PORTFOLIO INSIGHTS

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LONG-TERM CAPITAL MARKET ASSUMPTIONS

Time-tested projections to build stronger portfolios

J.P.Morgan
Asset Management

2018 LONG-TERM CAPITAL MARKET ASSUMPTIONS
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FOREWORD

CHRIS WILLCOX

MIKE O'BRIEN

"PREDICTION IS VERY DIFFICULT," Nobel Prize-winning physicist Niels Bohr wrote, "especially if it's about the future." Investors trying to assess the prospects for capital markets may sometimes share the sentiment.

Amid today's challenging investing environment, we present the 2018 edition of J.P. Morgan Asset Management's Long-Term Capital Market Assumptions (LTCMAs). In our 22nd year of publishing capital market estimates, we incorporate more than 50 asset and strategy classes; our return assumptions are available in 13 base currencies, which this year include the Chinese renminbi for the first time. Over the years, many investors and advisors have come to depend on our assumptions to inform their strategic asset allocation, build stronger portfolios and establish reasonable expectations for risks and returns over a 10- to 15-year time frame.

We formulate our LTCMAs as part of a deeply researched proprietary process that draws on quantitative and qualitative inputs as well as insights from experts across J.P. Morgan Asset Management —a collaborative effort that has been honed over the past two decades. Our own multi-asset investment approach relies heavily on our LTCMAs. The assumptions form a critical foundation of our framework for designing, building and analyzing solutions aligned with our clients' specific investment needs.

In this edition of our assumptions, we explore the complex interplay between secular themes, including global aging and technological innovation, and cyclical factors—notably the slow path of policy normalization and elevated equity valuations—that will influence asset returns over our 10- to 15-year investment horizon. During this period, we see more modest returns in many asset markets. All of this highlights the importance of a considered, long-term strategic perspective. It also shines a light on the power of active asset allocation, capturing alternative sources of risk premium, and careful manager selection as investors look for new sources of potential returns.

We look forward to working with you to make the best use of our assumptions in setting your own strategic perspective and pursuing your investment goals.

On behalf of J.P. Morgan Asset Management, thank you for your continued trust and confidence. As always, we welcome your feedback.

Chris Willcox
Chief Executive Officer,
Asset Management

Mike O'Brien
Chief Executive Officer,
Asset Management Solutions

2018 Long-Term Capital Market Assumptions

John Bilton, CFA, *Head of Global Multi-Asset Strategy, Multi-Asset Solutions*

IN BRIEF

This executive summary gives readers a broad overview of our 2018 Long-Term Capital Market Assumptions (LTCMAs) and provides a context for how some of the structural factors affecting economies today are likely to drive asset returns over a 10- to 15-year investment horizon. The key takeaways from this year's LTCMAs:

- Our 2018 trend real GDP growth estimates of 1.5% in developed markets and 4.5% in emerging markets are unchanged from last year. However, beneath this stable outlook is evidence that the prolonged series of downgrades to trend growth, reflecting population aging, may be nearing an end. We also see potential for a technology-driven boost to productivity, which creates an upside risk to our forecasts. Yet despite cautious optimism on secular growth trends, cyclical factors still constrain asset returns.
- Interest rates are rising but the pace of normalization remains slow. Equilibrium yields are constrained by muted inflation, low trend growth and persistent safe asset demand.
- High global equity valuations and corporate margins reflect a mature economic cycle and are a headwind for returns. The secular outlook for stocks is reasonable as low equilibrium interest rates compensate for modest equilibrium growth in our framework, but even long-term investors must navigate the near-term cyclical challenges.
- Despite outperforming in 2017, emerging market equities remain attractive. Elsewhere, credit and real assets are bright spots, while low correlations and the start of normalization enhance alpha opportunities in private equity and hedge funds.
- Expected returns for a simple 60/40 portfolio are lower than last year, and the clockwise rotation of the stock-bond frontier—as bond returns rise and valuations constrain equity returns—is indicative of the late-cycle environment. Diversification, active allocation and manager selection in alternatives will be essential tools for managing cyclical risks in anticipation of secular growth trends that might finally be bottoming out.

INTRODUCTION

As we compile the 2018 edition of our Long-Term Capital Market Assumptions, the world economy is enjoying its best period of synchronized growth in more than a decade. Policymakers have coaxed an unusually long, if shallow, expansion out of the near-death experience of the global financial crisis, and despite the long-run drag of global aging, technological innovation seems to be at a positive inflection point—giving a tantalizing glimpse of what might trigger a long overdue boost to productivity.

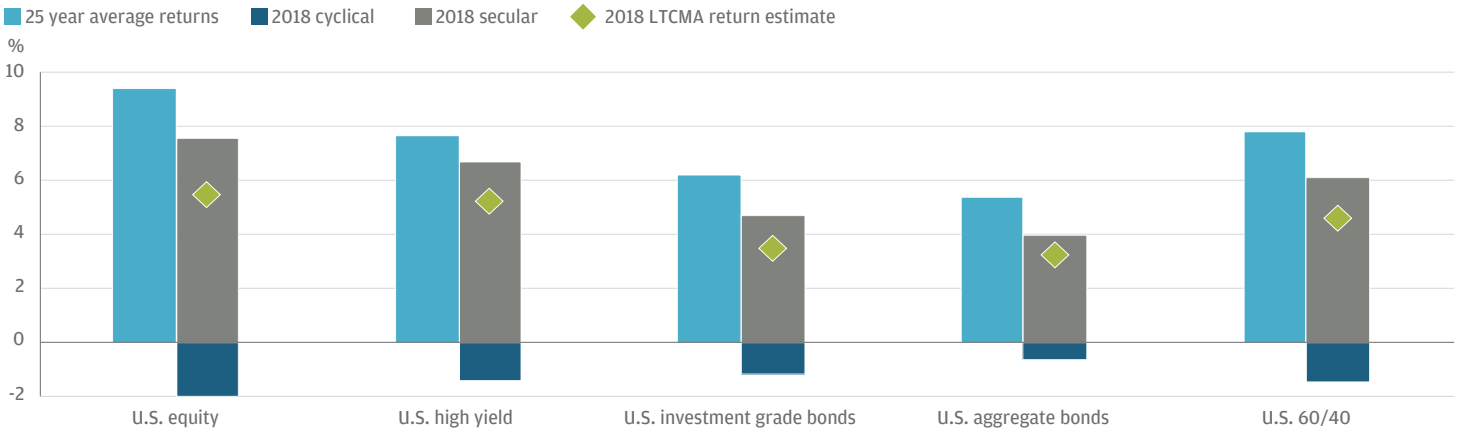
Yet few expansions have endured so many skeptics, and few bull markets have remained so unpopular. High levels of debt, the perceived trap of zero interest rates, the lack of inflation, and sporadic political dysfunction do more than keep some investors up at night; they often hijack the market narrative. Many of the patterns and trends in this year's LTCMAs will be familiar to regular readers, but given the maturity of this business cycle, the interplay of cyclical and secular factors is set to influence long-term investment outcomes far more than in recent years (**Exhibit 1**).

Since 2010, the steady trend of population aging has cut almost half a point from our estimates of trend GDP in developed economies, and the post-financial crisis productivity slump shaved the estimate by a further quarter point. At a global level, the steadily increasing weight of faster-growing emerging markets partially buffered the effect of aging populations, but the demographic strain remains apparent in the evolution of our global growth estimates. In our 2018 LTCMAs, the outlook for global growth is broadly stable at a modest level, but for the first time in a decade we have cause to upgrade our growth forecast for a major economic region—the eurozone. Cyclical momentum and strengthening of key institutions are laying the foundation for a secular uplift in trend growth, which we expect to be reinforced with gradual but ongoing reform of labor laws. The upgrade is notable—not least in light of the eurozone sovereign debt crisis of 2010-12—but it is not sufficient to spur a broader upgrade to aggregate global growth.

Against this backdrop, we have shifted our attention to a more rigorous analysis of some of the secular themes—along with a reflection on their nearer-term cyclical implications—that are set to drive asset returns in the coming decade. The themes may be felt directly, through their economic impact, as is the case for our themes of technological innovation, Chinese financial markets liberalization and long- and short- term drivers of the U.S. dollar. Others may be felt more indirectly via policy channels, as we'd anticipate for our demographics and pension de-accumulation themes.

Reduced long-term growth estimates have pulled down equilibrium returns for most asset classes compared with the last 25 years, but there is an additional cyclical penalty in most key assets due to extended valuations and low starting yields

EXHIBIT 1: HISTORICAL 25-YEAR AVERAGE RETURNS FOR KEY ASSETS AND THIS YEAR'S ESTIMATES, SPLIT INTO THEIR SECULAR (EQUILIBRIUM) AND CYCLICAL COMPONENTS



Source: Bloomberg, Datastream, J.P. Morgan Asset Management Multi-Asset Solutions; data as of September 30, 2017.

MACROECONOMIC THEMES: BALANCING SECULAR AND CYCLICAL FACTORS

Our 10- to 15-year aggregate forecasts for global growth are unchanged this year, with developed markets at 1.50% and emerging markets at 4.50% (**Exhibit 2**). This translates to rather modest return expectations for most asset classes at equilibrium, which are further affected by the cyclical positioning of the economy and markets. Simply put, we've already banked a great deal of the current cycle's returns, and with the global expansion now quite mature there's little scope for any cyclical uplift to average returns. But if we look beyond the limitations that today's mature cycle places on long-term returns, there are reasons for cautious optimism and even some upside risks emerging for our long-term economic forecasts. The impact of demographics has been well flagged, and has led to the steady lowering of potential growth estimates, but the possible upside from technology and its consequent additional boost to productivity has yet to come into base case economic forecasts.

Our long-term macroeconomic assumptions stand at the intersection of two powerful secular forces: demographics and productivity. While the long-term economic impact of an aging population is well documented, estimating productivity remains the "dark art" of economics. These secular forces tend to define potential growth over the long run. Short-term cycles fluctuate around this trend as demand ebbs and flows, but the supply-side factors effectively set an "average speed limit" for the economy.

Demographic trends can be tweaked a little by policy—raising the retirement age, increasing net migration, etc.—but the economic drag of a slower-growing working age population is persistent.

If the net economic effect of an older population is simply to limit potential growth, its impact on asset returns is more nuanced. Lower growth drives down equilibrium interest rates, b ut a competing factor is that as populations age, "savings gluts" (considered in some analyses[1] to depress equilibrium interest rates) may start to unwind. Another important consideration is that vast pools of pension assets are currently underfunded, with lower long-term interest rates exacerbating that underfunding. As pension plans seek to fulfill their commitments to a growing pool of retirees, the incremental demand for income from higher risk assets such as credit and equity may remain surprisingly strong. While policymakers may find the temptation to tackle pension underfunding by tolerating higher inflation somewhat appealing—financial repression by another name—it overlooks that many funds are already inflation proofed. But the bigger problem, perhaps, is that inflation isn't what it used to be and $11 trillion[2] of central bank interventions since the global financial crisis have failed, so far, to push inflation meaningfully higher (**Exhibit 3**).

[1] BIS working papers No. 656, Goodhart and Pradhan; Ben Bernanke speech at Virginia Association of Economists, Richmond, Virginia on March 10, 2005.

[2] The combined balance sheets of the U.S. Federal Reserve, Bank of Japan, European Central Bank, Bank of England and Swiss National Bank expanded from approximately USD 4.3 trillion at the end of 2007 to approximately USD 15.5 trillion at the end of Q3 2017.

Our 2018 assumptions anticipate slow real GDP growth globally; neither global growth assumptions nor the emerging market-developed market growth gap has changed from last year

EXHIBIT 2: MACROECONOMIC ASSUMPTIONS (%)

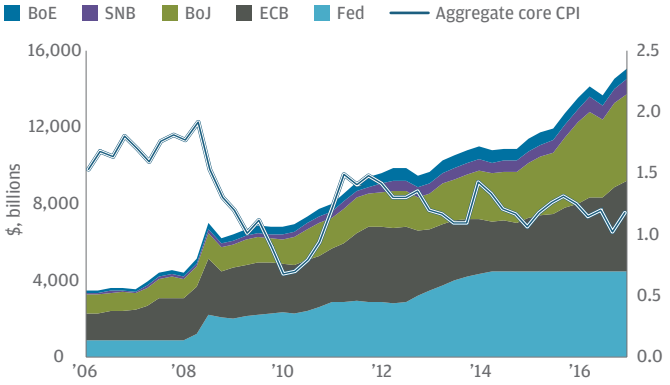
	2018 assumptions		2017 assumptions		Change (percentage points)	
	Real GDP	Core inflation	Real GDP	Core inflation	Real GDP	Core inflation
DEVELOPED MARKETS	**1.50**	**1.75**	**1.50**	**1.75**	**0.00**	**0.00**
U.S.	1.75	2.25	1.75	2.25	0.00	0.00
Eurozone	1.50	1.50	1.25	1.50	0.25	0.00
UK	1.25	2.00	1.25	2.00	0.00	0.00
Japan	0.50	1.00	0.50	1.00	0.00	0.00
Australia	2.00	2.25	2.25	2.25	-0.25	0.00
Canada	1.50	1.75	1.50	1.75	0.00	0.00
Sweden	1.75	1.75	1.75	1.25	0.00	0.50
Switzerland	1.25	0.75	1.50	0.75	-0.25	0.00
EMERGING MARKETS*	**4.50**	**3.50**	**4.50**	**3.75**	**0.00**	**-0.25**
Brazil	3.00	5.00	2.75	5.25	0.25	-0.25
China	5.00	2.75	5.25	3.00	-0.25	-0.25
India	7.00	5.00	7.00	5.00	0.00	0.00
Russia	1.50	5.50	2.25	5.50	-0.75	0.00
GLOBAL	**2.50**	**2.50**	**2.50**	**2.50**	**0.00**	**0.00**

Source: J.P. Morgan Asset Management; estimates as of September 30, 2017.

* Emerging markets aggregate derived from 9-country sample.

The balance sheets of the major central banks grew by over $11 trillion since 2007, yet core inflation remains low

EXHIBIT 3: GLOBAL CENTRAL BANKS BALANCE SHEETS SIZE ($, BILLIONS) VS. PREVAILING GLOBAL CORE* INFLATION



Source: J.P. Morgan Asset Management Multi-Asset Solutions, Bloomberg; data through September 2017.

*Core CPI across U.S., Switzerland, UK, eurozone and Japan, weighted by GDP.

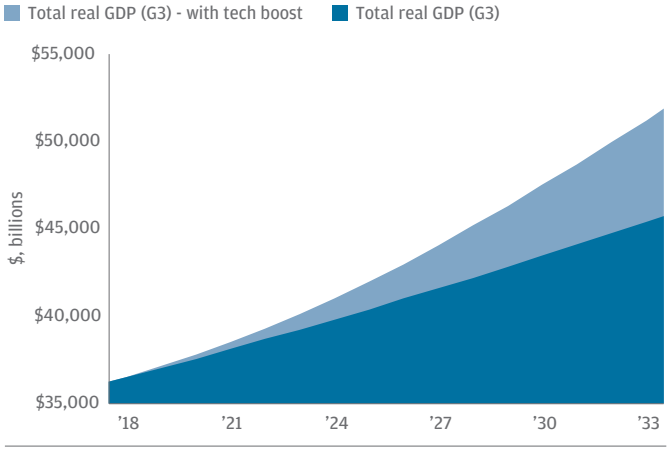
Population aging is a key factor in China's long-term outlook, in which gradually declining trend growth and the possible reversal in public sector savings rates could have a significant impact on global capital flows. China is the world's second-biggest economy, representing 15% of world GDP,[3] and is the largest international holder of U.S. debt. Yet China's domestic financial markets are undeveloped and difficult to access. The portion of China's stock market that is open to foreign investors accounts for just 3% of global free-float equity market capitalization.[4] However, the total scale of the Chinese equity market—including both domestic and non-domestic—is almost six times this size. We believe that over the next decade China's financial system will open up meaningfully to market forces and foreign access will be considerably easier. Liberalization of the financial system could exert some upward pressure on Chinese equilibrium interest rates and, over time, attract global savings away from lower yielding G4 bond markets. Such secular trends have led us to publish our first set of long-term Chinese asset return estimates this year.

These trends also strengthen our conviction that, over the long term, the U.S. dollar is moving lower. The reversal of fortunes in 2017 highlights the cyclical and structural crosscurrents that affect the U.S. dollar as secular drivers such as growth differentials and current account imbalances once again begin to dominate monetary policy in dictating the currency's path. Given that the U.S. dollar remains above our current estimate of long-term fair value, the path of the dollar is a critical consideration for any international diversification throughout our 10- to 15-year investment horizon.

If demographics are defining much of the debate over long-term economic risks, then it is productivity—and specifically technology—that creates the main upside risk to our outlook. Although productivity growth seems to have stalled in the aftermath of the global financial crisis, we reject the idea that productivity is permanently impaired. Based on the pace of development in automation and artificial intelligence, we estimate a potential upside risk to our baseline growth forecasts of 1.0%-1.5% if the promise of today's innovations are fully realized in productivity gains (Exhibit 4).

If just one tenth of the potential growth gain from technology accrues each year, it could boost G3 GDP by $6.5 trillion by the early 2030s

EXHIBIT 4: G3 GROWTH BOOST FROM TECH



Source: J.P. Morgan Asset Management Multi-Asset Solutions, Bloomberg, IMF World Economic Outlook; data as of September 30, 2017. Note: G3 economies defined as U.S., eurozone and Japan.

MAJOR ASSET CLASS ASSUMPTIONS

Our 2018 assumptions represent something of a watershed in our long-term economic outlook. Over the last decade, worsening demographic trends drove successive downgrades to our estimates of trend growth, but this sequence of downgrades may be nearing an end. Moreover, for the first time, we can see tangible upside risks to long-term trend growth expectations starting to emerge. It is too early to declare a trough in long-term trend growth estimates or, indeed, to fully bake in the promise of a technology-driven boost to productivity to our base case numbers. However, the possibility that we are nearing the end of a prolonged sequence of downgrades to long-term trend growth is significant for estimates of equilibrium asset returns.

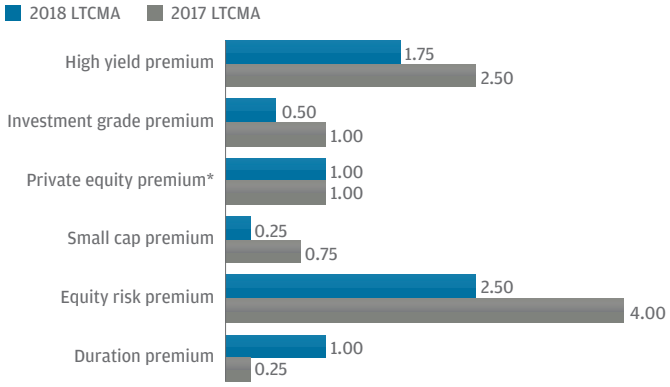
[3] April 2017 IMF World Economic Outlook, estimates for world and China 2017 nominal GDP.

[4] From MSCI data on free-float market capitalization: world, USD 43.7 trillion; China, USD 1.5 trillion.

Cyclical pressures are weighing on returns for long-term equity and riskier credit, while higher starting yields push bond returns modestly higher

EXHIBIT 5A: SELECTED LTCMA RETURNS (%)

EXHIBIT 5B: SELECTED LTCMA RISK PREMIA (%)



Source: J.P. Morgan Asset Management, estimates as of September 30, 2016 and September 30, 2017.

* Private equity premium assumptions are our alpha assumptions for private equity.

This year, though, the maturity of the current economic cycle is manifesting itself only too clearly in asset returns. Equity return expectations, especially, are displaying a cyclical drag from full valuations and above-average margins. These factors will very likely be in place for the remainder of the current business cycle. As the cycle matures, even investors with a very long investment horizon will need to further balance cyclical and secular influences on asset returns. Indeed, it will be a critical consideration (**Exhibits 5A** and **5B**).

FIXED INCOME—No rush to normalize

The slow and shallow path of normalization that we discussed last year is emerging as the preferred central bank playbook. Quite simply, the path of rates we described in our 2017 LTCMAs is little changed, bar rolling forward by a year. Return forecasts for G4 sovereign bonds are slightly improved this year, given the modest rebound in the duration premium as G4 bond yields have pushed up from their lows. Nevertheless, the outlook for most government bond returns remains challenged and only moderately above that of cash. Credit continues to offer a decent pickup in returns even though prevailing spread levels are tighter than our estimates of fair value. The duration component of corporate bonds is also a factor in the modest changes to return forecasts—investment grade returns up 0.25% and high yield returns down 0.50%. The outlook for emerging market (EM) economies continues to improve, and greater structural stability should offset some of the lingering fears over leverage. As a result, EM debt continues to offer fixed income investors both diversification and reasonable return potential.

EQUITY—Cyclical drags, but still the best for long-term returns

Our equity return forecasts are down 0.5% to 0.75% for most regions this year, reflecting primarily the strong returns delivered by stocks in 2017. With growth forecasts generally little changed compared with 2017, equilibrium revenue growth levels are unchanged, but both margins and valuations are a constraint on future returns in most major regions. In our estimation of long-term returns, equities, more than other asset classes, are reflecting the interplay of cyclical considerations and secular growth projections. The equity risk premium (ERP) has fallen meaningfully vs. last year but remains close to its long-run average and is distinctly attractive when compared with the duration premium. Nevertheless, the principal source of returns from developed market (DM) equities remains dividends and buybacks, and with this now a persistent trend, it is likely to push investors seeking capital growth further toward EM equities and private equity markets.

ALTERNATIVE ASSETS—Alpha better, beta abating

Lower equity return forecasts naturally create a headwind for private markets, but the downtrend in alpha expectations of recent years looks to have taken a pause as monetary policy around the world starts to normalize. High valuations are still an impediment to private equity returns, but at the same time, lower prevailing correlation across equity markets and a widening opportunity set serve to increase potential for alpha and enhanced returns. The improvement in alpha opportunities, though, is more pronounced in the hedge fund sector, where the shift from a macro-driven to a more fundamentally driven investing environment is supportive. Improved alpha opportunities

and worsening beta underline our view that manager selection remains the critical driver of returns for both private equity and hedge funds. Indeed, we anticipate a significant premium to our long-term return estimates for upper quartile managers.

We see a relatively attractive outlook for real asset returns, and despite the advanced stage of the U.S. business cycle we expect that real estate will prove to be quite resilient. Our estimates fall modestly, but supply and leverage constraint mean that the typical "late-cycle exuberance" that so often appears in real estate markets is largely absent. More broadly, real assets remain well supported by a combination of the strong and persistent bid for such assets and the relatively high illiquidity premiums that are keeping long-term return estimates elevated.

FOREIGN EXCHANGE—Secular forces starting to prevail

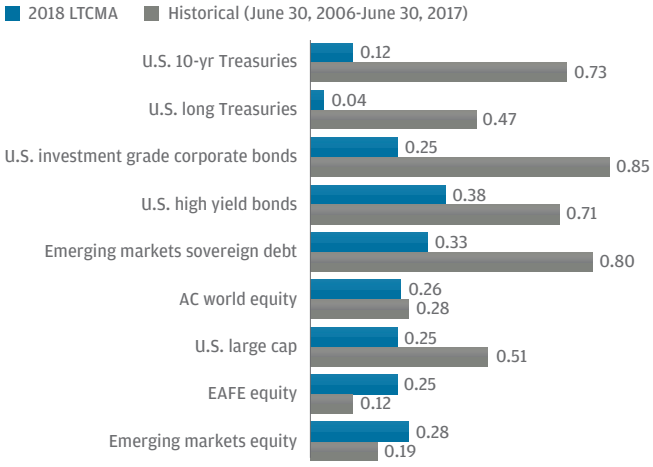
The secular forces that we expect to nudge the U.S. dollar down over the longer term began to assert themselves in 2017, when they started to dominate the cyclical monetary policy that had driven the dollar's appreciation in 2014-15. Despite the sharp decline in USD in 2017, the currency remains meaningfully above our long-term estimates of fair value, which we see as 1.34 for EUR/USD and 93 for USD/JPY. Now that the dollar has retreated from its recent highs,we would expect the pace of further declines to moderate somewhat. But the impact of currency translation on asset returns in globally diversified portfolios will continue to be an important consideration for many investors.

