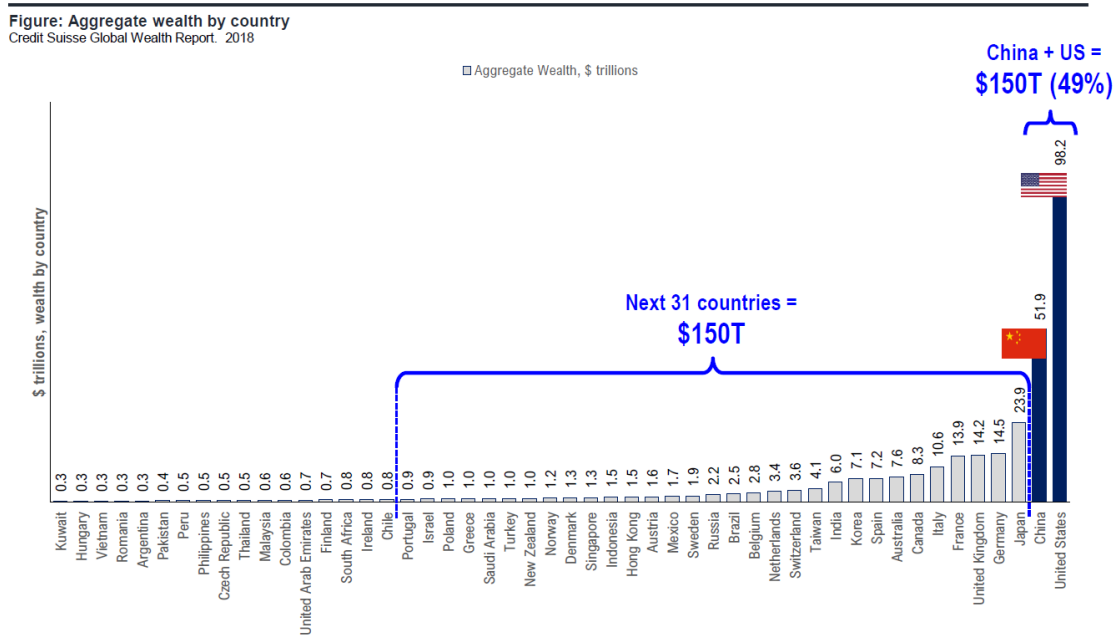


Exhibit 161. Aggregate Wealth by Country, source Credit Suisse and Fundstrat.

Another potential tailwind for the US economy is infrastructure spending, which is currently depressed and needs to increase significantly in future years. In the US, as recently as 2017, fixed investment spending as a percentage of GDP was at the same level as third world nations such as Venezuela and Afghanistan.