IMPLICATIONS FOR INVESTORS

Risk-adjusted returns for fixed income assets now stand at the low end of their typical ranges (**Exhibit 6**). As last year, equity Sharpe ratios are substantially better than those for government bonds, but in absolute terms U.S. large cap Sharpe ratios are below the average of the last 10 years, while EAFE and EM equity Sharpe ratios are above their 10-year average. Subdued forecasts for equilibrium growth play some part in this. But it is also a function of how late we are in the economic cycle, and of the valuation headwinds that most regions face. Further cyclical momentum could certainly front-load returns from equities—much as it has in 2017—but long-term investors should be clear that this is a cyclical, not a secular, trade. Overcoming the pressure on long-term potential returns from full valuations and high margins will require more active positioning around long-term themes (e.g., technology, Chinese financial liberalization, etc.), greater use of alternatives, an element of timing—or, most likely, all three. Despite these challenges for investors, the incremental deterioration in risk-adjusted returns from 2017 is quite marginal, and opportunities to enhance returns and generate alpha persist.

Forecast Sharpe ratios for bonds are well below their long-term average

EXHIBIT 6: RISK-ADJUSTED RETURN ASSUMPTIONS VS. HISTORICAL AVERAGES ACROSS ASSET CLASSES (SHARPE RATIOS)



Source: J.P. Morgan Asset Management Multi-Asset Solutions; estimates as of September 30, 2017.

Last year we argued that, after years of borrowing returns from the future, the future had finally arrived. This remains our view today. As we look forward, cyclical factors loom large, even for long-term investors, but the secular trends of lower growth and lower equilibrium interest rates must also be considered. Lower equilibrium interest rates and the glacial pace of normalization put secular constraints on government bond returns that will likely transcend this cycle. Even if trend growth surprises positively and equilibrium rates rise, they will force losses on government bondholders as yields adjust from cyclically depressed levels. he other side of this is that lower interest rates, all else equal, exert upward pressure on equity risk premia and valuations, which in turn may increase the lower bound for equity multiples over the full business cycle.

The asset market impact of the structural themes we explore in this paper is likely to be both complex and nuanced. Aging populations are an impediment to growth but may equally start to reverse savings gluts. Technological innovation could meaningfully boost trend growth but is likely to be disinflationary at the margin. On balance, we expect modest baseline economic growth with some upside risk from productivity gains, but generally subdued inflation. This condition should not necessitate overtly tight policy, reinforcing the secular anchor of low equilibrium rates. For investors of all types, recognizing this long-term trend will be essential in calibrating how today's cyclical environment will normalize and how to construct robust and versatile portfolios.

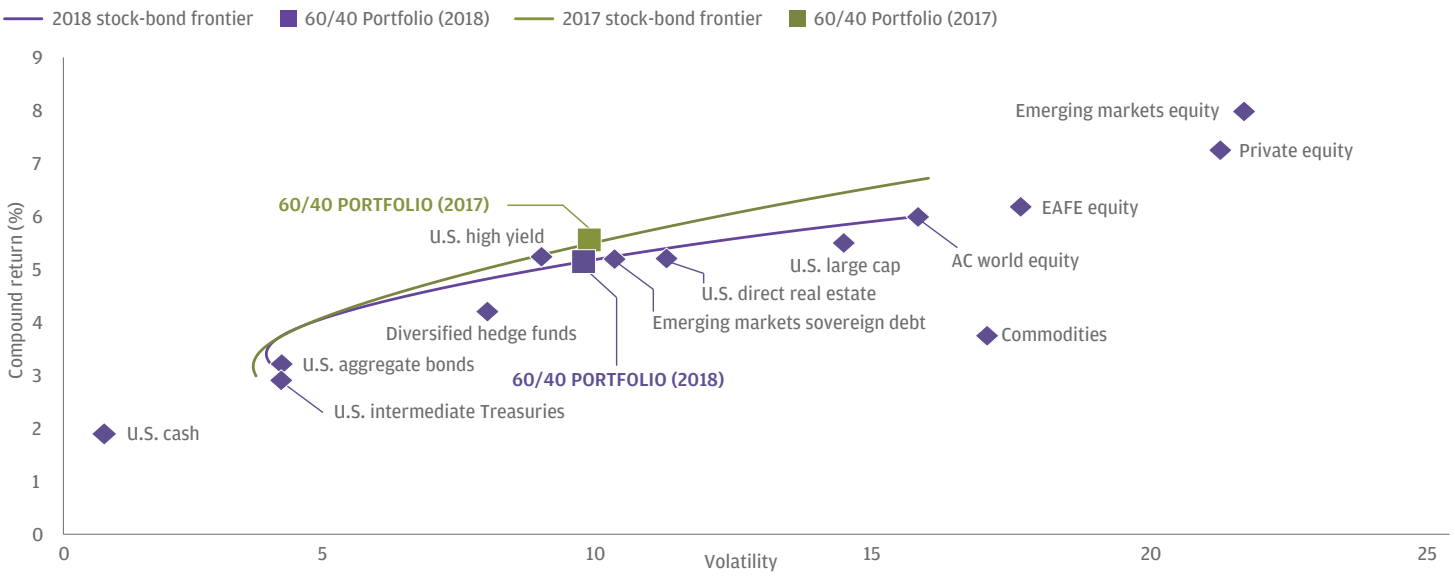
This year, our expected return for a U.S. dollar-based 60/40 portfolio is slightly lower at 5.25%, down from 5.50% last year, and the stock-bond frontier has rotated clockwise (**Exhibit 7**). This is a clear manifestation of the cyclical and secular considerations that investors face: Modest baseline growth continues to limit long-term return expectations for static balanced portfolios, while the late-cycle conditions of elevated equity valuations and gradually rising interest rates flatten the stock-bond frontier. The challenge for investors is that returns for a simple, static 60/40 portfolio are unlikely to turn meaningfully higher until this cycle ends—and that means riding out an inevitable period of disruption.

But opportunity lies in the clustering of many asset classes close to, and even above, the stock-bond frontier, which implies ample scope for diversification and enhancing returns.[5] Beyond this current cycle, however, there is reason for cautious optimism, as the persistent pattern of declining long-term trend growth estimates might be nearing an end. Indeed, the outlook this year for long-term investors might well be somewhat brighter than the dip in return estimates may imply.

[5] We use a simple, two-asset stock-bond frontier; addition of further assets—particularly uncorrelated ones—will typically improve the efficiency of the resulting portfolio.

Compared with last year, 60/40 returns are a little lower, and the late stage of the current cycle is rotating the stock-bond frontier in a clockwise direction; although returns are subdued, the clustering of many assets close to the frontier implies ample opportunity for diversification

EXHIBIT 7: USD STOCK-BOND FRONTIERS AND 60/40 PORTFOLIOS BASED ON 2018 VS. 2017 LTCMAS FOR RISK AND RETURN (%)



Source: J.P. Morgan Asset Management; estimates as of September 30, 2016 and September 30, 2017.

Mostly stable, mostly moderate

Michael Hood, *Global Strategist, Multi-Asset Solutions*
Dr. David Kelly, CFA, *Chief Global Strategist, Head of Global Market Insights Strategy*

IN BRIEF

- This year's edition of our Long-Term Capital Market Assumptions (LTCMAs) contains few significant changes to projected real GDP growth and inflation in major economies. The main themes from recent years' forecasts remain in place.
- Real growth will run at a modest pace by long-term historical standards, with aging populations representing the most important source of slowing relative to the past.
- The U.S. will continue to record somewhat stronger growth than the euro area, UK and Japan.
- As a group, emerging market (EM) economies will grow faster than their developed market (DM) counterparts. India will lead the way in emerging market growth as China gradually slows.
- Middle-of-the-road inflation, in general fairly close to central bank targets, will prevail in the long run.

MILDLY STRONGER GROWTH IN EUROPE, SLIGHTLY WEAKENED OUTLOOK FOR CHINA

The 2018 edition of our Long-Term Capital Market Assumptions makes few significant changes to our projections for real GDP growth and inflation in major economies. We have nudged up our euro area real GDP projection to 1.50% (from 1.25% in our 2017 edition), while trimming our Australia and Switzerland forecasts by a quarter point each, to 2.00% and 1.25%, respectively. The upward revision to the euro area GDP number reflects greater optimism about trend growth and today's starting point. We think that structural reforms pursued in the euro area in recent years will likely boost the underlying growth trend through two channels: labor force participation and total factor productivity (TFP). Meanwhile, the region's currently elevated unemployment rate should allow it to expand at an above-potential clip in coming years. On balance, our DM real GDP aggregate holds steady at 1.50%. Along with an unchanged set of inflation projections (at 1.75% for the group as a whole), our DM nominal growth assumption remains at 3.25% (**Exhibit 1**).

We have made several modifications to our emerging market GDP and inflation assumptions. Most important, we are lowering our expectations for Chinese nominal growth by half of a percentage point (ppt) from our projection in 2017: Half of the decrease reflects a slight drop in real growth (to 5.00%, vs. 5.25% last year), and half comes from inflation (now 2.75%, vs. 3.00% before). The Chinese economy has been decelerating gradually, a trend we expect to continue, so that rolling our projections forward by a year brings down the full-period average. We have raised our GDP forecasts for Brazil (up 0.25ppt to 3.00%) and South Africa (up 0.50ppt to 2.75%) while cutting our figures for Russia (down 0.75ppt) and Taiwan (down 0.25ppt). Some of the movement in these EM projections reflects an improved understanding of human capital dynamics, which look set to help Brazil and South Africa over the long run while undermining Russian growth. A number of the EM inflation projections have moved by a quarter point, notably an upward shift in South Africa and Turkey, where we observe less diligence than previously in pursuit of central bank targets. Our projections for emerging markets in aggregate are 4.50% real GDP growth, the same as last year, and 3.50% inflation, down 0.25ppt, pointing to 8.00% nominal GDP.

GDP GROWTH: DEMOGRAPHIC AND PRODUCTIVITY DRIVERS

To construct our real GDP forecasts, we estimate a long-term trend or potential rate of growth for each economy, focusing on supply-side drivers. Potential growth thus stems from (1) the labor input, itself divided into employment, average hours worked and human capital; (2) capital stock expansion, reflecting investment spending; and (3) total factor productivity, a residual that in developed

Our 2018 assumptions anticipate slow real GDP growth globally; neither global growth assumptions nor the EM-DM growth gap has changed from last year

EXHIBIT 1: MACROECONOMIC ASSUMPTIONS (%)

	2018 assumptions		2017 assumptions		Change (percentage points)	
	Real GDP	Core inflation	Real GDP	Core inflation	Real GDP	Core inflation
DEVELOPED MARKETS	**1.50**	**1.75**	**1.50**	**1.75**	**0.00**	**0.00**
U.S.	1.75	2.25	1.75	2.25	0.00	0.00
Eurozone	1.50	1.50	1.25	1.50	0.25	0.00
UK	1.25	2.00	1.25	2.00	0.00	0.00
Japan	0.50	1.00	0.50	1.00	0.00	0.00
Australia	2.00	2.25	2.25	2.25	-0.25	0.00
Canada	1.50	1.75	1.50	1.75	0.00	0.00
Sweden	1.75	1.75	1.75	1.25	0.00	0.50
Switzerland	1.25	0.75	1.50	0.75	-0.25	0.00
EMERGING MARKETS*	**4.50**	**3.50**	**4.50**	**3.75**	**0.00**	**-0.25**
Brazil	3.00	5.00	2.75	5.25	0.25	-0.25
China	5.00	2.75	5.25	3.00	-0.25	-0.25
India	7.00	5.00	7.00	5.00	0.00	0.00
Russia	1.50	5.50	2.25	5.50	-0.75	0.00
GLOBAL	**2.50**	**2.50**	**2.50**	**2.50**	**0.00**	**0.00**

Source: J.P. Morgan Asset Management; estimates as of September 30, 2017.

* Emerging markets aggregate derived from 9-country sample.

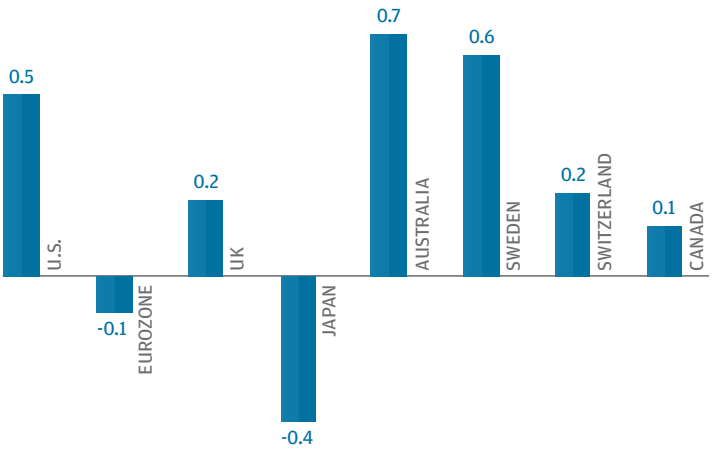
economies primarily owes to technological change. We forecast each of the subcomponents separately, combining them by using the shares of each country's output that come from labor and capital. This approach allows for more granularity than in our previous work, which relied on broader concepts of labor force and labor productivity growth.

DEVELOPED MARKET GROWTH: U.S. LEADS; EURO AREA IN RELATIVELY FAVORABLE POSITION

Demographic forces, as reflected in the employment part of the labor input, explain much of the expected shortfall in economic growth compared with history. Differences in this factor also generate the lion's share of dispersion among DM economies (**Exhibit 2**). We work off year-by-year population projections made by the U.S. Census Bureau, focusing on the 15-64 and 65-plus age cohorts. We then run several simulations for each country, with varying paths for labor force participation in these two age groups. This exercise gives us a plausible range for labor force growth, and we generally settle in the middle of this band in making our forecast. Projections for average hours worked and human capital improvement vary only marginally across DM economies, although the euro area gets a small fillip relative to others in human capital, thanks to ongoing gains in educational attainment in Southern European countries. For developed economies as a whole, though, human capital represents another source of slowdown compared with the past, as the multi-decade trend toward longer schooling has slowed significantly in recent years.

Demographic factors account for much of the dispersion among expected GDP growth rates in DM economies

EXHIBIT 2: PROJECTED EMPLOYMENT GROWTH (%, ANNUAL AVERAGE)



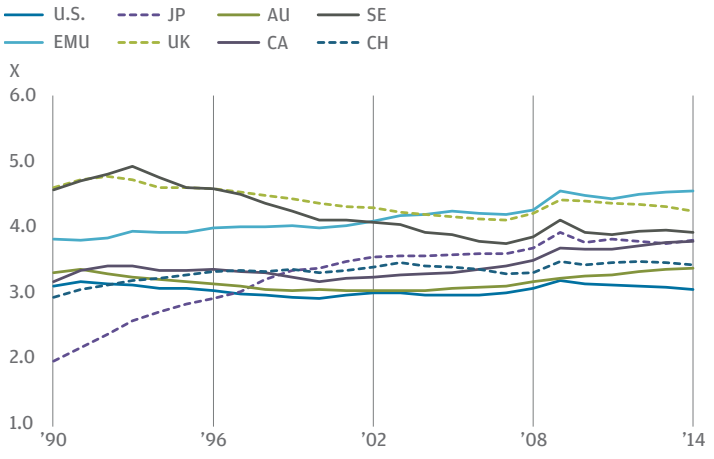
Source: U.S. Census Bureau, J.P. Morgan Asset Management; data and forecasts as of September 30, 2017.

We assume that total factor productivity contributes 0.6ppt per year to U.S. real GDP growth during our forecast horizon, primarily representing the advancement in the global technology frontier. This pace would represent a small pickup from the recent trend—with the world seemingly having gone through a fallow period for technological change in the past decade—but would lie noticeably below the long-term historical average. TFP forecasts for other DM economies, which also generally operate at the technology frontier, cluster tightly around the U.S. figure, with Switzerland and Canada—countries that have relatively sluggish TFP histories and face significant resource reallocation needs in the coming years—a bit below.

Standard growth theory creates an expectation that economies will expand in a balanced way, with the capital stock rising more or less in line with the other inputs (labor and TFP). In practice, this prediction has broadly held true, as the capital-to-GDP ratio has essentially held steady over time in DM economies (**Exhibit 3**). In our assumptions, this balance persists. We project DM capital stocks to grow at a similar pace to the combination of the labor input and TFP.

Growth in most economies has been balanced over time, with the capital stock rising in line with other inputs

EXHIBIT 3: CAPITAL STOCK AS A RATIO TO GDP (X)



Source: Penn World Table, J.P. Morgan Asset Management; data as of September 30, 2017.

These inputs lead us to an expected rank order for the G4 economies, with the U.S. leading the way, followed by the euro area, UK and Japan. As mentioned, some of our relative optimism about the euro area stems from the economy's cyclical position, which looks more favorable than the others, along with a projection that total factor productivity growth will match that of the U.S., having generally lagged by a small amount in the past. We continue to assume that the currency union will survive in something similar to its present form throughout our forecast horizon, and we note that political threats to the euro area appear to have receded since last year's edition. Long-term prospects for the UK remain cloudy as the country negotiates its exit from the European Union. Our GDP projection for the UK, which already embeds slower TFP gains than in other major DM economies, has not changed this year, but we believe the risks to the outlook are tilted to the downside, particularly if immigration policy ultimately compromises one of the UK's advantages, which is a relatively favorable demographic situation.

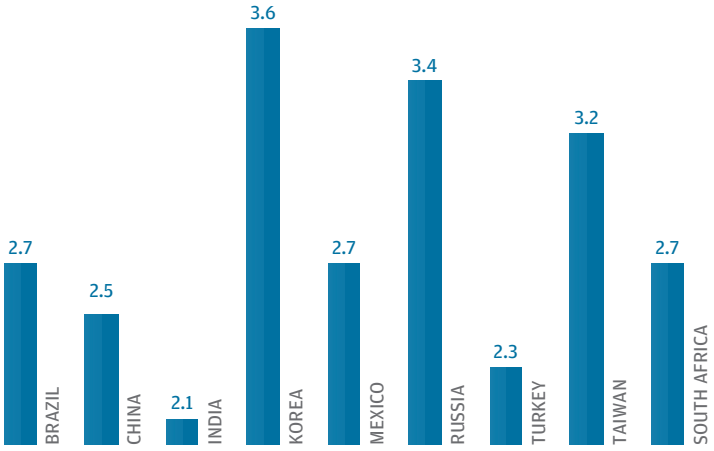
EMERGING MARKET GROWTH: EXCEEDING THE DM PACE, THOUGH NOT EVERYWHERE

We build our forecasts for EM economies through the same process. The faster rate of expected growth for the EM group as a whole owes primarily to three factors. First, while facing their own demographic challenges, EM countries are still experiencing faster increases in population, and by extension labor forces, than their DM counterparts. That said, the outlook on this front varies widely across EM economies, with some—notably Russia and Taiwan—likely to experience labor force shrinkage in coming years. The China story is more nuanced. While its prime-age population will decrease over the next 15 years, China will likely benefit from ongoing urbanization, given that it remains relatively rural for its stage of development, even after heavy city-bound migration in recent decades. Second, in comparison with DM economies, EM countries should experience greater improvement in the quality of their labor forces as school attainment continues to rise for most of the group (**Exhibit 4**). Third, TFP growth will likely continue to exceed the DM pace in some, though not all, EM economies, especially in the manufacturing- and tech-oriented EM Asian economies with proven track records of convergence toward the global frontier.

Our EM forecasts embed a roughly inverse relationship between current per capita income and expected future growth. India, the poorest country in our sample, leads the pack; we project strong gains in the labor force, human capital, TFP and (by extension) capital stock. China comes in second on our list.

The starting level of human capital varies widely across EM economies and should provide a relative boost to previous laggards as educational attainment rises

EXHIBIT 4: ESTIMATED HUMAN CAPITAL LEVELS*



Source: Penn World Table, J.P. Morgan Asset Management; data as of September 30, 2017.

* Estimated human capital levels are as measured by the PWT human capital index, a measure of human capital per person based on average years of schooling and assumed rate of return to education.

Despite China's impressive advance over the past 20 years, its per capita income level remains below the EM average. As mentioned, we believe ongoing urbanization will continue to boost the country's labor force, and China has generated fairly steady TFP gains over time, though the latter has slowed recently. More uncertainty surrounds the China forecast than some others, however, for two reasons. First, China's rapid development after 1990 depended heavily on very strong investment spending, and its capital stock rose rapidly relative to GDP, in contrast to the global norm. With the capital stock now fairly elevated, we expect more balanced growth from China in the future, but the country's ability to find a new economic model remains far from assured. Second, a steep increase in leverage has accompanied China's development, leaving the country vulnerable to a financial setback of some sort in coming years, though the timing of such an event is essentially impossible to predict. We are comfortable projecting that over the next 15 years China will grow significantly more slowly than during the past 15 but faster than the EM average, while recognizing a wide uncertainty band around our point forecast. At the other end of the spectrum, Korea and Taiwan, which have nearly reached DM economy status in per capita income terms, will likely grow only marginally faster than developed market economies. We see Russia, with its uniquely poor demographic outlook and commodity-dependent economy—unlikely to attract any great burst of capital investment absent another surge in price of oil—bringing up the rear among EM countries.

INFLATION: RANGE-BOUND AND CLOSE TO TARGETS

We use central bank targets as the starting point for our inflation forecasts. At the same time, we take into account our views about policymakers' commitment to those goals, as well as historical track records and any idiosyncratic forces that might affect a country's inflation rate over the long run (such as the likelihood of large and persistent currency moves). Several beliefs about inflation underlie our projections. First, our reading of history suggests that monetary policy works: When central banks pursue clear inflation targets using all available tools, they generally come close to their aims. Second, barring extraordinary circumstances—such as a central bank losing control over its own balance sheet—inflation tends to run in fairly narrow channels. The global experience since the financial crisis provides instruction in this respect. Despite very large and sustained output gaps, no major economy sank into persistent deflation in recent years. On the other hand, no DM country saw inflation skyrocket, even as central banks have pursued extraordinary accommodative policy stances for an extended period of time. Third, again in line with historical experience, we see no long-run trade-off between growth and inflation. In other words, we do not expect changes to individual countries' GDP and consumer price index (CPI) forecasts to be correlated.

DEVELOPED MARKET INFLATION FORECASTS: UNCHANGED FROM LAST YEAR

Given those views, and absent any major surprises in the inflation environment since last year's LTCMAs, our DM inflation forecasts have not changed this year. As in the past, we project 2.25% CPI inflation in the U.S., consistent with the Federal Reserve meeting its 2% target for the index it follows, the consumption spending deflator (for which the inflation rate tends to run a bit below the CPI). The asymmetric nature of the European Central Bank's 2% inflation target, and its historically hawkish bias, leave our euro area inflation projection at 1.75%. Japan's ongoing efforts to boost inflation from its currently low level put our forecast at 1.00% for the 15-year period, with an expectation of a 1.50% to 1.75% inflation rate at the end of our horizon.

EMERGING MARKET INFLATION: WIDE DISPERSION, THOUGH TURMOIL UNLIKELY

For EM economies, we follow the same approach, while bearing in mind several key differences from the DM atmosphere: (1) in some cases, vaguer or non-existent inflation targets; (2) central banks that may be less formally independent or more subject to political influence; (3) shorter track records of success; and (4) inflation indices that place greater weight on goods prices—which, though their inflation rates tilt lower than services prices, are also more prone to buffeting by the exchange rate swings prevalent in emerging markets. For these reasons, our EM inflation forecasts generally lie above these countries' central bank targets. That said, we do not expect a return to the instability that characterized many EM economies before the 1990s. For the countries in our sample, institutional improvements and voter-supported commitments to fairly low inflation make a recurrence of such turmoil unlikely.

As is the case with our emerging market GDP projections, our EM inflation projections show greater dispersion than those for DM countries. At the low end of the spectrum, we forecast 1.25% for Taiwan, which lacks a formal inflation target but has recorded quite low inflation during the past decade. By contrast, we pencil in 7.00% for Turkey, which has averaged slightly over 8% in the past 10 years. Although the Turkish central bank maintains an inflation target (currently 5%), it has not shown any great willingness to sacrifice growth in the short run to hit its goal, and we view monetary policymakers in Turkey as subject to significant political pressure. The other EM economies range between these two. We forecast 2.75% for China, similar to its 10-year average, but acknowledge considerable uncertainty around that estimate, with the risk distribution tilted toward the high side. With elevated leverage in its economy, China could conceivably require a period of somewhat higher inflation to make its debt burdens sustainable, and its move to a more services-oriented economy also will likely put some upward pressure on overall inflation, given slower productivity improvement in that sector. Chinese inflation has averaged a modest 2.0% over the past five years, however, so our forecast already points to a pickup from recent trends.

Thematic articles

TECHNOLOGY, PRODUCTIVITY AND THE LABOR FORCE

The impact of technology on long-term potential economic growth

John Bilton, CFA, *Head of Global Multi-Asset Strategy, Multi-Asset Solutions*
Shrenick Shah, *Portfolio Manager, Multi-Asset Solutions*
Patrik Schöwitz, CFA, *Global Strategist, Multi-Asset Solutions*
Michael Albrecht, CFA, *Global Strategist, Multi-Asset Solutions*
Brian Bovino, *Associate, Multi-Asset Solutions*

IN BRIEF

- Technological change is advancing with unprecedented speed, scope and scale—and with potentially far-reaching effects across economies and societies. Amid explosive growth in processing power and machine learning, a world where **artificial intelligence** (AI) eventually rivals human intelligence can no longer be dismissed as science fiction, with profound implications for economic growth and the labor force.
- Technology will affect economic growth rates and capital market returns in ways that are difficult to foresee. **Workforce automation** and AI have the potential to deliver significant overall productivity gains, and some nations facing growth challenges from aging populations could see an additional boost to trend growth rates. This suggests a possible increase to our current Long-Term Capital Market Assumptions (LTCMA) estimate of trend GDP growth in developed economies of 1% to 1.5%, while narrowing the growth spread among them.
- However, the latent power of automation has also raised fears of substantial job losses. Historically, fears of technological unemployment have not materialized, but, given the nature of the current wave of innovation, we cannot take historical patterns entirely for granted. If displaced workers are not efficiently re-employed, it could weigh on consumption and economic growth. Therefore, the above numbers represent a reasonable upper bound to potential growth forecasts *provided displaced labor is rapidly reabsorbed*.
- Recent backlashes against **globalization** point to the social and political strains that must be addressed to fully harness the benefits of technology. We envision a changing role for governments in helping workers and the broader economy adapt to technological change. Protecting the purchasing power of consumers will be critical.
- We identify five areas where we believe the early effects of technological change on the world economy are investible today: cloud computing, the Internet of Things, artificial intelligence, robotics and blockchain technology.

INTRODUCTION

Amara's law states that "we tend to overestimate the effect of technology in the short run and underestimate the effect in the long run."[1] Over the last few years, the media have been saturated with articles, papers, books and videos exploring how technology will change our lives. Some scenarios describe a fundamental transformation of society, the workforce and, indeed, the world order that would rival even the most fanciful science fiction.

Among many groundbreaking technologies on the horizon,[2] we focus here on automation and artificial intelligence. Exponential growth in these technologies will profoundly change economies and societies, and in ways we have not yet imagined. We expect the impact of these changes to accrue gradually at first and that Amara's law will be proven once more. Nevertheless, we believe that early effects of technology on economic growth, labor, policy and trade will begin to be felt over our 10- to 15-year investment horizon and that the early implications of those effects should influence investment choices now.

In the following pages, we examine how technological change—particularly automation and AI—might affect the way economies grow. We structure our analysis as follows:

- We first ask "Why now?" What is it about the nature of prevailing technological advances and the shape of today's global economy that pose unique challenges? Specifically, we look at how the current situation may differ from previous technological revolutions in its speed, scope and scale.
- We then explore how technology may affect growth in productivity and, ultimately, real GDP.
- We address the challenges to the labor force, consumption and government policy that will arise from automation and AI.
- We assess the implications of technological change for our LTCMAs.
- In a separate section, we explore current investment opportunities related to automation and AI.

The current wave of technological change, we conclude, is unlike any that has come before. Its unprecedented speed, scope and scale will profoundly, and simultaneously, impact many sectors of the economy. In the industrial revolutions of the past 200 years, the economy and labor force adapted positively to disruptive technology. But we cannot assume that today's (and tomorrow's) workers displaced by technology will be rapidly or easily redeployed in new functions. Although technology could boost productivity significantly, it is unclear whether a modern economy that is rapidly adopting automation and AI can deliver rising wages and rising productivity simultaneously. This creates complications in estimating the potential boost to trend GDP and in harnessing the positive—and mitigating the negative—effects across economies and societies. While we are probably a long way from a world in which artificial intelligence rivals human intelligence, we expect today's technological revolution to spark far-reaching economic, social and geopolitical changes—perhaps eventually redefining the role of human labor in the workforce.

WHY NOW?

Any analysis of the potentially disruptive impact of technology quickly runs into the question "Why now?" There are many who—quite rightly—point out that the economy and labor force proved remarkably good at adapting to disruptive technology over the last 200 years. The first two industrial revolutions took the world from an era reliant on human and animal power to execute physical tasks into an era in which machines powered by natural resources provided the physical power and humans increasingly added value with their minds. New industries and functions arose to demand labor, such that productivity and real wages grew in tandem. However, the disruptive potential of today's automation and AI is, in our view, something altogether new. Put simply, technology is now automating brains as well as brawn.

The speed of this technological progress is well characterized by Moore's law,[3] whose spirit is alive and well today in the continued exponential growth in processing speed, data storage capacity and connectivity relative to cost. For example, a 2017 smartphone has more processing power than Cray-2, the world's most advanced supercomputer in 1985—a time when just two of the popular contemporary video game consoles were together more powerful than the computers that put man on the moon in 1969. Moreover, the capacity for data storage has reached a critical level and continues to grow exponentially, even as human education and skills development remain linear (**Exhibits 1A** and **1B**). In our view, data is to the information economy rather like oil is to the industrial economy—thus, the cheap, widespread and instantaneous availability of data, and the power to process it, are critical enablers of the growth in automation and AI.

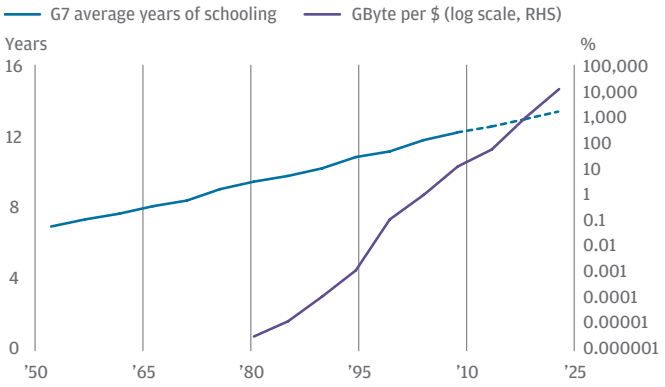
[1] Roy Amara, scientist and futurist (1925–2007).

[2] To name but a few others: biotechnology, nanotechnology, alternative energy.

[3] Moore's law is the empirical observation that the number of transistors in an integrated circuit—closely related to computational performance—has for several decades doubled approximately every two years.

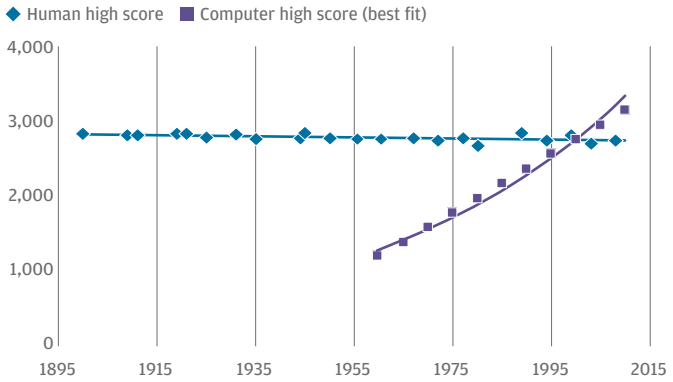
Human development and education follow a linear progression, while both data availability (proxied by storage costs) and the processing capabilities of machines (proxied by leading computer chess scores) are increasing exponentially

EXHIBIT 1A: G7 AVERAGE YEARS OF SCHOOLING VS. DATA STORAGE COSTS (GIGABYTE PER $1.00)



Source: Barro and Lee (2013), "A new data set of educational attainment in the world, 1950-2010," *Journal of Development Economics*; statisticbrain.com. Data to December 2016; trends extrapolated for forward estimates.

EXHIBIT 1B: AVERAGE SCORES, HUMAN CHESS GRANDMASTERS VS. COMPUTER CHESS PROGRAMS



Source: Chessmetrics, L. Muehlhauser, Wikipedia.

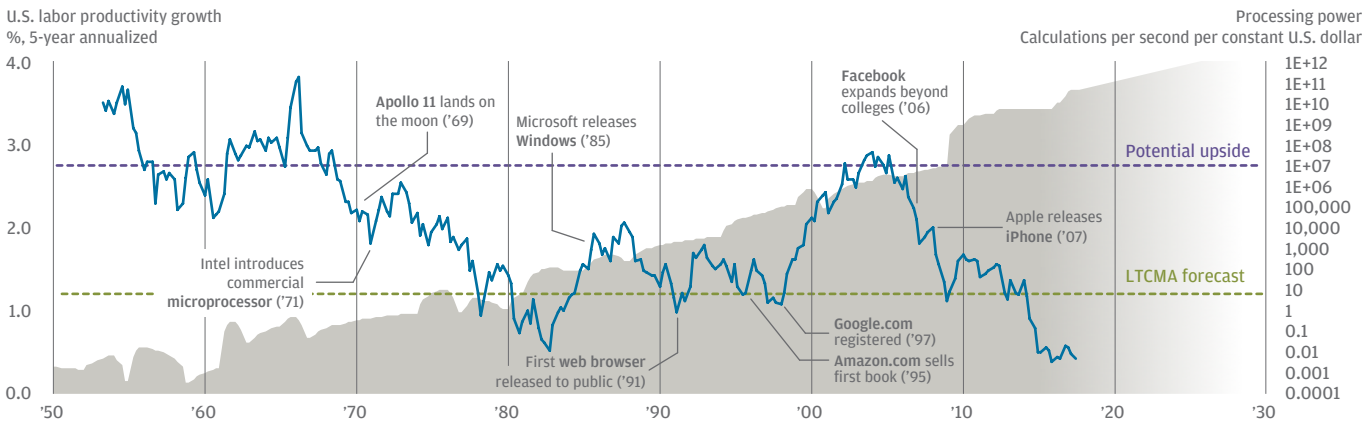
Despite promising advances across a range of new technologies, productivity growth seems to have stalled in the aftermath of the financial crisis, leading many experts to reduce their optimism for future productivity growth and thus GDP growth—a topic we explored in the 2017 edition of our LTCMAs. We agree that productivity growth is not guaranteed by some "magic force," but disagree with the notion that the heydays of productivity growth are behind us. That view is likely to be overly pessimistic: Historically, productivity growth has come in fits and starts, often but not always coinciding with the widespread adoption of specific previous breakthroughs—some of which have greater impacts on productivity than others (Exhibit 2).

In many cases, the impact of new technology on productivity might have been foreseen in advance, with technologies in the pipeline for some time before they had a measurable effect. For instance, Ford's Model T was introduced in 1908, but it would be about 20 more years before 50% of American households owned an automobile. The automobile, of course, had profound and measurable impacts on productivity.

By contrast, in the past decade many technological advances, from social media to the streaming of films and music, have resulted in large consumer benefits far exceeding the amounts paid, and their impact therefore has probably not been fully captured in GDP. In our view, the innovations in today's pipeline suggest meaningful

Throughout history, U.S. productivity growth has alternately surged and stalled, as the persistent and exponential growth in processing power has overlapped with both peaks and troughs in productivity—suggesting we should not extrapolate recent weakness in productivity data

EXHIBIT 2: U.S. LABOR PRODUCTIVITY GROWTH, 1950-PRESENT, AND SELECTED NOTABLE TECHNOLOGY DEVELOPMENTS



Source: Bureau of Labor Statistics, Goldman Sachs, Singularity.com; data as of August 2017.

opportunities to boost growth and GDP, as explored in the next section. Nevertheless, the potential upside from new technology brings with it concerns about labor displacement—an echo of fears raised at technological turning points throughout history. Previous technological advancements were absorbed to the benefit of capital owners and the labor force alike, but the speed, scale and scope of automation and AI create the unique policy challenge of optimizing both the level and spread of the economic gains.

ESTIMATING THE POTENTIAL UPSIDE FOR GROWTH

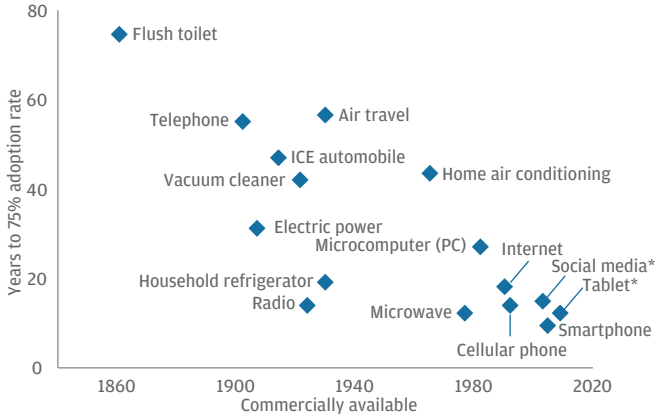
In the past, technological innovation transformed society and increased labor productivity in three key ways: **replacing** existing workers with machines and thus producing at least the same output with fewer workers (e.g., refrigeration vs. the iceman); **complementing** existing workers' jobs, boosting output per worker by automating some of their tasks (e.g., power tools); or **creating** entirely new, higher productivity industries (e.g., computer software engineering), offsetting the displacement of workers by machines or replacing altogether industries that had been made obsolete.

Many commentators focus on labor *replacement*, as it may be the most directly measurable impact of new technology—not to mention the subject of intense media attention and public debate. Driverless vehicles are a prominent example, offering a large potential upside to aggregate economic output from redeploying the nearly 5 million U.S. employees operating trucks, taxis and other ground transportation. If just half of these jobs were automated over the next 20 years and, critically, displaced workers were efficiently re-employed elsewhere at average productivity, the incremental boost to GDP from driverless car automation alone would be almost 0.1%. It is also plausible that transportation volumes would increase, given lower costs. Of course, the assumption that labor is redeployed is central to the positive case—and some skeptics question whether this is possible when other comparably skilled jobs are also being automated. But we will ignore this for one moment and extend the *replacement* concept across the whole U.S. economy. If we assume the most extreme estimates of automation—such as Frey and Osborne's projection that 47% of jobs are computerized[4]—and make the exceedingly optimistic assumption that *all of these individuals are redeployed into the workforce at average productivity*, it would imply as much as a 3.5% per annum boost to GDP growth over 20 years. More moderate estimates—for example, studies from the McKinsey Global Institute and PwC—suggest GDP gains from automation of approximately 1% to 1.5%.[5]

These calculations apply primarily to *replacing* labor rather than *complementing* existing jobs or *creating* entirely new ones. Other technologies known to be in development—including advances in nanotechnology and bioengineering—could precipitate an entirely new wave of even greater productivity gains and potentially deeper disruption, including through these two channels. They may also create new opportunities for displaced labor, particularly as the pace of adoption of new technologies today is much faster than it has been historically (**Exhibit 3**).

The pace of adoption of recent technological innovations is speeding up compared with history, offering potential for new job functions to emerge

EXHIBIT 3: U.S. TECHNOLOGY, RATE OF ADOPTION (%)*



Source: Asymco, compiled from various sources with support of the Clayton Christensen Institute.

* Estimated from current adoption trends.

RELATIVE WINNERS AND LOSERS, AND GROWTH ACCOUNTING

We turn now to a discussion of our Long-Term Capital Market Assumptions. At the heart of our LTCMA process are 10- to 15-year real GDP forecasts for major economies, based on a growth accounting framework (discussed below) that estimates potential growth over long periods by focusing on the supply side of the economy—that is, productive potential. That potential is divided into two components: total hours worked and labor productivity. Labor productivity is further subdivided into capital, skills and a residual total factor productivity (TFP).[6] Technological progress drives GDP growth in developed economies most directly through TFP. In our LTCMAs, we assume that all developed market (DM) economies are operating at the "technological frontier," with the latest business practices and technology, such that TFP

[4] Carl Frey and Michael Osborne, University of Oxford, "The future of employment: How susceptible are jobs to computerisation?" (September 17, 2013).

[5] The McKinsey Global Institute estimates 0.8% to 1.4%; PwC sees a 14% boost to world GDP by 2030, approximately 1.5% per annum.

[6] This framework is analogous to the widely used Cobb-Douglas production function, which represents output given two or more inputs (e.g., capital, labor).

advances at roughly the same pace across all the DM economies. Emerging market (EM) economies, in contrast, are still catching up to the technological frontier and thus should experience faster TFP growth.

Automation: The great leveler?

In our growth accounting framework, the key challenge facing most developed markets is the decline in labor force growth due to aging and reduced birthrates. The most extreme example[7] is Japan, where population decline subtracts 0.25% per annum from our long-term growth estimate (visible in our example calculation in **Exhibit 4** as the product of 0.4% assumed shrinkage in the labor force and the 60% labor share in the economy).[8]

In contrast, labor force *growth* in the U.S. *adds* 0.3 percentage point (ppt) per annum (again, we assume a 60% labor share in the economy). Simply put, just over half—nearly 0.6%—of the 1.1% differential between our Japan and U.S. GDP growth assumptions is explained by the different trajectories of labor force growth. In aggregate, emerging markets are not expected to suffer labor force shrinkage over our LTCMA time horizon, but there are wide divergences among specific EM nations—for example, between India's fast-growing labor force and Russia's rapidly shrinking one.

Automation has the potential to narrow these growth differences, offsetting shrinkage in the labor force. Thinking of technology in this way—as a means of making up the drop in labor force from population aging—would imply narrowing the spread in growth rates across developed economies. In our calculation in Exhibit 4, we simply assume that increased automation *exactly* offsets the impact of any negative labor growth numbers,[9] thereby shrinking resulting GDP growth differences. Clearly, this is somewhat speculative, and in reality there is no reason this could not go further. And while this would certainly be a boon to the affected economies, it would also raise the capital share in the economy at the expense of labor, an issue we discuss in a later section, "Challenges for labor and consumers, and a changing role for government?"

Automation is a clear boost to total factor productivity growth, but the related labor impact must also be taken into account in estimating trend growth rates

EXHIBIT 4: POTENTIAL IMPACT OF TECHNOLOGY ON GDP GROWTH, TREND GROWTH ESTIMATES, NEXT 15 YEARS

	U.S.	EMU	JP	EM
Capital input	1.7	1.5	0.8	5.3
Assumed labor offset from automation		+0.2	+0.6	
Labor input	0.7	0.5	-0.3	1.8
Labor force growth	0.5	-0.1	-0.4	0.6
Hours	0.0	0.2	-0.1	0.0
Human capital (skills)	0.2	0.4	0.2	1.3
TFP	0.6	0.5	0.5	1.0
Assumed TFP boost from automation	1.0	1.0	1.0	1.0
Labor share	0.6	0.6	0.6	0.5
Capital share	0.4	0.4	0.4	0.5
Original trend	**1.7**	**1.4**	**0.6**	**4.4**
Trend with TFP and labor impact	**2.7**	**2.5**	**1.9**	**5.4**

Source: J.P. Morgan Asset Management.

Automation: The end of the cheap labor advantage for emerging markets?

What is the impact of automation on emerging economies? Here we note that globalization has substantially benefited emerging markets, as the outsourcing of manufacturing from developed markets has offered a means to accumulate productive capital and develop a skilled workforce. Relatively cheap EM labor has sparked and sustained much of that outsourcing, but if factory automation reduces its appeal by reducing developed economies' domestic production costs, current and future generations of EM economies might have to find new sources of economic growth. Additionally, emerging markets are also likely to receive relatively less of a productivity boost from automation, given that their still relatively lower labor costs diminish their incentive to automate.

Overall, then, at least over the LTCMA horizon, we think automation will lead to a leveling of growth differences within both EM and DM economies, but also perhaps a small narrowing of the EM vs. DM growth advantage.

[7] Europe is also challenged, but to a much smaller degree over our LTCMA time frame.

[8] The impact is also negative in the euro area, but much smaller.

[9] Therefore, this only affects Japan and the euro area in our example. Note that given the 60/40 labor-to-capital shares in the economy, the boost to capital growth required to offset a given labor shrinkage is 1.5x larger.

GROWTH ASSUMPTIONS

The more clear-cut impact of automation within our LTCMA growth accounting framework is to boost total factor productivity growth, analogous to faster technological progress. For simplicity's sake, in the numerical example in Exhibit 4 we represent this effect by just conservatively adding 1.0%, the bottom end of the range of most studies of the likely productivity impact from automation. While in this simple example everyone benefits by the same total amount from the boost to TFP, clearly a 1.0% gain will feel much more meaningful in an economy with 0.5% trend growth than in one with 2% trend growth. However, implementing new technologies—such as investing in robots on the production line—might also be expected to appear in capital deepening.[10] Further, to compete with automation, the human jobs of tomorrow will require increased education and thus skills deepening. Of these latter two factors, for simplicity in our numerical example we only include the impact from potential labor force replacement into faster capital growth.

The overall impact on growth from these two aspects is as a leveler of differences. Picking the two extreme ends of the DM spectrum, in our example the U.S. economy would go from growing almost three times as fast as Japan to growing slightly less than one-and-a-half times as fast. Similarly, the relative advantage of emerging markets over developed markets shrinks.

Many of the effects described above reflect the potential upside to trend growth and paint a picture of an upper bound to our growth projections if all goes smoothly. However, the timing and extent of any economic boost is difficult to predict, and while we're optimistic that at least some of these gains will be realized, we are also keen to find tangible investing opportunities today around this theme. In the accompanying box, "**Where is technology most investible today?**" we highlight five areas where we believe the early effects of technological change on the world economy are investible today.

WHERE IS TECHNOLOGY MOST INVESTIBLE TODAY?

In an investing process founded on fundamental research, we divide our analysis into key themes that focus on the dynamics we feel will be important drivers of asset prices over the medium term. Among those themes is the widespread adoption of existing and emerging technologies. We believe understanding how these key technologies impact industries and the economy may offer the greatest investment potential in the current environment:

- **Cloud computing** is offering ubiquitous, flexible and on-demand access to a shared pool of computing resources. While delivering substantial cost savings, cloud computing is also fueling a wave of start-ups ready to disrupt incumbent companies in the software industry.
- **The Internet of Things**—the connection of non-computer devices, such as sensors, control systems, white goods and cars to the internet—will increase connectedness among people, processes and physical things, generating new business models, such as usage-based pricing in the insurance, telecommunications and energy sectors, as well as improving inventory control.
- **Artificial intelligence** will enable machines to perform a wider range of tasks, from autonomous driving in commercial transportation to computer-assisted diagnosis in health care to robo-advising in the financial services sector.
- **Robotics** will result in widespread automation and lead to increased productivity and competitiveness. Industrial companies will "re-shore" their manufacturing base, while retailers will fully automate the store experience with self-checkout and drone deliveries.
- **Blockchain** technology could completely disintermediate the settlement and recordkeeping of transactions. Blockchain-enabled "smart contracts" will facilitate, verify and enforce the execution of contracts and reduce transaction costs.

[10] Increased capital per worker.

CHALLENGES FOR LABOR AND CONSUMERS, AND A CHANGING ROLE FOR GOVERNMENT?

Reskilling the labor supply

Our growth accounting framework described above estimates potential growth over long periods by focusing on the supply side of the economy—that is, its productive potential. Embedded in that framework is the implicit assumption that displaced labor is smoothly redeployed, generally maintaining something close to full employment. However, one significant worry surrounding near-term technological advancement is the reduction in the number of human jobs available in the economy. Such concerns date back at least as far as the first industrial revolution. From the automation of textile manufacturing in the 19th century[11] to the recent digitization of music and film,[12] new technology has sparked fears of job destruction—fears that have mainly proved unfounded.