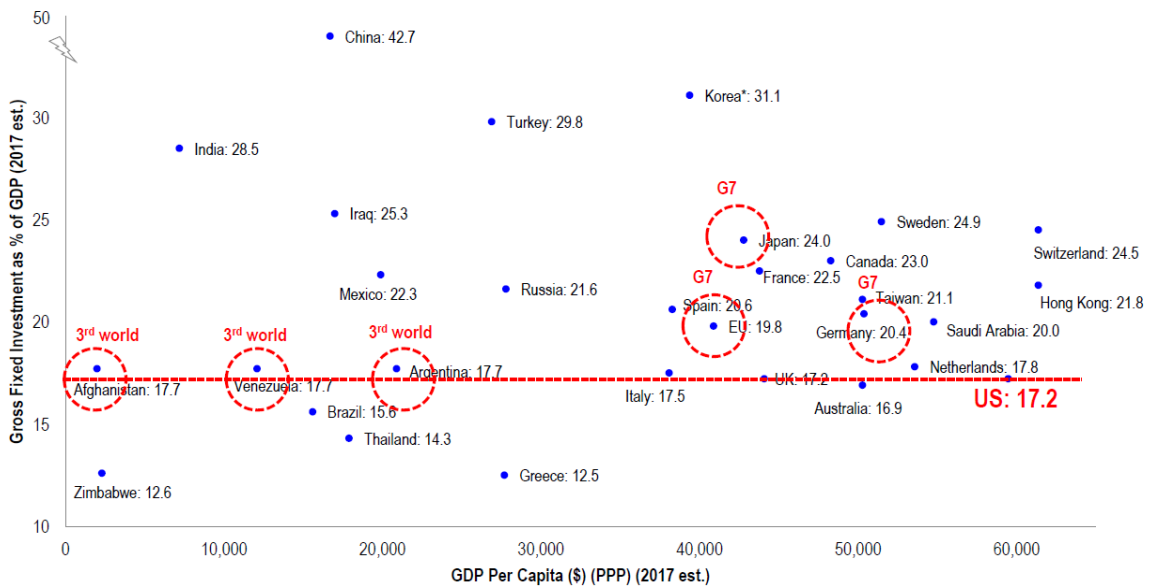
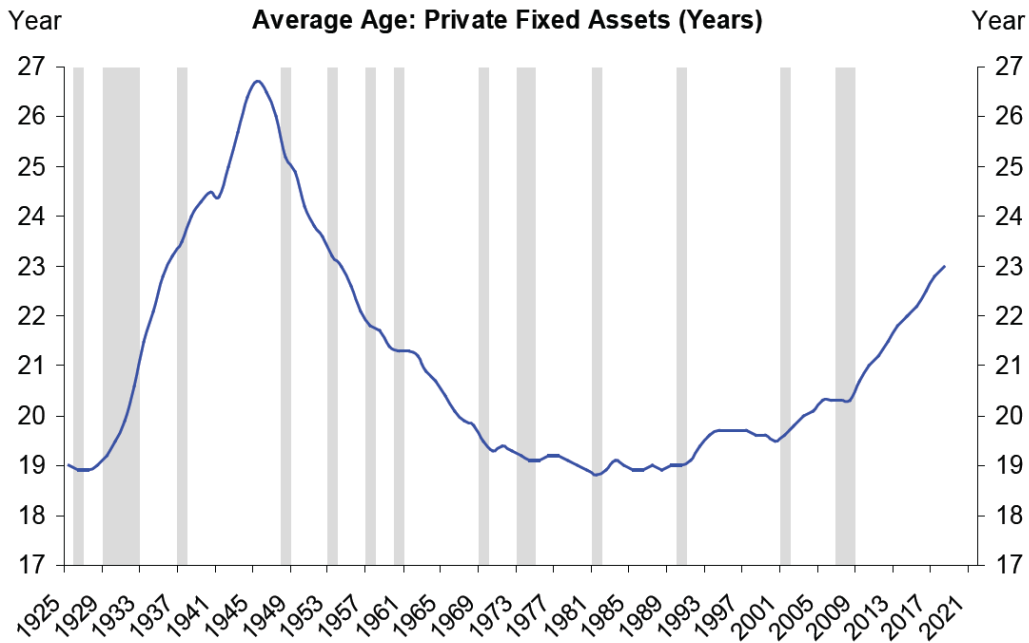


Exhibit 162. Gross Fixed Investment as a percent of GDP, 2017 Estimates, source Fundstrat and CIA World Factbook.

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As a result, US capital stock is aging rapidly.

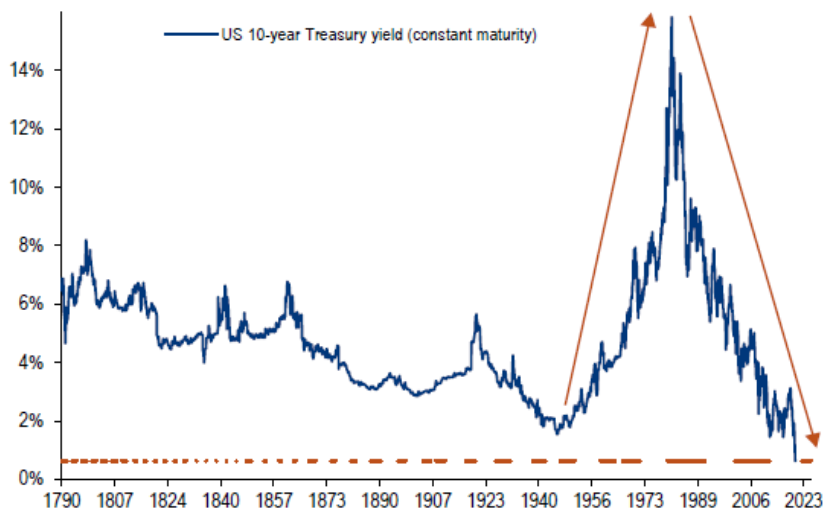


**Exhibit 163.** Average Age of Private Fixed Assets, source Deutsche Bank.

In summary, the underlying demographic backdrop in the US remains healthy. This creates a favorable environment for identifying long-term secular growth compounders.