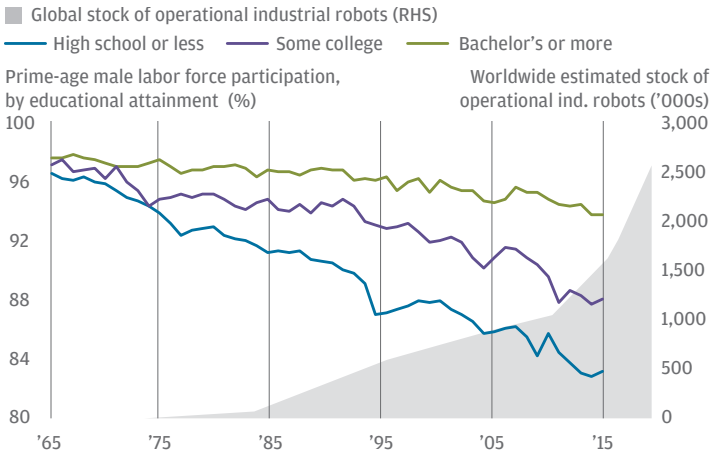
Our base case is that this historical pattern will hold—at least over our 10- to 15-year forecast horizon—and that the labor force will continue to adapt. But this outcome depends crucially on human skills keeping pace with technological advancement. Many past episodes of technological advancement were disruptive to specific industries or processes, in particular highly manual or labor-intensive activities. Reskilling or redeploying labor into other functions—or, indeed, new functions explicitly created with the new technology—generally prevented mass labor displacement and eventually boosted low skilled worker productivity.

However, the impact of the current wave of automation has so far been skills-biased. That is, it has enhanced the productivity of highly skilled workers while undercutting the prospects for low skilled workers. The functions at greatest risk are still likely to be routine physical jobs that can be fully automated. These collectively account for 13% of U.S. wages and 18% of time spent in all U.S. occupations[13]—affecting industries such as accommodation/food services and manufacturing. Going forward, the data computing and processing powers of emerging technologies will put many routine, non-physical jobs at risk, including white collar administrative functions that span industries. The jobs least vulnerable to technological disruption are likely to be non-physical and non-routine and generally include functions that require interpersonal skills and expertise—a core human element in many sales, communications, artistic, cultural, health care or management jobs.

All of the above only serves to emphasize the importance of skills deepening through education and retraining (**Exhibit 5**). In the past, this has allowed workers to benefit from technological innovation. Further, it has made it possible for economies and the labor force to flourish through successive episodes of disruptive technology, from Jethro Tull's[14] seed drill to the internet. The future needn't be dominated by machines or humans; in an optimal world, machine and human will productively coexist. Case in point: chess players and chess supercomputers. In *The Second Machine Age*, McAfee and Brynjolfsson note that although even chess grandmasters now have no realistic hope of beating the best chess supercomputers, an average chess player in combination with an average chess program can still prevail. Training displaced workers to function in combination with technology seems an obvious step in skills deepening. But, paradoxically, urging human workers to be more human might also enable them to keep their grip on functions that will probably remain beyond the scope of automation and AI—at least, in the intermediate term.

In the past, skills deepening through education and retraining allowed workers to benefit from technology, but widespread automation across many sectors at once creates a challenge to lower skilled workers that is already apparent in labor data

EXHIBIT 5: LABOR FORCE PARTICIPATION BY EDUCATIONAL ATTAINMENT VS. NUMBER OF INDUSTRIAL ROBOTS



Source: Bureau of Labor Statistics Current Population Survey; Council of Economic Advisers calculations as of June 2016; International Federation of Robotics as of August 2017.

[11] The Luddite rebellion of 1811-13 was driven by fears that new weaving machines would lead to mass unemployment of textile workers.

[12] CD sales fell from almost 800 million in 2000 to just 150 million in 2016 as music streaming took over from conventional album sales (gloriousnoise.com, Nielsen music via Billboard).

[13] McKinsey Global Institute, "A future that works: Automation, employment, and productivity."

[14] Viscount Jethro Tull developed the seed drill in 1701; it is credited as the first major automation in agriculture.

Government will play an important role in providing skills, training and education, but its track record in this area has been patchy, at least in part because it is difficult to keep educational content relevant in a fast-changing global economy. Given companies' role as the driving force of many of these changes, there is scope for innovation around tax structure and other incentives—such as the accounting treatment of corporate investment in human skills—to motivate companies to promote skills deepening and help optimize processes that combine human and machine labor.

Maintaining consumer demand

In prior sections of this paper, we have focused on technology's impact on the supply side of the economy. We now shift our perspective to a consideration of the economy's demand side.

One of the main threats from workforce automation is that a greater share of output, all else equal, is likely to accrue to a concentrated group of capital holders rather than more evenly to labor as wages. This risks increasing inequality and may weigh on consumer demand (**Exhibits 6A** and **6B**).[15] From an individual firm's perspective, it might be profitable to replace a human worker with a robot, but that robot will not need the shampoo, coffee, mortgage advice and myriad other consumer goods and services that its displaced human equivalent once did. Simply put, once we look at the economy in aggregate, we must acknowledge that one sector's displaced labor may be another sector's disenfranchised consumers.

The notion that economic demand, especially consumption, will keep pace with the potential levels of production that automation might allow cannot be taken for granted if those consumers have fewer jobs or lower salaries. For this reason, we believe that the policy debate will focus on two key areas: first, the new roles and responsibilities government may need to assume in maintaining the purchasing power of consumers, and by extension the demand side of the economy; and second, incentivizing education and reskilling the broad workforce to rapidly adapt to new technologies and fulfill new job functions. As we explain in the following section, proactive policies to prepare the labor force for emerging technologies are set to be important in maintaining social and political stability as automation and AI become more widespread.

This potential threat to demand is not the only contentious subject for governments, as it relates to a declining labor share of income. Even if the workforce doesn't face imminent decline—and with employment statistics[16] showing quite the opposite, this isn't an immediate risk—the level of real wages and the labor share of the economy are already displaying worrying trends. In particular, real wage stagnation, growing inequality and a diminished range of job opportunities appear to be stoking resentment in some quarters. The recent rise in populism across developed economies—the vote share for populist fringe political parties is at its highest point since the 1930s[17]—points to challenges that a disaffected labor force might create. Thus far, anger has been directed mostly at the forces of globalization, especially corporate outsourcing (often decried as "sending jobs overseas").

[15] The important subject of income inequality is beyond the scope of this paper.

[16] Prevailing labor data in the U.S. show the lowest level of unemployment since 2001 and robust demand for labor in most industries.

[17] Bridgewater Associates and Lombard Street Research.

The level of real wages and the labor share of the economy are already displaying worrying trends, particularly given that the lowest income brackets spend the greatest share of their income on consumption

EXHIBIT 6A: U.S. PRE-TAX INCOME BY INCOME QUINTILE (INDEX, 1990=100)

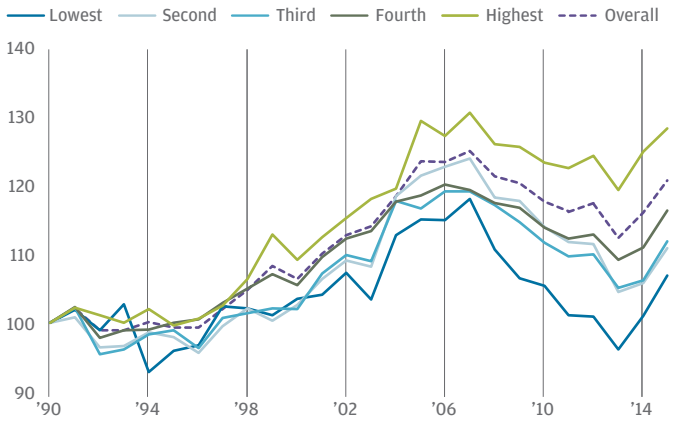
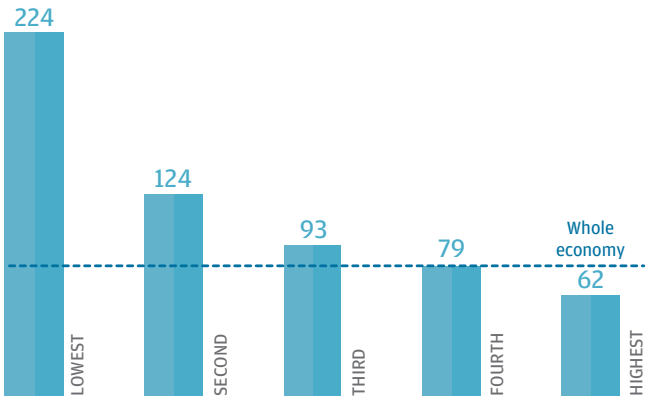


EXHIBIT 6B: MARGINAL PROPENSITY TO CONSUME BY INCOME QUINTILE*



Source: Bureau of Labor Statistics Consumer Expenditure Survey; data as of August 2017. * Marginal propensity to consume = average expenditure / pre-tax income.

Productivity gains have historically raised the demand for labor. But the scale and speed of today's technological changes mean we can't take a repeat of this outcome for granted

EXHIBIT 7: UPSIDE AND DOWNSIDE SCENARIOS OF THE ECONOMIC IMPACT OF AUTOMATION

	DEVELOPED MARKETS	EMERGING MARKETS
UPSIDE	• Automation fills labor force shortfalls, boosting supply side potential of developed markets with aging populations • Automation boosts total factor productivity growth • Net share of displaced workers is reskilled or subsidized for a time, maintaining purchasing power; wage gap and inequality trends subside • Faster absolute growth; spread of growth rates across developed markets narrows	• Automation boost to productivity growth muted relative to developed markets, given lower wages, but impactful in "last mover advantaged" scenarios • Displaced workers magnified given developed markets' reliance on emerging markets for low skilled tasks, but net share of displaced workers reskilled or subsidized to maintain purchasing power • Faster absolute growth, but emerging markets' growth advantage over developed markets may narrow
DOWNSIDE	• Failure of public policy to react means net share of displaced workers lose purchasing power • Wage gap and inequality trends magnify, depressing demand and risking populist backlash • Political uncertainty weighs on market confidence, leading to the growth boost from technology undershooting potential • Demand shortfall negates growth boost and creates structurally depressed interest and inflation rates	• Automation boost to productivity growth muted relative to developed markets, given lower wages. Displaced labor impact is magnified, given developed markets' reliance on emerging markets for low skilled tasks, but policy fails to react • Cross-regional wage gap and inequality trends magnify, depressing demand and risking political instability • Developed market service providers use improved global communications network to fill DM job needs with cheaper EM workers, depriving local EM markets of key higher skilled workers, while also suppressing DM wages and growth potential

Source: Richard Baldwin, *The Great Convergence: Information Technology and the New Globalization*, Harvard University Press, 2016; J.P. Morgan Asset Management.

We have yet to see a wave of 21st-century Luddism directed at automation, but should the object of populist ire shift that way, it will create a significant policy challenge of maximizing the positive impact of technology and minimizing its potentially disruptive effects.

The history of technological progress shows that productivity gains have typically raised the demand for labor, not destroyed it. However, the scale and speed of today's technological changes mean we can't take a repeat of this outcome for granted, and that policymakers have a role to play to encourage a continuation of this trend. Economies operate most efficiently when incentives are aligned and capital and labor are in equilibrium. Extreme policy in any direction will likely fail—a pure laissez-faire approach risks persistent wage pressure and swelling populism, while excessive redistribution risks capital flight. We expect governments to avoid both extremes and play a generally positive role, deploying a range of policies to help ensure that the economic benefits of automation and AI are widely spread.

The precise policy prescription will ultimately depend on how emerging technologies reshape the labor market. Where automation augments human labor, the policy imperatives are likely to be reskilling and retooling labor. But if automation substitutes for human labor, then the policy imperatives might shift more to redistribution in order to keep capital and labor in balance and, more crucially, to prevent a drop in demand.
In **Exhibit 7**, we present upside and downside scenarios of the economic impact of automation.

IMPLICATIONS FOR OUR LTCMA FORECASTS

Technological change—especially automation and AI—is likely to have profound effects on the global economy over the long term. We are often struck by how rapidly new technology is being developed and adopted. The early effects—at least over the 10- to 15-year forecast horizon of the LTCMAs—will probably accrue slowly. Nevertheless, the groundwork for more substantial changes to the economy will be laid. If automation and AI provide the kind of productivity boost suggested by a range of studies, including those from PwC and the McKinsey Global Institute, of 1%-1.5%, and technology also essentially offsets population decline in some developed nations, then annualized DM growth and equity returns could be more than a full percentage point higher than currently assumed. Moreover, the dispersion in equity return between developed and emerging markets has scope to narrow meaningfully.

The effect on equilibrium interest rates, however, may be more nuanced. While higher productivity and better growth might increase equilibrium yields, at the same time reduced labor bargaining power would likely keep inflation in check, which could reduce equilibrium yields. On balance, our baseline assumption is that these forces will roughly offset, so we expect equilibrium rates to be little changed. But even then, the 1%-1.5% boost to potential equity returns could meaningfully increase 60/40 returns as automation and AI become more widespread in the next 10 to 15 years.

This is, of course, a rosy view, but it does set a reasonable upper bound to the impact of technology on the economy and asset returns over our forecast horizon. By contrast, should automation and AI start to displace labor and reduce wage growth, it would potentially offset some of the boost from productivity—in turn, weighing on nominal growth forecasts and equilibrium interest rates, and bringing equity returns back down toward, or even below, our base case estimates.

Ultimately, modeling the impact of technology on productivity, the labor force, the economy and government policy is an issue of extraordinary complexity. Paradoxically, we might need to wait for a sufficiently advanced level of artificial intelligence to truly understand it.

How demographic change will affect savings, growth and interest rates

Benjamin Mandel, Ph.D., *Global Strategist, Multi-Asset Solutions*
Thushka Maharaj, DPhil, CFA, *Global Strategist, Multi-Asset Solutions*
Akira Kunikyo, *Client Portfolio Manager, Multi-Asset Solutions*
Diego Gilsanz, *Associate, Multi-Asset Solutions*
Nika Mosenthal, *Analyst, Multi-Asset Solutions*

IN BRIEF

- The world economy stands on the brink of a sizable, long-term decline in household savings, driven by a global aging process that is set to become faster and more synchronous in the coming decades. In this paper, we consider whether this shift will reverse the global savings "glut" of the early 2000s and apply upward pressure to interest rates.
- Our analysis of the U.S., Germany, Japan and China suggests that an aging-driven decline in savings of 2.6% of GDP will unfold over the next 30 years, translating into real interest rates that are 25 to 50 basis points (bps) higher than they would have otherwise been. In contrast, our Long-Term Capital Market Assumptions (LTCMAs) embed a population-aging effect (through slower labor force growth) that lowers trend growth and rates by ~50bps over the next 10 to 15 years.
- Which force prevails—whether demographics drive rates higher or lower—will depend on how other parts of the economy respond. For instance, whether investment demand wilts under lower trend growth or is buttressed by a transition to a more capital-intensive economy will be a key determinant.

GLOBAL AGING AND THE IMPACT OF DEMOGRAPHIC CHANGE

Deeply enmeshed in our capital market assumptions is the idea that demographic change influences long-term asset returns. Our interest rate projections are informed by an assumption about trend growth, itself a function of labor productivity and the demographic factors shaping the size of the workforce. A reasonable rule of thumb suggests that for each percentage point (ppt) change in trend growth, the real interest rate of the economy changes by about the same amount.[1]

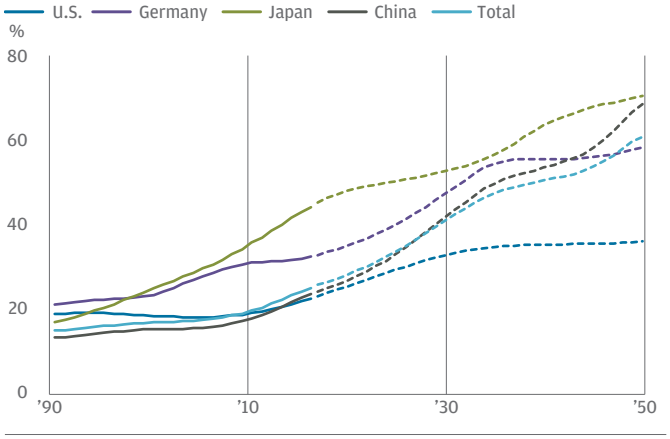
However, there are important exceptions. One exception arises when the supply of global savings changes so dramatically and quickly that it causes an imbalance in the world's desired (i.e., ex ante) level of savings vs. its desired level of investment—a so-called savings glut. Former Federal Reserve governor and chairman Ben Bernanke popularized this idea in the mid-2000s to explain why real interest rates were so low and why the U.S. was running such a large current account deficit (Bernanke 2005, 2007). He argued that the rapid buildup of savings in emerging market (EM) economies after a spate of financial crises in the 1990s, a sharp rise in the price of oil in the early 2000s and an upswing in household and corporate savings in China caused a shift outward in the global savings supply curve. (That is, it led to a greater supply of global savings at any level of the interest rate.) These increases in the supply of savings, in turn, could only be absorbed by global investment demand once interest rates moved lower and developed market (DM) economies became net borrowers. Importantly, real interest rates fell by more in the mid-2000s than did estimates of trend growth.

Today we stand on the brink of another massive swing in global savings, driven this time by the aging of the global population. Older cohorts transitioning out of the workforce and into retirement will save less as they draw down assets to finance consumption. The process is well underway in DM economies and will hasten in the coming years as U.S. retirement rates continue to rise and, eventually, as China's huge population ages and lowers its saving rate. In this paper, we explore the idea that this decline in savings will reverse the behavior that accompanied the savings glut of the early 2000s and will apply upward pressure to global real interest rates.

The first reason demographics matter in this context is that the global aging process will become faster and more synchronous in the coming decades. The dependency ratio—defined here as the ratio of the older to the younger population—has been rising for some time in Japan and Germany and is beginning to creep up in the U.S. and China.[2] According to United Nations population forecasts, the overall dependency ratio will rise by 10ppt per decade over the next 30 years (**Exhibit 1**).

The global aging process will become faster and more synchronous in the coming decades

EXHIBIT 1: DEPENDENCY RATIOS, 1990-2050



Source: United Nations, J.P. Morgan Asset Management Multi-Asset Solutions.

The second reason demographics matter is because the relationship between labor force growth and interest rates will arguably be more uncertain going forward. Demographic forces will likely push interest rates in opposite directions. Slower labor force growth, dragging on trend growth, will put downward pressure on rates; at the same time, lower saving rates in retirement will apply upward pressure on rates. More specifically: On the one hand, demographics will continue to exert downward pressure on trend growth of ~50bps over the next 10 to 15 years, reducing interest rates by about the same amount. On the other, we estimate that the corresponding reduction in savings—all else equal—will raise interest rates by 25bps to 50bps over the next 30 years. We are fairly confident that the demographic forces driving trend growth and rates lower will prove to be the more powerful influence in the long run. But we recognize that demographics can buffet interest rates along the way, subjecting our yield estimates to additional uncertainty.

[1] This rule is also rooted in economic theory. In neoclassical growth models, the saving rate that maximizes the level of consumption, known as the "golden rule" saving rate, implies that the risk-free rate in the economy equals its trend growth rate. See Solow, Robert M. (1956): "A contribution to the theory of economic growth." *The Quarterly Journal of Economics* 70:1, 65-94.

[2] The analysis herein will focus on these four economies, which together compose 26% of the global population, 50% of global GDP and 55% of global gross savings.

LIFE CYCLE SPENDING PATTERNS AND THE FUTURE OF GLOBAL SAVINGS

In defining a reversal of the savings glut, we first relate the large expected swing in the age composition of the population to aggregate savings. We focus on the household saving rate as the most direct channel and use a simple technique to parse the overall saving rate of each country into a saving rate for the younger cohort (under 65) and the older cohort (over 65).[3] The technique is based on the idea of consumption smoothing over the life cycle, since people entering retirement face a large decline in their income but use their accumulated savings to finance consumption.[4] Therefore, under our assumptions about average changes in income and consumption between working age and retirement, we are able to estimate the average saving rate in each cohort.[5] For example, the official gross household saving rate in the U.S. was 7% of disposable income in 2016, from which we estimate a 13% average saving rate for younger cohorts and a -48% average rate for older people.

Armed with age-specific saving rates and a forecast for dependency ratios, we estimate the effect of aging on average saving rates in the coming decades. Our estimates are shown in **Exhibit 2**, with each economy's saving rate falling roughly in line with the contour of the rise in its dependency ratio. In the U.S., where saving rates have been oscillating around 9% in recent decades, the retirement of the baby boom cohort (Americans born 1946-64) will subtract about 2ppt between now and 2030 before stabilizing. In Japan and Germany, where saving rates are generally higher and dependency ratios have already been on the rise, the swing will be of similar magnitude between now and 2030. But while U.S. saving rates are

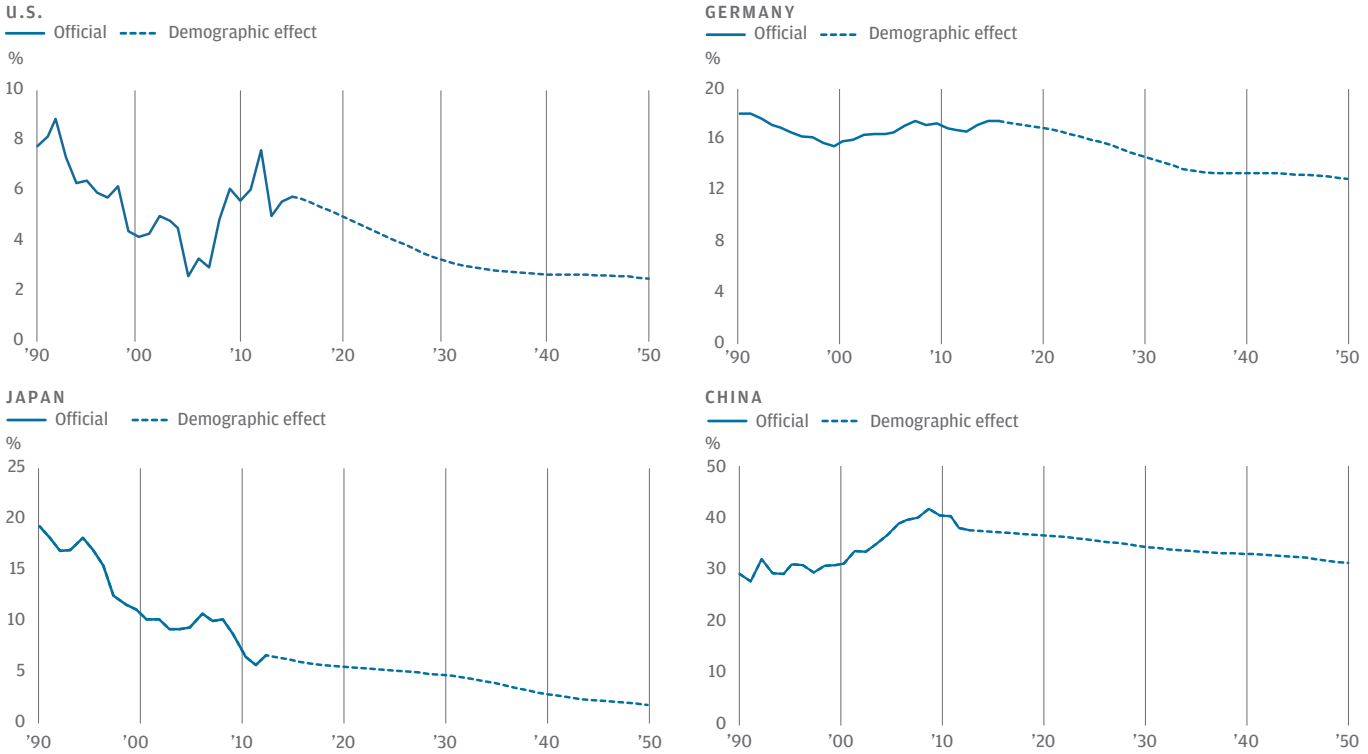
[3] We use slightly different definitions of older cohorts across countries, reflecting differences in retirement ages. The cutoff is assumed to be 65 years old in the U.S., Germany and Japan. In Japan, retirement age varies by pension scheme, but under current legislation the varying ages will center around 65 in the coming years. The Chinese cutoff is set at 60, the current retirement age for men (the female age is 55).

[4] Another important driver of household savings operates via real estate. In previous research using the U.S. Survey of Consumer Finances (https://am.jpmorgan.com/gi/getdoc/1383246462222), we found that residential property alone contributed 59% of the average baby boomer's total asset growth since 1989. Unfortunately, a similar forensic decomposition of household balance sheets by age group is not possible for the other countries, given data limitations, and that is why we focus on the flow of income diverted to savings as opposed to the stock of savings.

[5] Our calculations assume a decline in income of 50% and a decline of consumption of 15% in old age.

Life cycle saving patterns will exert downward pressure on household saving rates

EXHIBIT 2: HOUSEHOLD SAVING RATES, U.S., GERMANY, JAPAN, CHINA, 1990-2050 (%)



Source: National statistical offices, United Nations, J.P. Morgan Asset Management Multi-Asset Solutions.

Note: Throughout this analysis, we use gross household saving rates rather than net rates, given data availability constraints for China. Gross household saving rates are generally higher levels than net rates since they include depreciation and other forms of household capital consumption, but have little effect on the changes in saving rates that we forecast.

projected to stabilize in 2030, in Japan and Germany they are expected to continue falling, bringing the total decline in the saving rate to 4%-5% through 2050.

In China, where the puzzlingly high level of household savings has been the subject of a voluminous literature (see, for instance, Modigliani and Cao 2004 or Ma and Yi 2010), demographic effects are expected to bring down saving rates steadily, from 38% at present to 31% in 2050. China's case, in particular, allows us to examine whether it is reasonable to assume a constant saving rate going forward, given that the age-specific rates themselves might be driven by changing demographic factors. Indeed, according to our calculations, if China's working age saving rate were to revert to where it was at the beginning of the 2000s, its overall saving rate would be closer to 25% by 2050. It could also be the case that these types of forecast errors are offsetting across countries: Germany, for example, has had a rising dependency ratio since 2000 without any notable decline in its saving rate. We discuss Japan's experience in the accompanying sidebar, "**The Case of Japan**."

THE CASE OF JAPAN

Our analysis makes a series of assumptions about the nature of savings in the wake of a demographic shift. For example, we've embedded an assumption that households smooth out consumption over their life cycles and therefore have lower saving rates in retirement. We have also focused on the household sector, paying little attention to the effects of demographic transition on corporate or government savings. Japan's experience over the past quarter century provides a case study in addressing whether these assumptions are reasonable.

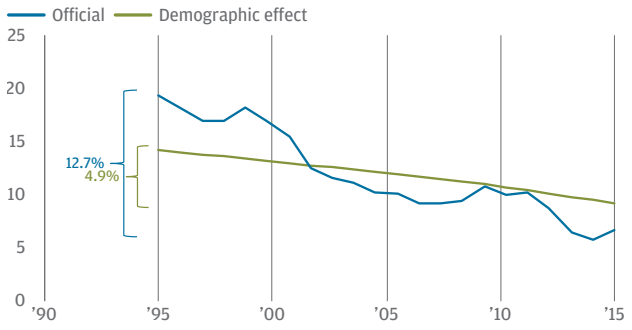
To put the Japan case in context, the economy's dependency ratio has nearly tripled since the early 1990s. Consistent with our thesis that a higher share of older age cohorts translates into lower savings, household saving rates have fallen dramatically over that period, from 19% in 1995 to 7% in 2015 (**Exhibit 3**). Using our estimates of age-specific saving rates from the mid-1990s, demographic changes would have accounted for 4.9ppt (40%) of the total 12.7ppt decline in the saving rate. Of course, demographic change was but one factor that caused saving rates to decline.

Others include the gradual recovery of household balance sheets following the financial crisis in 1990. And, even prior to that, modest tax incentives for saving had been scaled back over the course of the 1980s. Delayed retirement is an example of a factor that would have slowed the decline in saving rates, though older worker labor force participation has actually fallen slightly since the mid-1990s.

We also note that, even as household saving rates continued to decline in the mid-1990s, the contribution of corporates to the country's gross national savings (i.e., the total including household, corporate and government savings) was steady at ~4%-5% of GDP (**Exhibit 4**). The fact that corporate savings swung from negative to positive raises the possibility that lower trend growth—largely driven by demographics—reduced incentives for Japanese companies to borrow. However, that swing may have simply reflected the deflation of the 1980s bubble. The lack of any discernible correlation between weakening demographics and steady corporate savings after the initial change in the 1990s is consistent with the idea that the country's financial crisis was a more powerful influence on corporate savings. Overall, these patterns leave us fairly comfortable with our focus on demographically driven shifts in household savings.

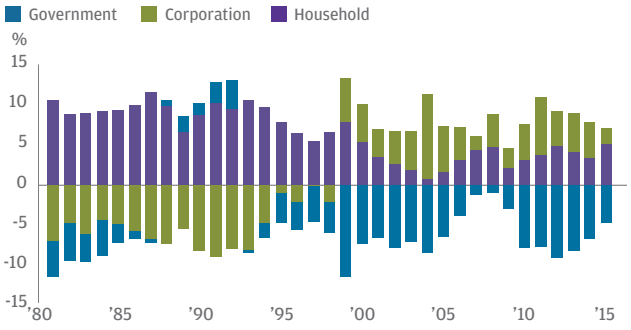
Japanese household saving rates have fallen dramatically since the mid-1990s, with demographics accounting for about 40% of the decline

EXHIBIT 3: HOUSEHOLD SAVING IN JAPAN



In Japan, corporate contributions to gross national savings have held relatively steady as household saving rates have declined

EXHIBIT 4: CONTRIBUTIONS TO TOTAL SAVING RATES IN JAPAN



Source: Bank of Japan, Cabinet Office of Japan, Haver Analytics, J.P. Morgan Asset Management Multi-Asset Solutions; data through July 2017.

THE EFFECT ON REAL INTEREST RATES

Having established a connection between demographic transition and savings, we now link our projections of slowing household savings to real interest rates. A stylized way to render that link is through the supply and demand for global savings. The idea is that the aging of the global population– as measured here in the U.S., Germany, Japan and China–represents an inward shift in the savings supply curve (**Exhibit 5**). If demographic forces influence interest rates primarily through supply–and not by shifting the demand curve for investment–the contraction in household savings we've identified will put upward pressure on the price of savings, which is the real interest rate.

Given that demographic change is an increasingly *global* influence on savings, we model the corresponding shifts in *global* supply and demand. We believe that this mechanism will become increasingly influential over time. For instance, we expect the effect to be larger in the coming decades than it was in Japan, which was at the forefront of developed market demographic shifts in the 1990s. In that case, the savings effects were more local in nature and domestic interest rates continued their downward trend.

We calibrate the effect on real interest rates using our estimates of the aging-driven decline in savings in the coming decades, as well as estimates of the slope of the supply and demand curves (i.e., the price elasticity of savings and investment, respectively).[6] Aggregating across our savings projections for the U.S., Germany, Japan and China, we estimate that aging will subtract 1.2ppt of GDP over the next 10 years and 2.6ppt cumulatively over the next 30 years; these are the leftward shifts in the supply curve shown in **Exhibit 5**.[7] Translating these shifts into increases in the real interest rate, aging will push up rates by 15bps over the next 10 years and 35bps over the next 30 years. Allowing for some uncertainty about what the true elasticities are, the effect is in the range of 25bps-50bps over the next 30 years.

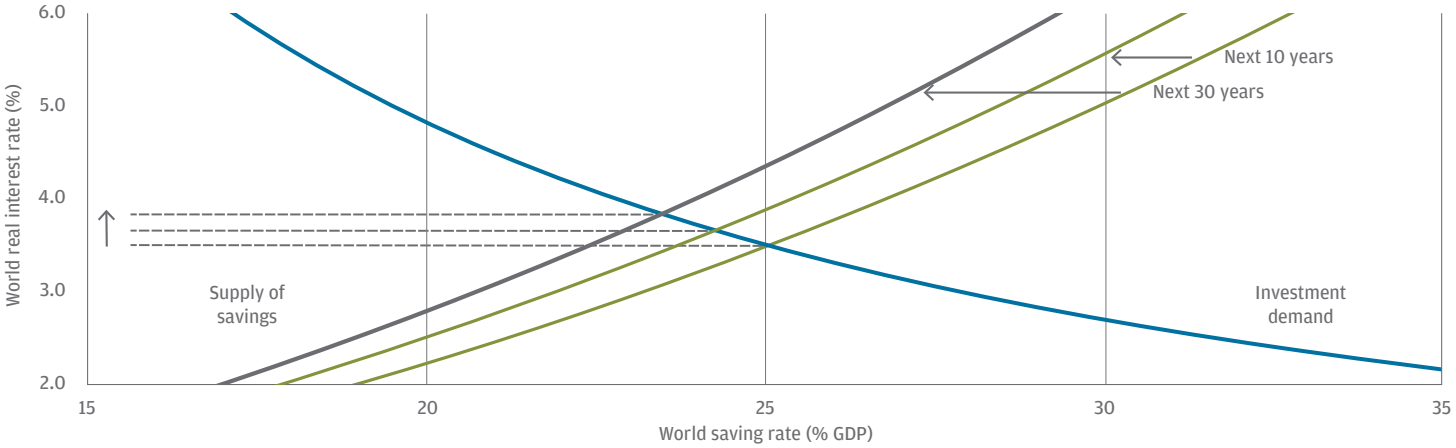
[6] Our baseline elasticity assumptions are based on work by Rachel and Smith (2015). In their work, $\beta s=0.5$ in a savings supply equation of the form: $\ln(r)=\alpha_S+(1/\beta_S)\ln(\frac{S}{Y})$ and $\beta i=-0.7$ in an investment demand equation of the form: $\ln(r)=\alpha_I+\ln(1/\beta_I)\ln(\frac{S}{Y})$. We present results for a range of elasticities: $\beta s=[0.1,0.9]$ and $\beta i=[-0.3,-1.1]$.

Our starting point for the current global real interest rate is something we would consider to be a "normal" rate in the absence of quantitative easing and other factors pushing around the net supply of safe assets. To estimate what that normal real rate would be, we use an assumption similar to the LTCMA framework for fixed income, linking it to trend real growth. Since we think that trend global growth is currently ~3%-3.5%, that is the starting point for the global real interest rate in Exhibit 5. The starting point for the national savings as a share of GDP (25%) is a weighted average across countries and comes from the IMF World Economic Outlook.

[7] These projections are arguably conservative compared with what would be obtained using prior estimates of the link between dependency ratios and overall savings. Rachel and Smith (2015) present cross-country evidence that a 1ppt increase in the dependency ratio tends to lower savings by about 50bps of GDP, implying a decline in savings of 4%-5% of (overall) GDP over our forecast horizon.

If demographic forces influence interest rates primarily through supply, a contraction in household savings will put upward pressure on real interest rates

EXHIBIT 5: SUPPLY AND DEMAND FOR GLOBAL SAVINGS (%)



Source: Rachel, Lukasz and Thomas D. Smith (2015): "Secular drivers of the global real interest rate." Bank of England Staff Working Paper No. 571. J.P. Morgan Asset Management Multi-Asset Solutions; data as of July 2017.

CONCLUDING THOUGHTS

As we have discussed, a tension between two opposing forces will play out in the way that aging populations will influence interest rates. As more workers retire and workforce growth slows, the demographic change will act as a source of downward pressure on both economic growth and equilibrium interest rates. However, the change will also coincide with a large downshift in savings as those workers save less in retirement, and in this way it will apply upward pressure to rates.

Which force will prevail over our 10- to 15-year forecast horizon? It will depend in part on how other areas of the economy respond. Viewed through the lens of our supply and demand framework, to get to the lower equilibrium interest rates that theory implies even as the supply curve of savings is shifting inward, the rest of the economy would need to increase savings somehow, or investment demand would need to shift inward as well.

As households lower their saving rates, aging populations may well boost savings in the rest of the economy. Governments may be required to shore up savings to meet future entitlement obligations, and businesses may take on less debt as they anticipate a slower-growth future. It is also possible that China's growing weight in the world economy will pull global saving rates closer to China's own astronomical levels. In other words, the fact that China is growing relatively quickly means that its contribution to global savings flows will actually grow, not shrink. Finally, from the U.S. perspective, to the extent that foreign savings fall by more than that in the U.S., the U.S. current account deficit would likely shrink.

While lower trend growth will depress investment, all else equal, we also see several factors boosting investment in the coming years. Take business investment spending or capital expenditure (capex), for example. Notwithstanding the fact that capex trends generally follow those of overall growth, we expect recent cyclical distortions in capex to normalize and for investment in technology (and intellectual property more generally) to support overall investment. Perhaps the biggest question mark with regard to aging and investment is whether the demographic process we have described here spurs additional developments in labor-saving technologies and automation, which would cause the economy to become more capital intensive and support investment spending along the way.

All in all, these crosscurrents make it difficult to predict whether we will see a strong reversal of the global savings glut and a corresponding upswing in interest rates. As a case in point, in the 1990s and 2000s Japanese government bond yields did not show any discernible upward impulse as household savings declined, perhaps swamped by the effects of weak trend growth or the international drivers of interest rates. What is clear, though, is that the accelerating and increasingly globally synchronized nature of demographic change will put this hypothesis to the test in the coming decades. And while the arrival of higher interest rates is by no means an inevitable outcome of the demographic shifts to come, we view it as an important upside risk.

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Matching cash flows and managing liquidity in maturing pension funds

Sorca Kelly-Scholte, FIA, *Global Strategist, Global Pension Solutions*
Timothy Lintern, *Analyst, Global Strategist, Multi-Asset Solutions*

IN BRIEF

- Many maturing developed market pension plans are becoming steadily more cash flow negative. The challenge is most pronounced for closed or frozen plans, whose payments to beneficiaries are increasing and contributions to fund younger participants' benefits are declining.
- The combination of underfunding, negative cash flow and a low return environment can lead to a downward spiral in which funded status falls irretrievably (without additional contributions).
- Rising rates alone are unlikely to stop the fall, particularly in the U.S. Applying our 2018 Long-Term Capital Market Assumptions (LTCMAs), we demonstrate that most of our projected rise in U.S. yields is already incorporated in liability discount rates through current market forward yield expectations. Closing the remaining gap is unlikely to be enough to provide the required uplift for U.S. pension funding levels. The potential implications for European plans are more encouraging, although rising rates alone are still not expected to solve the funding shortfall.
- For underfunded pension plans with substantial allocations to risk assets, liability-driven investment (LDI) strategies are only partially addressing near-term cash flow servicing—and those using the derivatives market to implement liability hedging may be compounding the problem, especially in a rising rate environment.
- We expect that chronically negative cash flows will lead corporate pensions to shift toward buy and maintain[1]-style credit portfolios and income-generative assets, structured to manage both short-term liquidity requirements and duration risk.
  We expect that this will sustain the pension fund demand for bonds through our 10- to 15-year assumptions period.

[1] Buy and maintain portfolios are constructed based on an investor's funding profile; bonds are selected based on the issuer's ability to service its debt until maturity and are intended to be held to maturity unless the probability of default for a particular bond held rises to unacceptable levels (in which case, it is sold).

INTRODUCTION

Many of the developed world's maturing pension plans are now reaching a tipping point as they move toward final runoff. They find themselves in a negative cash flow position in which they are paying out more in benefits than they are receiving in contributions. The need to service cash outflow is an additional burden for investment portfolios already straining to achieve long-term investment goals, a burden that will weigh ever more heavily as plans mature.

We examine how negative cash flow impacts funding, risk and return for pension plans and provide insight on how plans are likely to adapt their investment strategies in response, taking into account current capital market conditions and our 2018 Long-Term Capital Market Assumptions. We expect sustained demand from pension funds for high quality bonds and income-generative assets over the 10- to 15-year horizon of our LTCMAs. This will be associated with a shift away from hedging duration with derivatives and toward matching cash flows with physical assets—in particular, buy and maintain credit and core real assets. Once maturing plans are more fully funded and matched, they will continue to be big holders of bonds, but they will have little need to buy further bonds through runoff. Beyond our LTCMA time frame, therefore, we envisage a drop-off in demand from defined benefit pension funds, with few obvious candidates to replace that demand.

THE JOURNEY TOWARD FINAL RUNOFF

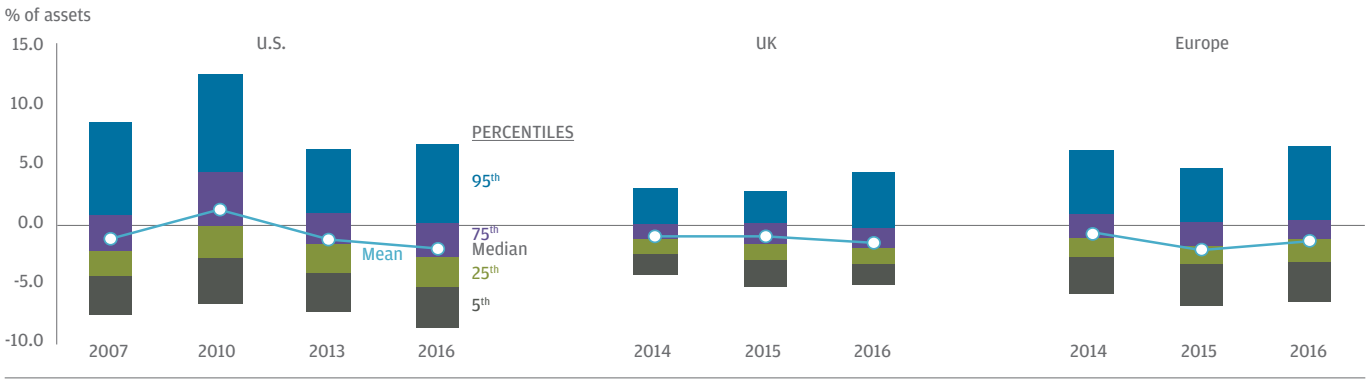
Taking the simplest possible definition of net cash flow position—total contributions less total benefit payments—**Exhibit 1** shows how the net cash flow position has evolved for corporate pension plans in the U.S., UK and Europe. The trend is clear—pension funds have become steadily more cash flow negative. This is evident in the U.S., where we have the longest, most robust data set. It is also apparent in the UK and Europe, although data prior to 2014 is less reliable, given the small number of plans represented. Net cash flow positions were briefly positive in the post-crisis years, largely as a result of crisis deficit repair contributions made in response to plummeting funding levels at that time. Contribution patterns tend to be lumpy under U.S. funding regulations, which can cause the distribution of cash flow positions across plans to be quite wide in any given year. The underlying trend in the data at the median level is clear, however, and our analysis of the effect of removing outliers (spikes in contributions or benefit outflow, where the amount in a given year is substantially greater than the average over the full period) confirms this. Today almost three-quarters of corporate defined benefit plans have negative cash flows, and we expect the trend to affect more and more corporate funds as they mature.

Indeed, there are good reasons to believe that this negative cash flow trend might accelerate. The majority of corporate pension plans in the UK and large plans in the U.S. are now closed to new participants, and many are frozen—closed to any further accrual of benefits. Once a fund is closed or frozen, the march toward a negative cash flow position is inexorable because offsetting contributions to fund younger participants' benefits decline, most rapidly for those funds that are frozen.

More immediately, contributions continue to be elevated in the ongoing bid to shore up funding levels, and it is these deficit repair contributions that are holding many pensions, in Europe in particular, in a cash flow-positive position for now. In the U.S., as noted previously, contributions at the individual plan level can be lumpier, but in aggregate contributions are elevated while funding levels are low. Once funding levels reach required regulatory standards, however, it is reasonable to expect that contributions will drop back to the levels required to cover the ongoing accrual of the dwindling active participants' benefits.

Net cash flow position is increasingly negative for developed market pension systems

EXHIBIT 1: CORPORATE DEFINED BENEFIT NET CASH FLOW POSITION AS % OF ASSETS



Source: HOLT® (based on accounting disclosures for S&P 500, FTSE 350 and MSCI Europe), J.P. Morgan Asset Management; data as of June 30, 2017.

We expect the deficit repair process to proceed at a slow, steady pace rather than through sudden, rapid improvements. A sizable part of the yield increase embedded in our Long-Term Capital Market Assumptions has been priced into bond markets in the U.S. as bond yields have risen over the last year, with pension funds enjoying an associated uplift in funding levels. Consequently, if our yield expectations are borne out, most of the future funding level repair in the U.S. will need to come from asset returns and contributions rather than from rising interest rates. In a low return world, this repair process will be slow. In the UK and Europe, by contrast, yields have not risen by as much over the last year and yield normalization in line with our long-term capital market expectations has the potential to help lift pension funds out of their current funding stress over the next 10 to 15 years. However, we expect this to occur slowly as yields grind, rather than spike, upward; we do not expect interest rate movements alone to solve the pension funding challenge (**Exhibit 2**).

CHANGING THE SHAPE OF CASH FLOWS

There are several forces at work with the potential to speed up the journey to final runoff or, at least, change its route. On the regulatory front, for example, the "freedom and choice" agenda in the UK—reform that gives people greater access to their pensions—is currently driving substantial activity in the form of individual lump sum transfers out of defined benefit pension plans, a trend that may accelerate negative cash flows and runoff.

Risk transfer to insurance companies by means of a buy-in or buy-out contract is another avenue for changing cash flows. Strictly speaking, these contracts involve a transfer of cash flows from the pension system to the insurance system and therefore do not result in a change in aggregate pension cash flow. However, if the risk transfer is financed in part by a one-off contribution to make good any shortfall relative to the insurance contract's price, the cash flow pattern is changed. What may have been a positive net cash flow position for some time is converted to a large one-off positive cash flow before the negative cash flow runoff begins.

PUBLIC PENSION PLANS: ON A SLOWER-MOVING TREND

Public pension plans are more likely to be open than corporate pension plans, but they are not immune to negative cash flow positions. (Neither are defined contribution [DC] plans immune, as discussed in the sidebar on DC plans and demographic trends.) An open, public defined benefit plan, depending on its funding arrangements and demographic profile, can become cash flow negative over time—but this is likely to happen more gradually than for a closed or frozen plan.

The U.S. public pension system is one example: It is substantially cash flow negative and has been so for the last decade. The UK's Local Government Pension Scheme (LGPS) is similarly in a negative cash flow position, but to a much lesser degree (**Exhibit 3**). The trends for these largely open defined benefit systems may not be as inexorable as for closed plans. However, aging demographics can push an open fund slowly but surely toward negative cash flow. The Public Service Pension Fund of Taiwan is a case in point—from 1996 to 2015, its net cash flow declined from 97% to -2% of assets (**Exhibit 4**).

Rising rates alone are unlikely to solve the pension funding dilemma—particularly in the U.S.

EXHIBIT 2: POTENTIAL UPLIFT IN CORPORATE PENSION FUNDING LEVELS DUE TO INTEREST RATE NORMALIZATION

	U.S.	UK	Netherlands**
Current funding level (%)	84	89	106
Current average duration (years)	12	18	21
Estimated duration range in 2028 (years)	6–8	12–14	18–20
Estimated hedge ratio* (%)	50	50	39
Potential uplift in funding levels due to gap between current market forward yield expectations and LTCMA expectations (ppt)	1–2	3–7	6–11

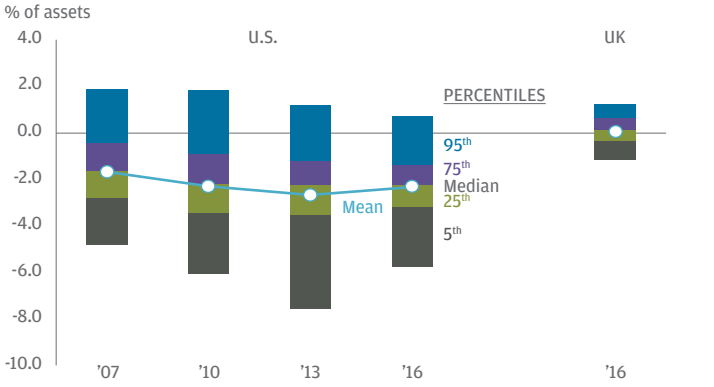
Source: De Nederlandsche Bank, Milliman, Pension Protection Fund PPF 7800 Index, J.P. Morgan Asset Management; data as of June 30, 2017. Yield data from Bloomberg as of July 19, 2017.