*Asset Allocation Implications*

From an asset allocation standpoint, investors are faced with an incredible scarcity of attractive asset choices. In particular, as Treasury yields hit all-time lows, a historic fixed-income bull market may be coming to an end.



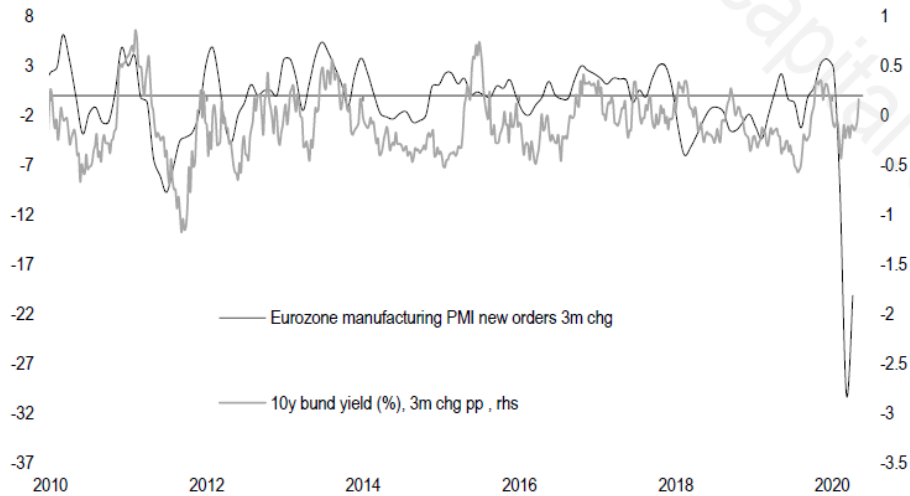
**Exhibit 164.** 10-Year Treasury Yield, source BofA Merrill Lynch.

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As bonds mature, investors are faced with a fundamental question: should they re-invest all of this cash back into record-low yielding fixed-income investments or invest in other asset alternatives? If the answer is invest in other asset alternatives, will stocks gradually become the “new bonds”? After all, the free cash flow yield on the S&P 500 currently stands at 4.8% versus an approximately 0.7% yield for the 10-year Treasury.

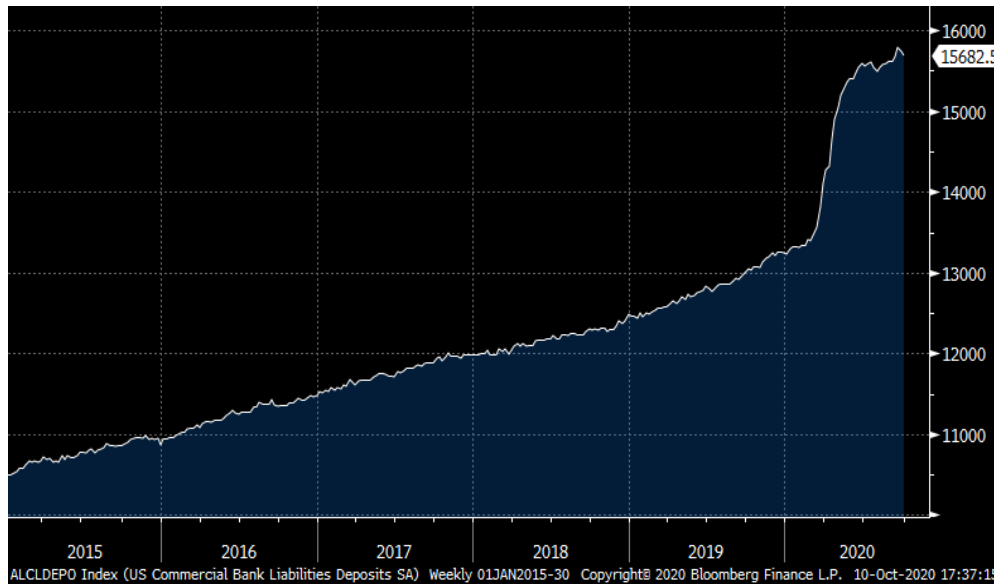
As rates hit the zero-level “barrier” and central banks are reluctant to cut rates further and risk asset bubbles and impeding the profitability of banks—which are needed to finance the recovery—, bonds fail to provide the protection they once did.

This can already be seen in Europe. At the deepest point of the crisis in March, and when PMIs collapsed, Bund yields only fell marginally.



**Exhibit 165.** *Bund Yields Did Not Fall That Much When PMIs Fell, source Credit Suisse.*

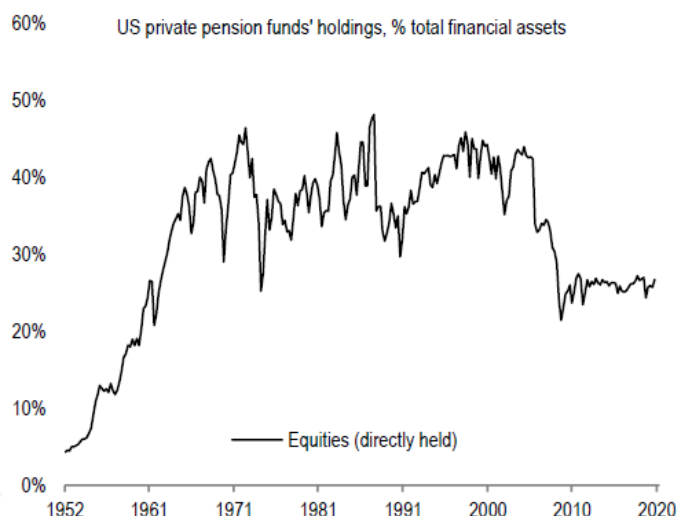
Certainly, there is no shortage of dry powder for reallocation to equities if sentiment changes. Not only have money market fund assets reached a new multi-year high this year, but also US bank deposits have surged sharply.



**Exhibit 166.** *US Commercial Bank Deposits, source Bloomberg.*

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Additionally, institutional equity allocations are low relative to bond allocations.



**Exhibit 167.** *Equity Holdings by US Private Pension Funds, source Credit Suisse.*

As a result, and in our view, in this environment of a severe lack of attractive asset allocation choices, the value of high quality, high-free-cash-flow-yielding, growth businesses stands out in stark contrast to a plethora of lower-quality and lower-yielding investment instruments. We believe that publicly-traded businesses that fit this mold represent the “New Real Assets”, and, grouped together, form a rare oasis of safety and relative value in the desert of unattractive asset allocation choices in which investors continue to find themselves wandering.

It is precisely this scarcity of compelling asset allocation choices that elevates the attractiveness of high quality, pristine balance sheet, high-free-cash-flow-yielding equity investments, many of which offer not only superb relative value but also a safer alternative to a broad array of unattractive and increasingly vulnerable investment options within both the fixed-income and correlated low-volatility equity bubble formations.

We also believe this environment presents compelling opportunities on the short side. This is an important part of our strategy and is embedded in the DNA of our firm, as we always deploy a significant amount of capital on the short side. Our committed long-short approach, has allowed us to outperform the market and our peers –represented by the HFRX Equity Hedge Index– in all negative markets since the 2008 crisis.<sup>32</sup> Moreover, our strategy has also sizably outperformed both the market and our peers since its inception and YTD.

Period	MSCI World	HFR Equity Hedge	AGP
YTD Q3 2020	0.37%	-2.95%	38.58%
2018	-10.44%	-9.42%	-4.65%
2015	-2.74%	-2.33%	6.36%
2011	-7.62%	-19.08%	0.40%
2008	-42.08%	-25.45%	-16.68%
Since Inception (annualized)	4.16%	4.49%	(AGS) 15.12%

**Exhibit 168.** *YTD Performance and Negative Market Performance from 2008 Financial Crisis through Q3 2020, source Alkeon and Bloomberg.<sup>33</sup>*

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## V. Conclusion

In summary, we are hopeful that the economic and social crisis wrought by COVID will see significant signs of scientific improvement by year-end. Purely from an investment standpoint, we currently believe economic uncertainty is creating some unique long-term investment opportunities ahead of the rebuilding phase. In particular, not only do we see a significant scarcity of attractive asset allocation choices globally, but also a strong environment for fundamental stock picking. Lastly, we consider the present investment opportunity set to be equally attractive for both long and short investments. Overall, our broad market views are currently balanced; we see attractive relative equity valuations but also emphasize the need to be selective – more so now than ever before in recent years given the unprecedented earnings dispersion among companies.

We have continued to invest in all parts of our business. Over the past few years, we have grown our investment team, opened a new office in Silicon Valley for our team that heads our VC Technology Innovation investments, and added to our Healthcare and Asia investing capabilities. We remain strongly committed to our fundamental, quality-biased, private-ownership approach to investing in public equities and, importantly, we remain deeply committed to our short activities and to maintaining a sizable short book in all market environments.