*Hedge ratio measures the sensitivity of plan assets to a change in interest rates relative to the sensitivity of plan liabilities to the same rate change. A 50% hedge ratio implies, for example, that for a given interest rate increase (decrease), assets would decline (increase) half as much as liabilities.

**Note that Dutch pension funds must target at least 110% funding before any indexation can be granted, and build reserves of 123%, on average (scheme dependent), before full indexation can be paid to members.

Pension systems with largely open plans can still be in a negative cash flow position

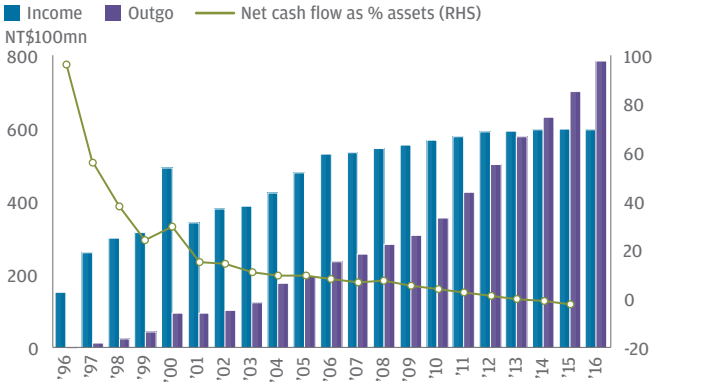
EXHIBIT 3: PUBLIC PENSION PLAN NET CASH FLOW POSITION



Source: Department for Communities and Local Government, Public Plans Data (www.publicplansdata.org), J.P. Morgan Asset Management; data as of June 30, 2017. U.S. data based on actuarial (smoothed) value of assets.

Aging demographics can nudge even an open plan toward a negative cash flow position

EXHIBIT 4: PUBLIC SERVICE PENSION FUND OF TAIWAN CASH FLOWS TAIWAN NEW DOLLAR 100 MILLION



Source: Public Service Pension Fund, J.P. Morgan Asset Management; data as of July 19, 2017.

Nonetheless, the trend will be much slower for open plans; in the UK and the U.S., it is more likely that an upward shift in contribution levels will offset any underlying demographic trend, at least for the time being. Corporate defined benefit plans have, in many regions, been obliged to very rapidly recognize reduced future return expectations via discount rates linked to interest rates, and to make corrective contributions accordingly. By contrast, public pension funds have been much slower to lower their long-term return expectations. As return expectations are gradually revised downward, consistent with the mostly moderate growth, low return world described by our 2018 LTCMAs, contributions will eventually need to be adjusted upward (or benefits adjusted downward).

FUNDING AND INVESTMENT CHALLENGES

All of this—underfunded plans, negative cash flows, a low return environment and the inability of rising rates alone to shore up pension funding—matters because the combination creates additional challenges for both the funding and the investment of defined benefit plans.

THE "SINKING STONE" EFFECT: If a plan is underfunded, then having more cash flowing out than coming in acts as a further drag on the funding level—rather like trying to fill a leaking bucket. All else being equal, this negative cash flow will raise the level of return required to achieve funding targets. If returns are insufficient, funded status will drop further. The more deeply negative the cash flow and the more underfunded the pension plan becomes, the heavier the drag. At a certain point, investment returns alone will be unable to stabilize funded status; it will keep falling irretrievably, like a sinking stone, unless contributions are injected.

FORCED SELLING: Negative cash flow also puts the fund at risk of becoming a forced seller of assets to service cash flows. If this occurs after periods of market drawdown, a loss is locked in. Of course, the symmetrical argument on the upside means that gains may be locked in. The overall effect of a negative vs. positive cash flow position is to amplify rather than smooth funding level volatility. For many corporations with large legacy pension funds, this additional funding level volatility is unlikely to be tolerable.

THE LIQUIDITY SQUEEZE: A fund in negative cash flow will be at increased risk of liquidity squeezes and will need to address the operational challenge of regular divestment of assets. At modest levels of negative cash flow, such as those seen in the UK's LGPS, these challenges can be readily addressed by tilting toward income strategies. For plans with higher levels of negative cash flow, current levels of yield on low risk financial assets are not sufficient to deliver the required level of cash flow, and declining risk tolerance will limit the reach into higher risk assets for yield. For these funds, which include a large portion of Western corporate defined benefit plans, deeper structural changes to portfolios will be required.

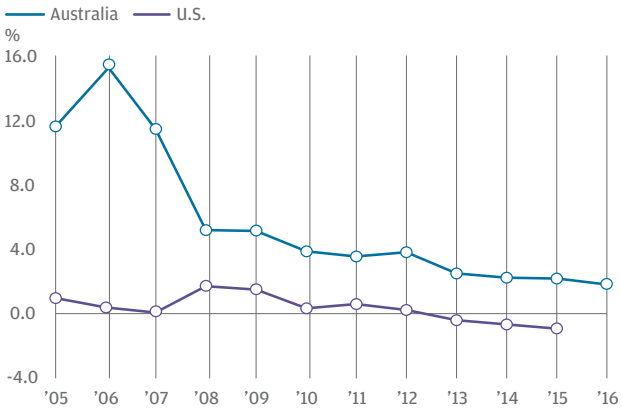
MANAGING DURATION AND LIQUIDITY RISK: To avoid the need to regularly divest assets, cash flows can be serviced with principal payments from high grade bonds as well as general investment income. Although corporate pension funds have been de-risking, liability-driven investment portfolios have been structured principally to manage duration risk across the full term structure of the liabilities rather than to manage near-term liquidity requirements. If a pension plan is fully funded and invested entirely in bonds, the bond portfolio can be structured to

DEFINED CONTRIBUTION SYSTEMS: SUBJECT TO THE SAME DEMOGRAPHIC TRENDS

Defined contribution (DC) retirement savings systems are, in general, much less mature than defined benefit systems, but in time they too will start to decumulate. In the U.S., the corporate defined contribution system has been in negative cash flow for the last few years. This may be due in part to transfers from DC plans into individual retirement accounts (IRAs)—which would not contribute to net dissaving from the overall pension market. If transfers to IRAs are part of the explanation, the Department of Labor (DOL) Fiduciary Rule may slow this DC outflow by focusing greater scrutiny on financial advisors' recommendations to clients to roll over from DC plans to IRAs.* Australia's DC system remains in positive net cash flow, but the downward trend is clear (see exhibit, right). Any declining trend in net cash flow in these open systems will be driven by demographics, eventually reaching the point where the retired cohort is drawing income out faster than the younger cohorts are paying in.**

Demographic trends are a major driver of defined contribution system aggregate net cash flows

U.S. AND AUSTRALIAN DEFINED CONTRIBUTION SYSTEMS—NET CASH FLOW AS % OF ASSETS



Source: Australian Prudential Regulation Authority, Cerulli, J.P. Morgan Asset Management; data as of July 19, 2017.

* The DOL Fiduciary Rule holds financial advisors to a fiduciary (vs. suitability) standard—and will generally require advisors to act in the client's best interest, mitigate conflicts and disclose all fees and commissions. The rule's definition of fiduciary investment advice includes that related to distributions from, or rollovers to, a plan or IRA.

** For more on the impact of demographics on savings, see "How demographic change will affect savings, growth and interest rates," J.P. Morgan Asset Management, 2018 Long-Term Capital Market Assumptions.

meet both the duration-hedging and the cash flow-matching requirements of the plan. But for underfunded pension plans with substantial allocations to risk assets, LDI portfolios are only partially addressing near-term cash flow requirements. For plans that achieve the duration hedge with leverage via the derivatives markets, as is commonplace in Europe, increasingly onerous collateralization requirements in a rising rate environment have the potential to compound the cash flow challenge.

RESPONDING TO THE CHALLENGE

We expect that, over time, chronically negative cash flows will lead corporate pensions to shift toward buy and maintain-style credit portfolios, structured to manage short-term liquidity requirements as well as duration risk. In the case of European pension funds, we expect a concomitant shift from unfunded duration hedging (using derivatives) to funded duration hedging. The pace at which this occurs will be driven by the path of funding levels; as discussed earlier, we expect the shift, in general, to be slow and to vary greatly across individual pension funds. Some funds are already well down this path, but many have a long way to go.

In the meantime, and for the longer term, high yielding, stable cash flow assets are increasingly attractive for pension funds seeking to service cash flow requirements, especially if these assets offer the potential for long-term capital growth. This underscores the merits of real assets for pension investors—in particular, core real estate and infrastructure. We also expect that the alternative credit markets will continue to be a key area of interest for pension funds seeking stable yield.

CONSIDERATIONS BEYOND THE LONG TERM

What could all this mean for capital markets—beyond the time frame of this year's Long-Term Capital Market Assumptions? In concluding, we share some thoughts on the potential direction of trends and developments that could influence our long-term outlook in future years.

Pension fund demand for bonds may eventually fall away

The expected sustained demand for bonds from pension funds is already well established. Indeed, matching assets and liabilities as an approach to de-risking pension plans is a long-standing and powerful industry megatrend.

However, we do begin to foresee some potentially tangible effects arising should pension funds entering into runoff mode adopt buy and maintain strategies. A shift toward buy and maintain credit-oriented portfolios would, all else being equal, further reduce liquidity in the marketplace as pension funds buy into these strategies. Once pension funds become fully funded and fully matched, demand for bonds will begin to drop off—the principal repayments will be applied to service cash flow and will not be available for reinvestment. A reasonable proportion of pension funds could reach this status in the next 10 to 15 years. This is especially true for corporations that make one-off final payments to facilitate risk transfers or take other substantive de-risking measures when the magnitude of payments required comes into a reasonable range. We estimate the impact on capital markets would be on a scale similar to that of central banks exiting quantitative easing (QE) (**Exhibit 5**).

It is unlikely that public defined benefit and defined contribution plans will replace this demand for credit, as neither has the same imperative to de-risk and cash flow-match liability payments. The precise shape of decumulation strategies for defined contribution savings is a topic of much current debate as those systems move toward maturity, and will likely result in a mix of annuitization, income-oriented asset strategies and managed divestment. Public defined pension plans will have little appetite to de-risk into lower risk, lower returning investment strategies and will likely continue to lean hard on their long-term nature and the relatively younger age of their participants to support return-oriented strategies.

A new era of equitization?

The period since the financial crisis has been characterized by de-equitization[2] and expansion of the credit markets, fueled by ultra-low interest rates and further supported by pension and insurance demand for low-risk assets. It is perhaps beyond the horizon of our long-term assumptions, but as interest rates normalize, demand for bond assets from defined benefit plans falls off and the global savings glut reverses, perhaps we'll enter a new era of equitization.

Could the eventual tapering of pension fund bond demand have as great an impact on capital markets as the unwinding of QE?

EXHIBIT 5: CURRENT CENTRAL BANK BALANCE SHEETS AND DEFINED BENEFIT BOND ASSETS (USD, BILLIONS)*

	U.S.	UK	Europe	Japan
Central bank balance sheet	4,460	565	4,710	4,469
Total defined benefit pension assets	8,992	2,352	3,117	2,696
Defined benefit bond assets	3,327	1,277	1,221	884

Source: OECD Global Pension Statistics, Pension Protection Fund Purple Book 2016, Willis Towers Watson Global Pension Assets Study, J.P. Morgan Asset Management; data as of June 30, 2017.

* Results for Europe are based on data for Finland, Germany, Italy, the Netherlands, Spain and Switzerland, with each country assumed to have 100% of pension assets in defined benefit plans, except for the Netherlands, which is reported by Willis Towers Watson as having 94% of pension assets in defined benefit plans.

[2] De-equitization refers to the substitution of debt for equity, especially at the level of global capital markets. At the company level, it is the process whereby companies shift from equity financing to debt financing.

The cost of capital in China's changing markets

Hannah Anderson, *Global Market Strategist, Global Market Insights Strategy*
Leon Goldfeld, CFA, *Portfolio Manager, Multi-Asset Solutions*

IN BRIEF

- Identifying a benchmark interest rate, the risk-free cost of capital, and understanding how it might move in the future are essential for investors to price assets and assess likely future returns.
- We forecast a path for Chinese benchmark interest rates, exploring how ongoing financial liberalization in China—involving a shift from explicitly policy-driven interest rates toward a more market-driven system—will impact all interest rates, now and over our long-term forecast horizon.
- We use a natural rate of interest (r*) approach to model a theoretical, unsubsidized economic cost of capital for China, incorporating our economic forecasts and assumptions about the evolution of China's financial system.
- The average of China's most frequently referenced lending and deposit rates, in real terms, is currently about 300 basis points (bps) below where our natural rate estimate suggests it would be in a more liberalized environment.
- The interest rates available to investors in China have moved significantly closer to our natural rate estimate in recent years, and we forecast that over the next 10 to 15 years the gap will narrow further as market forces gain influence.

SOLVING CHINA'S INTEREST RATE PUZZLE

Investors often rely on a benchmark interest rate, the cost of capital in its most basic form, to make investment decisions. Determining this rate in China can be confusing, both because China maintains several interest rates—varying by the type of financial activity—and because many of these rates have not reflected economic fundamentals. Along with knowing the benchmark rate, assessing its likely future behavior is critical, since investor returns over time are composed of this rate plus a risk premium. China's ongoing transition to a more market-driven financial system obscures the future path of all interest rates and, most important, how a benchmark interest rate might move. To aid investor understanding of interest rate behavior in China, present and future, we construct an estimate of an economically determined cost of capital—the natural rate of interest (r*). We then present a framework for using r* to understand how the financial system liberalization process underway in China will impact future interest rates.[1]

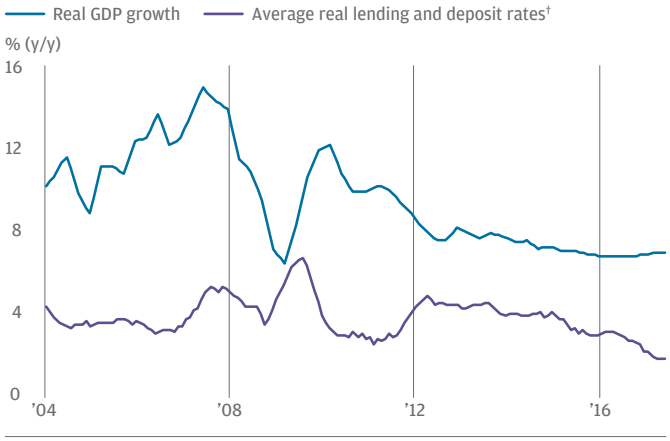
A FINANCIAL SYSTEM WITH CHINESE CHARACTERISTICS

China's financial system developed in response to the country's economic goals. Policymakers determined that an investment-led economic growth model would make best use of China's abundant labor supply. The low corporate borrowing costs this model requires are financed by high levels of domestic savings. These low rates are facilitated by government participation in the banking system, a regulatory environment aligned with policy goals and the implicit official backing of financial activities.[2] Extending low-cost credit, mainly to large corporate borrowers, has proven economically successful but has begun to fuel unproductive investments and financial speculation.

In China, restrictions on financial activities and interest rates tend to depress returns to savers and enhance the benefits to borrowers. Published rates can demonstrate limited responsiveness to economic activity; nevertheless, market forces are gaining influence (**Exhibit 1**). For example, the People's Bank of China (PBOC) liberalized, or stopped officially setting, the deposit rate ceiling in 2015 and the lending rate floor in 2013, but these rates have still tended to follow published guidance since then.

Interest rates in China have largely been driven by policy

EXHIBIT 1: REAL GDP GROWTH AND AVERAGE REAL LENDING AND DEPOSIT RATES (Y/Y % CHANGE, AVERAGE REAL LENDING AND DEPOSIT RATES†)



Source: CEIC, National Bureau of Statistics of China, J.P. Morgan Asset Managment; data as of August 21, 2017.

† The average of the nominal interest rate on one-year RMB loans deflated by the investment price index (IPI), a measure calculated from the productive investment components of the fixed asset investment price index, and the nominal interest rate on one-year RMB deposits deflated by the non-food consumer price index (nfCPI).

Liberalizing the financial system is a top priority for China's authorities in order to advance economic development, dampen financial speculation and support China's integration into the global economy. An aspect of liberalization is giving market forces greater sway over the cost of capital; extending credit at a below-economically efficient cost has spurred financial crises elsewhere, something China aims to avoid. Understandably, authorities are unwilling to let market forces potentially derail development goals, and they fear that rapid change could cause instability. However, allowing market forces to play a larger role will serve additional goals, like discouraging wasteful investment, since a market-determined interest rate would likely be higher than current rates, and would ration capital more efficiently.

THE THEORY BEHIND r*

As noted, there is a disconnect among a theoretical interest rate determined by China's economic situation, the policy need for cheap borrowing costs and currently available rates. This disconnect makes it difficult for investors to assess the true cost of capital and how it might evolve, complicating the consideration of Chinese assets. To aid investors in this situation, we construct an estimate of the natural rate of interest (r*) for China.

[1] The authors are greatly indebted to the work of Dong He, Honglin Wang and Xiangrong Yu at the Hong Kong Monetary Authority, whose methodology we follow.

[2] Low rates and high savings are related, as low returns on savings equal higher required savings levels, which anchor rates at low levels, as discussed in this edition in "How demographic change will affect savings, growth and interest rates," J.P. Morgan Asset Management, 2018 Long-Term Capital Market Assumptions.

In economics, r* is the benchmark cost of capital, which over the long run equals nominal output growth (typically measured by nominal GDP) at a level where inflation is stable and the economy is operating at its potential—a crucial assumption for many economic models. This golden rule forms a useful guide to how output and interest rates should move in relation to each other and is the basis of long-run forecasts for many assets. In emerging markets, r* is often well below the rate of nominal GDP growth, partly because those financial systems are relatively inefficient at intermediating credit and growth, but this gap narrows as financial systems develop.[3] Accessible interest rates for investors may be lower than r* due to policies that favor investment activity. Therefore, we would expect first that China's r* sits below nominal GDP growth and, second, that the country's rapid development in recent decades would have narrowed this gap substantially.

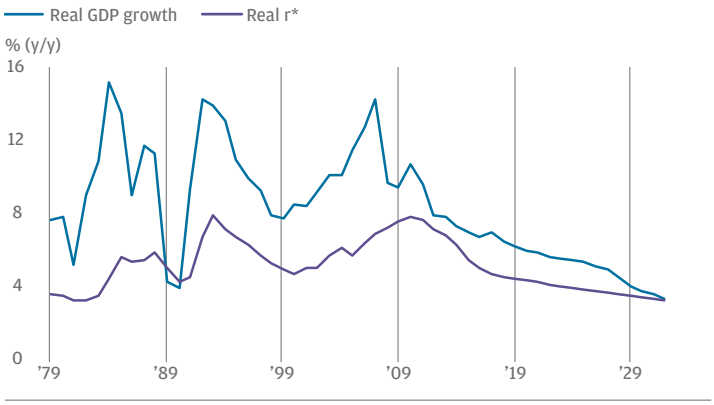
Movements in the real natural rate of interest—r* adjusted for inflation—significantly influence investment decisions.[4] Since most investors want to beat inflation, to at least preserve their money's value, they care more about real interest rates. The benchmark interest rate, typically determined by a market's key interest rate,[5] guides investors when they consider how much compensation they require, at a minimum, after inflation, to invest instead of save. Borrowing is relatively cheap, and higher returns may be found in investments vs. savings when the real key rate is below real r*. In theory, over the long run, the gap between real r* and the real key interest rate should equal zero in an economy in equilibrium. They are never perfectly equal in reality, but the gap should average to zero over one business cycle.

GROWTH AND r* IN CHINA

Because r* is not an immediately observable variable, it must be estimated from existing economic data. As economic conditions shift over time, so does r*. Given that real r* is the more important rate for investors, we construct an estimate of real r* and its future path for China (see "**Estimating China's r***"). Comparing our estimate of China's real r* with real GDP growth (**Exhibit 2**) reveals that r* has been persistently below real GDP growth, as we would have expected, and that this gap will likely narrow over our Long-Term Capital Market Assumptions (LTCMA) forecast horizon.

Real r* has been persistently below real GDP growth, but is moving closer

EXHIBIT 2: REAL GDP GROWTH AND REAL r* (Y/Y % CHANGE, ESTIMATED REAL r* ANNUAL %)



Source: CEIC, National Bureau of Statistics of China, Penn World Tables, PwC, J.P. Morgan Asset Management 2018 Long-Term Capital Market Assumptions; data as of August 21, 2017.

Real r* is estimated, here and throughout, utilizing the model described in this paper.

Chinese economic growth could potentially be faster or slower than our base case. If so, the capital stock, and therefore real r*, might also evolve differently. We remodeled our real r* estimate under reasonable lower and higher growth scenarios and concluded that slower-than-expected growth would have little impact on the trajectory of real r*, while higher growth would place real r* below real GDP growth for the foreseeable future. Authorities would likely have to turn on the credit spigots to achieve higher growth, as they did during the 2009 credit boom, resulting in a large unproductive debt load. The economic impact of that, and related policy decisions, would likely hold a benchmark interest rate below real GDP growth.

THE FUTURE OF FINANCIAL LIBERALIZATION

Chinese authorities recognize the need for more robust sources of financing—to efficiently support growth and ensure financial stability—and have been reforming the system of allocating capital. Reforms will introduce more market forces, but the financial system will not become entirely independent of the government. Financial institutions have a strong preference for lending to government-linked projects, or those that appear to have government backing, due to both political concerns and the low default risk. This, combined with state involvement in banking, has created an implicit guarantee for the entire financial system.

[3] Julio Escolano, Anna Shabunina and Jaejoon Woo, "The puzzle of persistently negative interest rate-growth differentials: Financial repression or income catch-up?" International Monetary Fund Working Paper 11/260, 2011. https://papers.ssrn.com/sol3/papers.cfm?abstract_id=1961907

[4] John C. Williams, "FRBSF Economic Letter: The natural rate of interest," Federal Reserve Bank of San Francisco (2003). http://www.frbsf.org/economic-research/publications/economic-letter/2003/october/the-natural-rate-of-interest/

[5] The key interest rate in an economy determines the cost of money, which usually then determines the benchmark rates for borrowing and lending. In economies with interest-targeting central banks, like the U.S., the federal funds rate is the key interest rate. The PBOC is not an interest-targeting central bank and therefore does not set a benchmark rate for the economy as a whole. This is why we construct a benchmark rate of our own from an average of deposit and lending rates.

Rightly or wrongly, investors perceive that most investment enjoys a government backstop.[6] Over the next 10 to 15 years, this implicit guarantee is likely to remain in effect. Removing it entirely would require a much higher tolerance for volatility than we believe policymakers possess.

Consequently, we expect China's financial system will continue to subsidize investment, leaving rates, even in a more market-driven system, below our estimate of real r*. In practice, market-determined rates should not equal real r*, since financial institutions charge slightly above the benchmark interest rate to cover their costs. We can measure present distortions between the rates available and an estimated economically determined interest rate by comparing the average of real deposit and lending rates with our estimate of real r*. Considering how the difference between these will evolve in the context of ongoing financial system reforms, we forecast a future deviation from real r*.

In **Exhibit 3**, we demonstrate the current difference is around 300bps. As market forces play a larger role in setting these rates, we anticipate that by the end of our 10- to 15-year window this gap will have narrowed to between 50bps and 100bps. This forecast is based on our judgment of the pace and degree to which China's financial system becomes more market-driven.

DRAWING INVESTMENT CONCLUSIONS FROM OUR MODEL

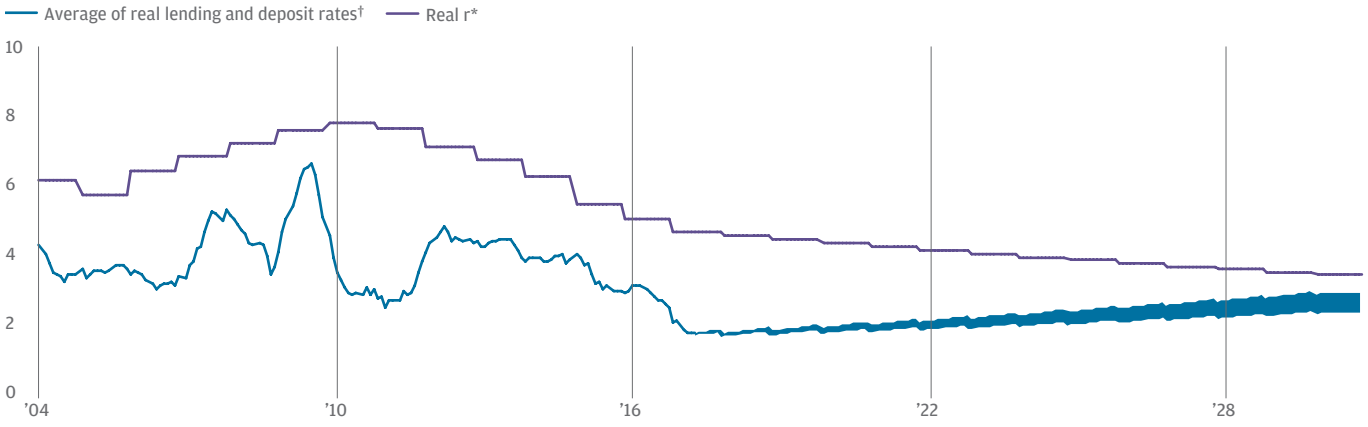
This framework will be most useful to investors where it can be applied to rates currently on offer. While we have used the average of lending and deposit rates as a logical point from which to estimate the size of the subsidy borrowers enjoy in China, in practice these rates are not frequently used in trading. That leaves investors in need of a local reference rate. Limited data is available on the history of China's interest rates, and the appropriate rate for investors to reference has shifted several times in recent history, a pattern we expect to continue. Currently, China's seven-day repo rate is the most appropriate, accessible market rate to which we can apply our framework.

Examining the relationship among the seven-day repo rate, adjusted for inflation, the average of real lending and deposit rates, and our estimate of real r* yields two important insights. The seven-day repo rate and the lending and deposit rates' average have begun to converge, suggesting market forces are indeed playing a larger role in setting interest rates. And the gap between these two rates and real r* is narrowing (**Exhibit 4**). This indicates that investors can increasingly rely on real r* as a guide for the direction of future accessible interest rates, relative to what economic fundamentals suggest.

[6] Douglas J. Elliot and Kai Yan, "The Chinese financial system: An introduction and overview." (2013) The John L. Thornton China Center at Brookings. https://www.brookings.edu/wp-content/uploads/2016/06/chinese-financial-system-elliott-yan.pdf

We project that real benchmark interest rates will converge closer to an economic rate

EXHIBIT 3: REAL r* AND AVERAGE OF REAL LENDING AND DEPOSIT RATES (ANNUAL %, AVERAGE OF LENDING AND DEPOSIT RATES†)

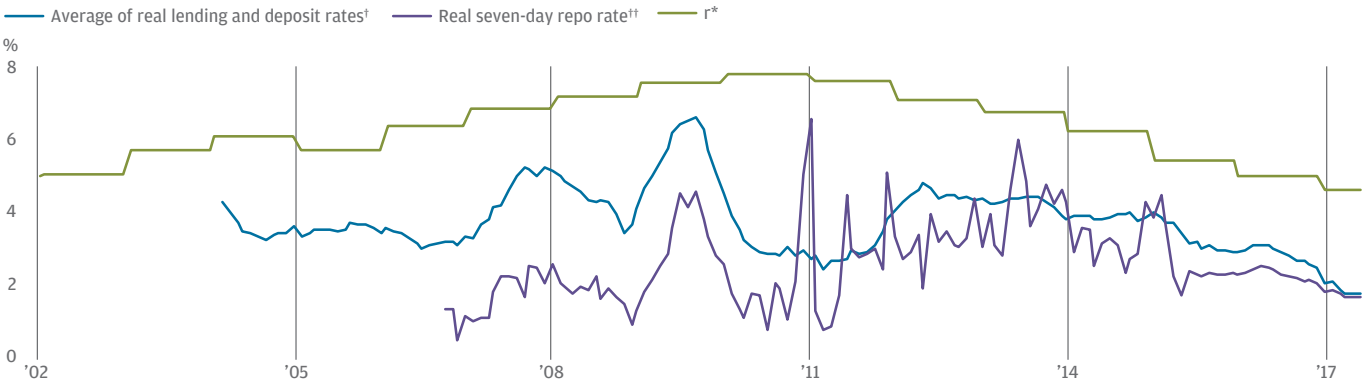


Source: CEIC, National Bureau of Statistics of China, Penn World Tables, PwC, J.P. Morgan Asset Management 2018 Long-Term Capital Market Assumptions; data as of August 21, 2017.

† The average of the nominal interest rate on one-year RMB loans deflated by the investment price index (IPI), a measure calculated from the productive investment components of the fixed asset investment price index, and the nominal interest rate on one-year RMB deposits deflated by the non-food consumer price index (nfCPI).

Market forces are having more influence on China's interest rates

EXHIBIT 4: REAL r*, AVERAGE OF REAL LENDING AND DEPOSIT RATES, AND REAL SEVEN-DAY REPO RATE (ANNUAL %, AVERAGE OF REAL LENDING AND DEPOSIT RATES,† REAL SEVEN-DAY REPO RATE††)



Source: CEIC, National Bureau of Statistics of China, Penn World Tables, PwC, J.P. Morgan Asset Management; data as of August 21, 2017.

† The average of the nominal interest rate on one-year RMB loans deflated by the investment price index (IPI), a measure calculated from the productive investment components of the fixed asset investment price index, and the nominal interest rate on one-year RMB deposits deflated by the non-food consumer price index (nfCPI).

†† Seven-day repo rate is deflated by the average of the IPI and the nfCPI.

While we believe this paper outlines a useful tool for investors, a few complicating factors should be considered when drawing conclusions from the model. Our estimate is drawn from existing data sources, which are not entirely reliable. Our model assumes the economy is operating at its potential; we believe China could see productivity gains in excess of recent history. If this occurs, real r* would likely move toward real GDP growth at a faster pace than we currently estimate.

RISKS REMAIN ON THE PATH OF FINANCIAL LIBERALIZATION

Higher interest rates—even if they are lower than fully market-determined rates—will further the development of China's financial system. As rates rise, households and corporates will likely further diversify their portfolios beyond bank deposits, shrinking available lending pools and forcing many banks to compete by offering higher deposit rates. Higher returns on savings, combined with the ongoing cleanup of the financial system, will likely divert some assets away from currently popular but less well-regulated credit products. However, demand for higher returns—especially among the growing urban middle class—will likely continue to draw investors to riskier instruments.

Some of these assets will likely find their way into more traditional portfolio investments, supporting the development of China's corporate debt and equity markets.[7] Lending rates will likely remain lower than the natural rate would suggest, reflecting banks' continued preference for supporting state-owned enterprises. But banks' increasing willingness to finance those firms—typically smaller and privately held—engaged in the transition toward a services economy, plus the loosening of rate controls on different financial activities and the gradual removal of explicit policy guidance, will likely raise the average lending rate above its current level.

Nonetheless, the cost of investment is likely to remain below r* as a result of the implicit guarantee system. Financial liberalization undertaken in these circumstances tends to decrease financial stability, raising questions for policymakers about how to best ensure stability while meeting their reform goals.[8] Even with these questions outstanding, we expect investors' attraction to China will increase as its capital markets continue to develop.

The framework presented here offers investors a method for evaluating the economic cost (for which real r* is a conservative proxy) of the capital they might want to put to work in China, and how that cost may rise over time. Comparing this model with the path of available rates in China can provide investors with a guide to an appropriate reference rate they should require for parting with their capital. These tools should enable more informed consideration of onshore assets in China's changing financial landscape.

[7] This edition of our Long-Term Capital Market Assumptions features an expanded set of estimates for onshore Chinese assets. The expansion of China's financial markets is also covered in our Fixed Income Assumptions.

[8] Diego Anzoategui, Mali Chivakul and Wojciech Maliszewski, "Financial distortions in China: A general equilibrium approach," International Monetary Fund Working Paper WP/15/274 (2015). https://www.imf.org/external/pubs/ft/wp/2015/wp15274.pdf

ESTIMATING CHINA'S r*

In any economy, the interest rate relates the cost of an investment and its return. We can expand this principle into a model where a country has a natural rate of interest that equates investment and return. A country's economic return, typically measured by GDP, can be broken down into two components: labor and capital. A marginal-returns-to-capital function allows us to estimate what level of interest rates, r*, equates output and its components for China, focusing on the relationship between investment—how capital is built—and interest rates. We do this by determining the real return on the marginal product of capital—or how much an investor (here, anyone investing in China's capital stock) will receive in proportion to the additional economic output we can get from one additional unit of investment.

This concept can also be written as:

$r^* = (\alpha/(K/Y) - \delta) * (1- \tau)$

Where α is capital's share of output, K is the real capital stock, δ is the depreciation rate on that capital stock, Y is real output, and τ is the tax rate on capital.[i] We use China's corporate income tax rate for taxes on capital, gross fixed capital formation's share of GDP as capital's share of income, the depreciation rate for China's capital stock calculated in the Penn World Table, our own estimate of China's real capital stock, and annual real GDP in this equation to arrive at an estimate of real r*.

Estimating China's capital stock, data that China does not publish, was the most challenging part of this exercise. The essential question was: How much productive capital is created from the country's high investment rate since not all investment goes into economically productive activities? Different methodologies produce vastly different results. We took two approaches: One assumed capital stock grows at the pace of real capital formation's contribution to real GDP, and the other assumed it grows at the rate of productive fixed asset investment (ex-financial and real estate investment). The first likely overstated the present capital stock and the second likely underestimated it, so we used the average of the produced real r* estimates for further analysis. Looking forward, we assumed that the recent average discrepancy between the rate of real GDP and capital stock growth held in each methodology and incorporated our macroeconomic assumption for real GDP growth.[ii]

[i] Dong He, Honglin Wang and Xiangrong Yu, "Interest rate determination in China: Past, present, and future," *International Journal of Central Banking* (2015). http://www.ijcb.org/journal/ijcb15q5a7.htm

[ii] The starting capital stock was estimated using data and methodologies presented by Gregory C. Chow, "Capital formation and economic growth in China," *Quarterly Journal of Economics* 108:3 (1993). https://www.jstor.org/stable/2118409?seq=1#page_scan_tab_contents, and by Kui-Wai Li, "China's Capital and Productivity Measurement Using Financial Resources," Yale University Economic Growth Center Discussion Paper No. 851. https://ssrn.com/abstract=382400

The path of the U.S. dollar: Looking forward by looking back

Dr. David Kelly, CFA, *Chief Global Strategist, Head of Global Market Insights Strategy*
Roger Hallam, *Chief Investment Officer, Currency Management*
John C. Manley, *Global Market Strategist, Global Market Insights Strategy*

IN BRIEF

The U.S. dollar (USD) exchange rate is a critical variable shaping long-term asset returns. Presently, the currency is overvalued in real terms, which is likely unsustainable in the long run. We expect the dollar to be pushed gradually lower over our Long-Term Capital Market Assumptions forecast period by:

- a large U.S. current account deficit
- narrowing interest rate and real economic growth differentials between the U.S. and its major trading partners, resulting in relative capital flows supportive of non-dollar currencies
- the U.S.'s gradual abandonment of its several-decades old "strong dollar policy"

INTRODUCTION

One critical variable shaping long-term global financial asset returns is the exchange rate of the U.S. dollar. This is, of course, obvious for U.S. residents investing abroad and for foreign investors in U.S. assets, but beyond the currency-hedging implications, it is also an important driver of U.S. inflation and interest rates and has a powerful impact on global commodity prices.

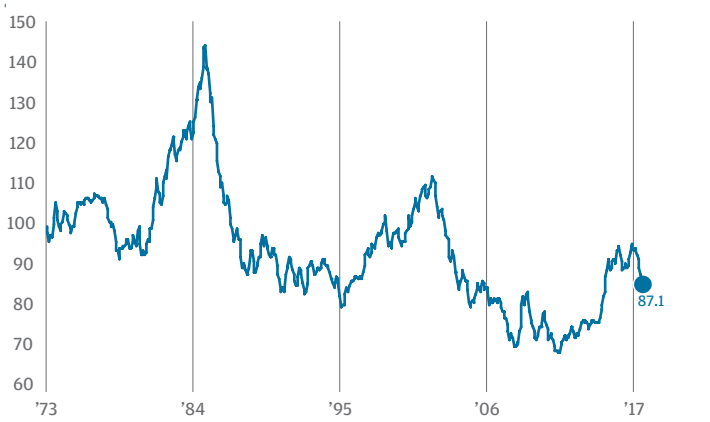
But what fundamentally drives the U.S. dollar? Three broad forces: Classical economic theory highlights the importance of balance of payment flows and suggests that, in the long run, purchasing power parity and current account balances should drive the currency. A more monetarist view focuses on financial flows: A country that attracts foreign capital through higher interest rates or higher expected returns on investments should, in theory, generally see an appreciation of its currency over time. In addition, bouts of active policy intervention to manipulate exchange rates have been overlaid on this markets-based framework by both governments and central banks, either individually or in coordination.

In our Long-Term Capital Market Assumptions, we take a long look forward at how key economic variables and financial markets may evolve over the next 10 to 15 years. When attempting this for the U.S. dollar, we start by looking at how these three broad forces have shaped the path of the dollar in recent decades, then we look at how these forces may evolve in the future and why we believe they justify projecting a generally declining dollar over our forecast period.

Examining 45 years of twists and turns in the dollar allows us to explain chronologically the broad forces that have shaped its path. Looking at the nominal major currency index for the U.S. dollar from January 1973 to September 2017 (**Exhibit 1**), we see how extreme and long-lasting currency regimes can be.[1]

A visual history of the modern U.S. dollar

EXHIBIT 1: NOMINAL MAJOR CURRENCY TRADE-WEIGHTED EXCHANGE RATE, U.S. DOLLAR, MONTHLY, INDEXED



Source: Federal Reserve, FactSet, J.P. Morgan Asset Management; data as of September 30, 2017.

Trade and the dollar: The aftermath of Bretton Woods

Under the Bretton Woods agreement, signed in 1944, a global monetary management system was installed for the first time in history: Signatory countries pledged to peg their respective currencies to gold, while the U.S. government guaranteed a fixed rate conversion of gold to U.S. dollars—$35 per ounce—effectively maintaining an exchange rate across the developed world.[2] This was not a pure gold standard, which would have constrained global money supply growth to the very slow growth in the gold stock. Still, the guarantee of convertibility at the heart of the Bretton Woods framework became increasingly untenable in the 1960s, as nominal GDP growth, and consequently the money supply, far outstripped the growth in the global gold stock.

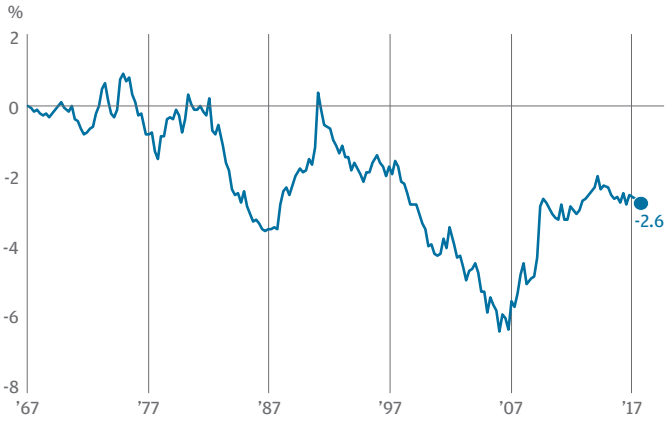
After the U.S. and other countries abandoned direct convertibility in the early 1970s, the U.S. dollar became a floating currency. At first, in the otherwise tumultuous early 1970s, the U.S. dollar exchange rate was relatively stable against major U.S. trading partners. Later in the decade, however, the U.S. dollar began to drift downward. This move largely reflected the traditional and predictable impact of balance of payment flows: In a decade of very high inflation throughout the developed world, U.S. inflation managed to be worse, on net, with the effect of gradually shifting the U.S. from maintaining a current account surplus to a current account deficit (**Exhibit 2**). This current account deficit, in turn, increased the international supply of dollars, putting downward pressure on the exchange rate as dollar supply ballooned.

[1] The Federal Reserve's major currency index is a geometrically weighted average of the U.S. dollar's bilateral exchange rates with seven currencies: the euro (and its predecessors), the Canadian dollar, the Japanese yen, the British pound, the Swiss franc, the Australian dollar and the Swedish krona. The weights are based on exports, imports and third-country trade for each currency region. See "Indexes of the foreign exchange value of the dollar," Federal Reserve Bulletin (Winter 2005), https://www.federalreserve.gov/pubs/bulletin/2005/winter05_index.pdf

[2] Signatory countries included the U.S., Canada, Australia, Japan and Western Europe (Germany, France, the UK, Italy, Spain, the Netherlands, Belgium, Switzerland, Greece, Denmark, Finland and Norway).

The U.S. maintains a substantial current account deficit

EXHIBIT 2: U.S. CURRENT ACCOUNT BALANCE AS A % OF NOMINAL GDP, QUARTERLY SAAR



Source: U.S. Bureau of Economic Analysis, FactSet, J.P. Morgan Asset Management; data as of September 30, 2017.

Financial flows and the U.S. dollar: The early 1980s

The U.S. recessions of the early 1980s were "stagflationary," characterized by simultaneously high inflation and high unemployment. To combat the inflation component, which had been unacceptably high for over a decade, the Federal Reserve (Fed) under then-chairman Paul Volcker implemented a very tight monetary policy, boosting nominal U.S. interest rates to extreme highs. In addition, tax cuts and increased defense spending introduced by the Reagan administration early in the decade added to the federal deficit but also helped pull the U.S. out of recession, eventually leading to outsized economic growth.

Extremely high U.S. interest rates attracted global investment into U.S. bonds, while the promise of stronger economic growth fueled international flows into U.S. equities and real estate. The net result was that, although the U.S. still had a significant current account deficit in the early 1980s, the dollar began to appreciate drastically, rising 55% from July 1980 to March 1985.

In retrospect, this appreciation seems wildly overdone. The U.S. was far from the only attractive opportunity for global investors in the 1980s, and because of the lagged effect of the exchange rate on current account economics, the U.S. dollar peaking in 1985 would very likely have led to a much bigger trade deficit in the years that followed, pushing the currency back down. However, investors had become irrationally convinced that the U.S. dollar was a one-way bet, contributing to a speculative spike in the exchange rate.

Policy intervention and the dollar: The 1985 Plaza Accord

The Reagan administration initially regarded the rising dollar of the early 1980s as a benign reflection of greater confidence in the American economy. This sentiment was reversed, however, after President Ronald Reagan's re-election in 1984. James Baker, the new Treasury secretary, signaled that the Treasury would need to re-examine its previous policy of non-intervention in exchange rates to address growing U.S. concern about a rising dollar. This re-examination led to the 1985 Plaza Accord, in which, at New York's Plaza Hotel, the G5 nations (the U.S., Japan, West Germany, France and the UK) agreed to intervene jointly to push the dollar down. While the central banks' actual currency transactions were relatively modest, the joint nature of their actions sent markets a powerful signal. The dollar had already declined from its peak, reached six months before the accord was signed as the coming policy changes were being signaled. It fell more sharply following the September 22 statement, retreating 39% by April 1988.

Over the years, many economists have doubted the impact of central bank interventions on foreign currencies, particularly if the actions are "sterilized"—that is, if foreign currency transactions are offset domestically to prevent any impact on the domestic money supply. However, the Plaza Accord experience suggests the opposite: When a market is dangerously caught up in rampant speculation and momentum, central bank messages can be very effective, provided they are trying to push the currency in an economically logical direction and the policy's purpose is clearly signaled to markets.

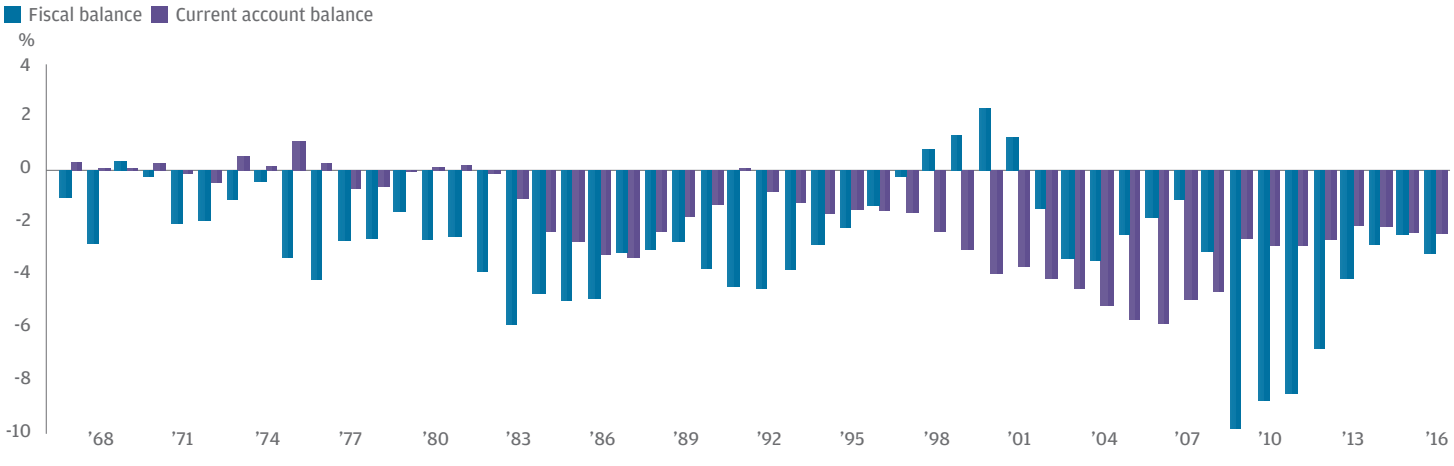
Financial flows and a "strong dollar policy": The 1990s U.S. dollar revival

By early 1987, a severely depreciated dollar following the Plaza Accord had not resulted in a contraction of the U.S. current account deficit, nor had Japan or Germany seen their current account surpluses decline. Economists opined that a falling dollar hadn't fixed the U.S. current account deficit due to a large U.S. budget deficit—America was consuming more than it was producing because the government was spending in excess of its revenues. This was frequently referred to as the "twin deficit" problem (**Exhibit 3**).

With the benefit of hindsight, we can see that critics should perhaps have been a little more patient—exchange rates impact the current account balance with a lag, and the U.S. current account deficit did improve in the late 1980s, even as the fiscal deficit worsened. Nevertheless, fiscal mismanagement has always been a popular scapegoat, particularly for global finance ministers and financial institutions. Consequently, in February 1987 with the Louvre Accord, six nations (the G5 signatories of the Plaza Accord plus Canada)

The U.S. has faced a "twin deficit" problem

EXHIBIT 3: U.S. CURRENT ACCOUNT BALANCE AND U.S. FISCAL BALANCE AS A % OF NOMINAL GDP, ANNUAL



Source: U.S. Bureau of Economic Analysis, Congressional Budget Office, FactSet, J.P. Morgan Asset Management; data as of September 30, 2017.

agreed to a trading range for the U.S. dollar[3] to try to stop its thus-far relentless slide. The accord also prescribed a reduced federal deficit for the U.S. and urged Japan and Germany to take measures to reduce their current account surpluses.