Throughout the year we have expected continued market volatility, which we generally welcome as we firmly believe that market dislocations and drawdowns can create significant opportunities for long-term investors. We are humbled by the events of this year and remain immersed in our work, a welcome therapy during these difficult times of social distancing and isolation.

Sincerely,

Alkeon Capital Management Investment Team

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<sup>1</sup> Performance data is from another investment vehicle which runs pari-passu to Alkeon Growth Partners, LP (AGP) and follows substantially the same investment strategy (the "Alkeon Growth Strategy" or "AGS") as AGP. The other investment vehicle's performance represents the longest track record available for the Alkeon Growth Strategy with an inception date of January 5, 1998 (MSCI data is as of January 1, 1998) and reflects the deduction of the vehicle's actual fees and expenses during the period shown, including the deduction of a 20% incentive fee and a 1% management fee charged to investors prior to March 1, 2004, a 1.5% management fee charged to new investors beginning March 1, 2004 and a 1.75% management fee charged to all investors beginning July 1, 2011. AGP commenced operations in January 2003, and it is subject to a 20% incentive fee and management fees ranging from 1.25% to 2% depending on the series of interests. AGS performance shown above may have been lower during certain periods had it been subject to similar fees as AGP. Performance for both AGP and AGS are presented on a fund level. Unless otherwise indicated, index returns are presented on a price return basis only - dividends and reinvestments are excluded. Please see Important Notes at the end of this letter, including "Comparisons to Indices". Past performance is no guarantee of future results.

<sup>2</sup> JP Morgan, May 2020.

<sup>3</sup> JP Morgan Equity Strategy, July 2018.

<sup>4</sup> Fundstrat, August 2017.

<sup>5</sup> Fundstrat, January 2018.

<sup>6</sup> Fundstrat, January 2018.

<sup>7</sup> Credit Suisse, July 2019.

<sup>8</sup> <https://www.cnn.com/2019/10/08/call-of-duty-mobile-game-sees-100-million-downloads-in-first-week.html>

<sup>9</sup> Merrill Lynch, Thematic Research, March 2019.

<sup>10</sup> 13D Global Strategy and Research, February 2019.

<sup>11</sup> Klaus Schwab, Founder and Executive Chairman, World Economic Forum, 2016.

<sup>12</sup> Jen-Hsun Huang, Keynote Speech, GTC 2017.

<sup>13</sup> <https://www.chess.com/news/view/updated-alphazero-crushes-stockfish-in-new-1-000-game-match>.

<sup>14</sup> <https://arxiv.org/pdf/1712.01815.pdf>.

<sup>15</sup> 13D Global Strategy and Research, September 20, 2018.

<sup>16</sup> <https://futurism.com/artificial-intelligence-remember-agi>.

<sup>17</sup> <https://www.design-reuse.com/news/46628/xilinx-fpga-virtex-ultrascale-vu19p.html>.

<sup>18</sup> <https://www.nature.com/articles/s41586-019-1666-5>.

<sup>19</sup> Nvidia GTC, Munich, October 2017.

<sup>20</sup> Morgan Stanley, May 2018.

<sup>21</sup> Morgan Stanley, May 2018.

<sup>22</sup> Graphcore AI Call, March 31, 2017.

<sup>23</sup> Macquarie Research, August 2016.

<sup>24</sup> Bernstein, AI Part VII, June 2017.

<sup>25</sup> GTC 2020 Nvidia Keynote.

<sup>26</sup> <https://www.graphcore.ai/blog/what-does-machine-learning-look-like>.

<sup>27</sup> <https://www.wsj.com/articles/elon-musk-launches-neuralink-to-connect-brains-with-computers-1490642652>.

<sup>28</sup> <https://techcrunch.com/2017/04/19/facebook-brain-interface/>.

<sup>29</sup> Bernstein, April 2017.

<sup>30</sup> Morgan Stanley, July 2018.

<sup>31</sup> Fundstrat, October 2019.

<sup>32</sup> The HFRX Equity Hedge Index is comprised of approximately 225 constituents with typically a minimum \$50 million AUM, 24-month track record and 50% invested in equities, long and short.

<sup>33</sup> Negative market performance as determined by the MSCI World Index. HFRX Equity Hedge Index is shown for reference purposes only. Past performance is no guarantee of future results. See endnote 1 for further information on AGS performance.

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FactSet provided forward year EV/EBITDA for securities and indices. Only EV/EBITDA numbers that Alkeon believes to be reasonable were used in calculations.

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