There was little reason to believe that the Louvre Accord would be fruitful; indeed, the agreement did nothing to prevent the dollar from falling a further 12% over the next 14 months. More significantly, the October 1987 stock market crash was widely blamed on distortions caused by the earlier Plaza Accord, casting coordinated central bank intervention in currency markets as a chaotic and negative force. This change of sentiment toward intervention is critical in explaining the dollar's trajectory since the late 1980s: Without a popular desire for intervention, the U.S. would tolerate a highly over-valued currency for long periods over the next 30 years.

From the failure of the Louvre Accord until the mid-1990s, the U.S. dollar remained relatively range-bound, and by 1991 the U.S. had managed to post a small current account surplus for the first time in a decade. This would be short-lived. In the late 1990s, the dollar began to rise more quickly. The economy started to boom as technology investment spending surged and the Clinton administration, determined to avoid being labeled too "liberal" on financial issues and willing to use a rising current account deficit as a safety valve to defuse concerns about an overheating economy, maintained the policy position that "a strong dollar is in the interest of the United States."[4] This strong dollar policy, alongside booming economic growth and, eventually, higher U.S. interest rates, combined to push the dollar up 40% between April 1995 and February 2002. This, in turn, contributed to a rising current account deficit, which reached almost 6% of GDP in 2006.

This high dollar, which had clearly broken away from the anchors of economic fundamentals, finally began to retreat in the mid-2000s, but not before dealing a severe blow to the international competitiveness of most of the U.S. manufacturing sector, a problem that still resonates today.

By March 2008, the dollar had fallen back to levels that might, in time, have brought the current account deficit close to equilibrium. However, the unfolding subprime mortgage crisis increased fears in global markets and—somewhat perversely, since the crisis was centered in the U.S.—caused a global flight to safety, boosting demand for U.S. Treasuries and, in turn, for the U.S. dollar. This "fear trade" reversed soon after the stock market troughed in March 2009, but re-emerged in 2011 with the eurozone crisis, again nudging the dollar higher.

The dollar was bid up further in 2014 and 2015, prompted by the perception that the U.S. was once again outpacing its trading partners in growth and by the expectation that the Fed would soon boost interest rates. Finally, in 2016 and up to the present, the importance of expectations was again underlined as a strengthening global economy, and a lack of confidence in Fed resolve, pushed the dollar sideways and then down—even as the Fed began to implement the tightening that it had long threatened. A brief spike in the dollar following the U.S. presidential election, predicated on rhetoric heralding U.S. economic growth, dissolved as the promised policy change failed

[3] Jeffrey Frankel, "The Plaza Accord, 30 years later," NBER Working Paper 21813 (December 2015). http://www.nber.org/papers/w21813

[4] David E. Sanger, "Rubin hints at end to long U.S. push of strong dollar," *New York Times* (February 1997). http://www.nytimes.com/1997/02/08/business/rubin-hints-at-end-to-long-us-push-of-strong-dollar.html

wwwwwto materialize and efforts got underway to reduce U.S. trade imbalances, resulting in a 2017 that has thus far brought the dollar closer to fair value.

The dollar going forward

So where will these forces likely drive the dollar? At present, the dollar is modestly ahead of historical long-term real valuations, and about 10% above our ex ante estimate of fair value (**Exhibit 4**). It has moved higher as a result of the global economic crisis and tolerant U.S. policy. This overvaluation is likely unsustainable in the long run.

The U.S. dollar is currently modestly overvalued relative to history

EXHIBIT 4: REAL MAJOR CURRENCY TRADE-WEIGHTED EXCHANGE RATE, U.S. DOLLAR, MONTHLY, INDEXED

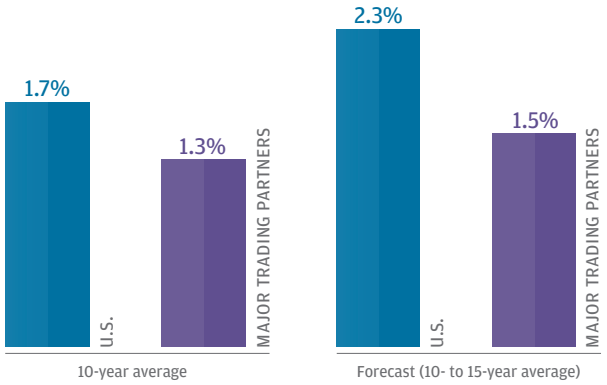
Source: Federal Reserve, FactSet, J.P. Morgan Asset Management; data as of September 30, 2017.

First, balance of payment flows should generally push the dollar down. In the second quarter of 2017, the U.S. current account deficit was 2.6% of GDP, or roughly $500 billion annualized. This is gradually pumping dollars into the world economy and should, by creating an oversupply, push the dollar lower.

Inflation differentials should also reduce the nominal value of the dollar. In our Long-Term Capital Market Assumptions, we assume that U.S. inflation will exceed that of most of its major trading partners[5] by about 0.7% per year (**Exhibit 5**).

Future U.S. inflation should exceed that of most major trading partners

EXHIBIT 5: U.S. HEADLINE CPI Y/Y CHANGE VS. TRADE-WEIGHTED HEADLINE CPI Y/Y CHANGE OF MAJOR TRADING PARTNERS



Source: U.S. Bureau of Labor Statistics, Statistics Canada, Melbourne Institute, Swiss Federal Statistical Office, SCB—Statistics Sweden, Japan Ministry of Affairs & Communications, UK Office for National Statistics, Eurostat, FactSet, U.S. Bureau of Industry and Security, J.P. Morgan Investment Bank, J.P. Morgan Asset Management; 10-year average major trading partners data include J.P. Morgan estimates for Canada and Japan September headline inflation; data as of September 30, 2017. Forecasts based on 2018 Long-Term Capital Market Assumptions data.

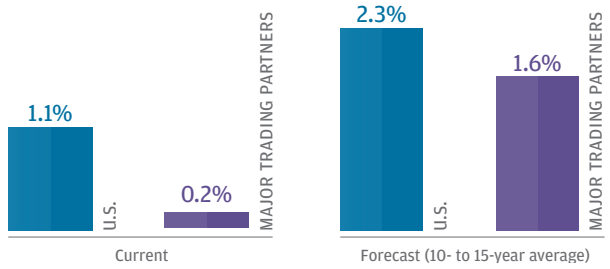
Second, financial flows should also generally push the dollar down. As of September 2017, both long-term and short-term interest rates are higher in the U.S. than in most of its major trading partners. To some extent, this simply reflects that the U.S. is further along in its economic expansion than its trading partners, although we expect U.S. rates will continue to be relatively higher in the decade ahead (**Exhibits 6** and **7**). That said, we are likely beyond the peak of central bank policy divergence and, as such, short-term yield differentials are likely to narrow, providing less support for the dollar compared with the present. Our forecasts show a modest widening of the gap in nominal long-term bond yields, but because of faster rising U.S. inflation, the gap in real long-term bond yields should narrow, putting further downward pressure on the dollar.

Additionally, the real economic growth differential between the U.S. and its developed market trading partners should narrow over the next 10 to 15 years (**Exhibit 8**) and, given more compelling relative valuations, we expect international equities to provide generally better returns than U.S. equities over that time horizon. The resulting relative capital flows should provide support for non-dollar currencies. An improvement in European institutional infrastructure in recent years should also have a similar impact on the euro-dollar relative value; in the years ahead, we will likely see at least a partial reversal of the outflows from Europe that occurred during the eurozone crisis (**Exhibit 9**).

[5] Major trading partners are defined as the countries/regions included in the Federal Reserve's major currency index: Canada, Australia, Switzerland, Sweden, Japan, the UK and the eurozone. Aggregate figures are calculated taking the given metric (i.e., inflation) and weighting it by trade weights as provided by the U.S. Bureau of Industry and Security. Current figures are as of September 2017. This methodology is used throughout this paper whenever "trade-weighted major trading partners" is referenced.

The short-term interest rate gap between the U.S. and its major trading partners should narrow moving forward

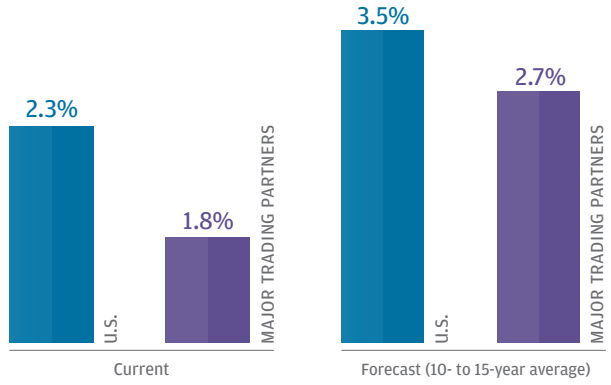
EXHIBIT 6: U.S. 3-MONTH BENCHMARK BILL YIELD VS. U.S. 3-MONTH BENCHMARK BILL YIELD OF MAJOR TRADING PARTNERS



Source: Tullett Prebon, Statistics Canada, Australian Financial Markets Association, Bank of Sweden, ICE Benchmark Administration, FactSet, U.S. Bureau of Industry and Security, J.P. Morgan Asset Management; data as of September 30, 2017. Forecasts based on 2018 Long-Term Capital Market Assumptions data.

The 10-year interest rate gap between the U.S. and its major trading partners should widen modestly

EXHIBIT 7: U.S. 10-YEAR BENCHMARK BOND YIELD VS. 10-YEAR YIELD OF MAJOR TRADING PARTNERS



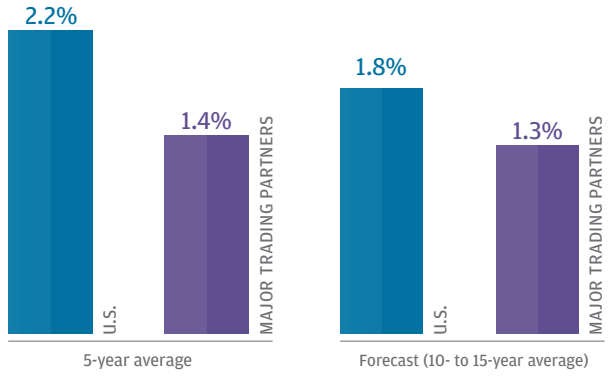
Source: Tullett Prebon, FactSet, U.S. Bureau of Industry and Security, JPMorgan Chase & Co., J.P. Morgan Asset Management; data as of September 30, 2017. Forecasts based on 2018 Long-Term Capital Market Assumptions data.

Third, policy intervention may push the dollar down in the years ahead. For the last 30 years, under both Republican and Democratic administrations, the U.S. has generally pursued a so-called "strong dollar policy," despite its negative impact on U.S. manufacturing. However, the presidential election of 2016 may mark a turning point in U.S. trade policy: The Trump administration is more explicitly protectionist than any of its recent predecessors. Moreover, while this protectionism has often been manifested specifically in calls for tariffs or "border adjustments," a more general stance of encouraging a weaker dollar may yet prove more palatable at home and harder to oppose around the world. While the best example of such a policy is now more than 30 years old, history suggests that a determined and visible attempt by the U.S. to depreciate an overvalued dollar can work.

From the dollar's presently overvalued state, it is reasonable to assume that the currency should follow a path laid out by fundamental forces. Together, these forces—including the U.S.'s significant current account imbalance, a convergence in global interest rates and economic growth rates and the gradual abandonment of the U.S.'s strong dollar policy—underlie our assumption of a gradual decline in the U.S. dollar exchange rate over the next 10 to 15 years.

The economic growth gap between the U.S. and its major trading partners should narrow

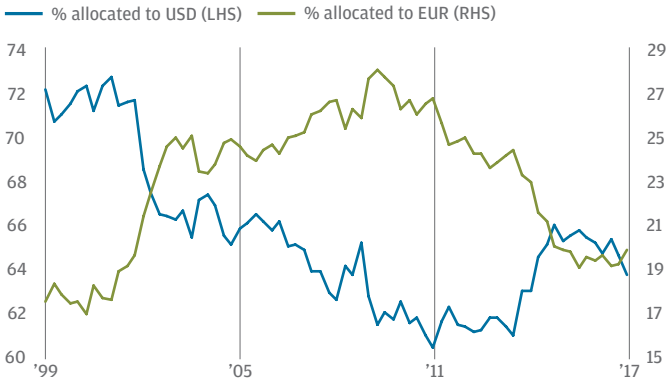
EXHIBIT 8: REAL U.S. GDP GROWTH VS. TRADE-WEIGHTED REAL GDP GROWTH OF MAJOR TRADING PARTNERS, SAAR



Source: U.S. Bureau of Economic Analysis, Statistics Canada, Australian Bureau of Statistics, Swiss State Secretariat for Economic Affairs, SCB—Statistics Sweden, Japanese Cabinet Office, UK Office for National Statistics, Eurostat, FactSet, U.S. Bureau of Industry and Security, J.P. Morgan Asset Management; data as of September 30, 2017. Forecasts based on 2018 Long-Term Capital Market Assumptions data.

The euro has lost status against the dollar as a reserve currency, but this should change

EXHIBIT 9: % OF GLOBAL RESERVES ALLOCATED TO THE EURO AND U.S. DOLLAR



Source: International Monetary Fund, FactSet, J.P. Morgan Asset Management; data as of September 30, 2017.

II Assumptions

G4 government bonds: Slow road, low yields

John Bilton, CFA, *Head of Global Multi-Asset Strategy, Multi-Asset Solutions*
Michael Feser, CFA, *Portfolio Manager, Multi-Asset Solutions*
Jonathon Griggs, *Head of Applied Research, Global Fixed Income, Currency & Commodities*
Sorca Kelly-Scholte, FIA, *Global Strategist, Global Pension Solutions*
Nandini Srivastava, *Quantitative Analyst, Multi-Asset Solutions*
Timothy Lintern, *Analyst, Global Strategist, Multi-Asset Solutions*

IN BRIEF

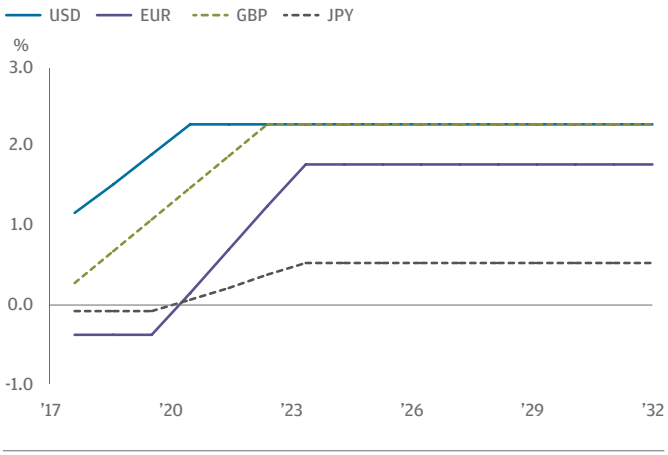
- Expectations of an extremely slow path of normalization and a lower terminal rate are playing out even as global central banks become incrementally more hawkish.
- We make few changes to our economic framework this year, and continue to expect G4 10-year yields to reach equilibrium at or just below national nominal GDP.
- We expect the effects of regulation and aging populations to increasingly manifest themselves in ultra-long dated yields, especially for countries like the UK, where pension scheme underfunding challenges macro fundamentals as the principal driver of long-dated yields.
- Credit remains a bright spot in fixed income, and although the current credit cycle is rather mature, our long-term projections of credit spreads, defaults and recovery rates continue to imply a reasonable return uplift above government bonds.
- The emerging market (EM) debt outlook continues to improve, implying that it offers an attractive diversifier to credit portfolios even with current spreads quite close to long-term fair value.

INTRODUCTION

In last year's edition of our Long-Term Capital Market Assumptions (LTCMAs), we significantly extended the time horizon over which we anticipate normalization of interest rates to play out. We noted that zero and negative nominal interest rate policies are unlikely to remain a permanent feature over our forecast horizon. But with potential growth lower and little sign of inflation, there are few reasons for policymakers to rush normalization. Over the last 12 months, we have seen increasing evidence of this "gradualism" among major central banks. While the eight U.S. rate hiking cycles between 1970 and 2006 lasted, on average, 22 months, the current cycle is already almost two years old, yet perhaps only halfway complete (**Exhibit 1**). Global central bank communications have certainly taken on a more hawkish tone over the past 12 months, but the U.S. has arguably advanced the furthest down the path of hiking. Eventually, we expect rate normalization to occur in all economies, but the path of normalization will be both slow and shallow (**Exhibit 2**).

We expect a slow and shallow path of rate normalization across developed economies

EXHIBIT 2: FORECAST FOR USD, EUR, GBP AND JPY CASH RATES



Source: J.P. Morgan Asset Management; estimates as of September 30, 2017.

* Cash rates at equilibrium are not an estimate of the terminal rate for the current cycle, which may exceed the long-run equilibrium fair cash rate. The equilibrium cash rate represents the central tendency of policy rates over the long run.

Past U.S. rate hiking cycles lasted around 22 months, on average

EXHIBIT 1: U.S. RATE HIKING CYCLES, 1972-PRESENT

Hiking cycle	Starting federal funds rate (%)	Ending federal funds rate (%)	Number of hikes (in 25 bps increments)	Number of months
1972-1974	3.50	13.00	38	28
1976-1979	4.75	15.50	43	36
1980-1981	10.00	20.00	40	10
1983-1984	8.50	11.75	13	16
1986-1989	6.00	9.63	15	31
1994-1995	3.25	6.00	11	13
1999-2000	5.00	6.50	6	12
2004-2006	1.25	5.25	16	25
Average	5.28	10.95	23	21
2015-Present	*0.125*	*1.125**	*4**	*22*

Source: Bloomberg; data as of September 30, 2017. * As of September 30, 2017.

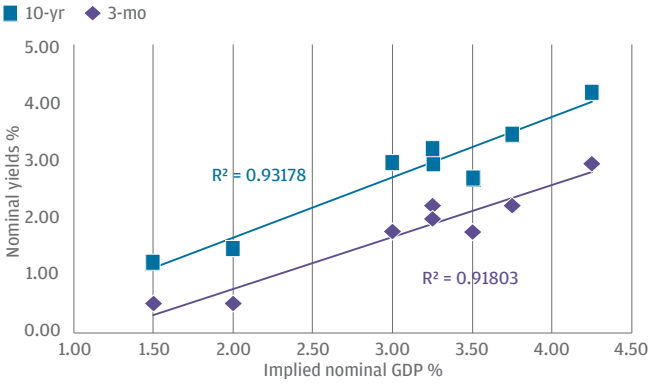
OUR FIXED INCOME ASSUMPTIONS METHODOLOGY CONSTRUCTS EQUILIBRIUM YIELDS FROM SIMPLE BUILDING BLOCKS

BUILDING BLOCKS: ANATOMY OF FIXED INCOME YIELDS AND SPREADS

1. **Equilibrium cash rate**
   - The level of cash rates consistent with our long-run growth and inflation forecasts by country
2. **+ Curve (equilibrium long-dated yield)**
   - Additional yield to compensate investor for holding long-term bonds (term premium)
3. **+ Credit spread**
   - Additional credit spread, incorporating rating migration assumptions for *investment grade* (IG) and credit/liquidity risk premia and expected default loss for *high yield* (HY)
4. **Return calculation**
   - Reflects normalization path to equilibrium interest rate, annual roll-down and rebalancing to a constant maturity index, plus coupon accrual and any defaults/losses

We assume that a rank ordering of short rates will reflect the rank ordering of real GDP growth across developed economies

EXHIBIT 3: 10-YEAR AND 3-MONTH NOMINAL YIELDS VS. IMPLIED NOMINAL GDP, LTCMA 2018 ASSUMPTIONS



Source: J.P. Morgan Asset Management; estimates as of September 30, 2017.

For each region, implied nominal GDP is calculated by adding our forecast for core inflation to our forecast for real GDP. In the U.S., the inflation metric is PCE; for all other regions, the inflation metric is CPI.

In recent editions of the LTCMAs, we have acknowledged the gradual decline in the estimated real natural short-term rate of interest (real r*) across major economies. For most major economies, we assume that real r* is a little above zero,[1] in turn implying that equilibrium short-term interest rates are equal to or slightly above our equilibrium estimate of consumer price index (CPI) inflation. This year we maintain this assumption but also pay more attention to the relative ranking of real GDP relative to equilibrium interest rates across developed economies. We explicitly reduce Japanese equilibrium short rates below equilibrium inflation—implying a negative real rate of interest throughout our forecast horizon. By contrast, we see UK short rates a little above equilibrium CPI despite a weakening growth outlook—accounting for a modest political and inflation risk premium, given the uncertainty hanging over the UK economy for the early part of our horizon. Aside from these outliers, the rank ordering of our baseline assumptions of real r*, which are near-zero across developed economies, matches the rank ordering of our real GDP growth assumptions (**Exhibit 3**).

The elevated correlation of 10-year G4 bonds suggests that the globalization of longer-end yields persists as a market factor. The normalization of bond yields has begun, however, and this year's higher starting yields result in a pickup in duration premium relative to cash. Even then, the duration premium remains quite compressed. Until G4 central banks have made further progress toward balance sheet normalization—and the term risk premium has picked up markedly (**Exhibit 4**)—it is hard to see projected bond returns rising meaningfully above cash returns. This also implies flatter curves in equilibrium[2] as the combined effect of aging populations, increased regulatory requirements to hold bonds and larger central bank balance sheets weighs on longer-dated rates. Cash vs. 10-year curves will likely be flatter than historical averages, and the tendency should be especially acute in the very long end of yield curves, leading to quite flat 10-year vs. 30-year curves across developed economies.

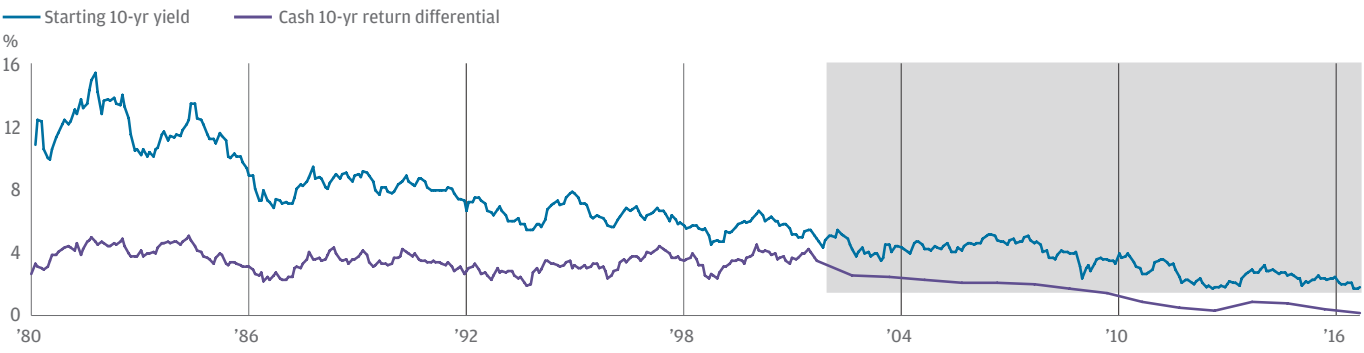
The persistently disappointing return outlook for sovereign bonds certainly does not eradicate all opportunities for bond investors. Credit remains a bright spot, and despite growing cyclical concerns we believe current spreads, despite being tighter than equilibrium fair value, provide for a reasonable return uplift given our long-term expectations of default and recovery rates. As a result, long term, default-adjusted returns across both high yield credit and EM debt look reasonably attractive.

[1] Thomas Laubach and John C. Williams. 2015. "Measuring the Natural Rate of Interest Redux." Federal Reserve Bank of San Francisco Working Paper 2015-16. http://www.frbsf.org/economic-research/publications/working-papers/wp2015-16.pdf

[2] Although in reality yield curves will periodically flatten and steepen in response to shorter-term economic cycles, we have assumed a smooth evolution during the adjustment process toward our assessment of long-term equilibrium 10- and 30-year yields and short-term policy rates.

Until the term risk premium has picked up substantially, it is difficult to see projected bond returns rising much above cash returns

EXHIBIT 4: 10-YEAR TREASURY YIELD AND SUBSEQUENT 15-YEAR RETURN DIFFERENTIAL VS. CASH, HISTORICAL AND PROJECTED (%)



Source: J.P. Morgan Asset Management; estimates as of September 30, 2017.

U.S. RATES

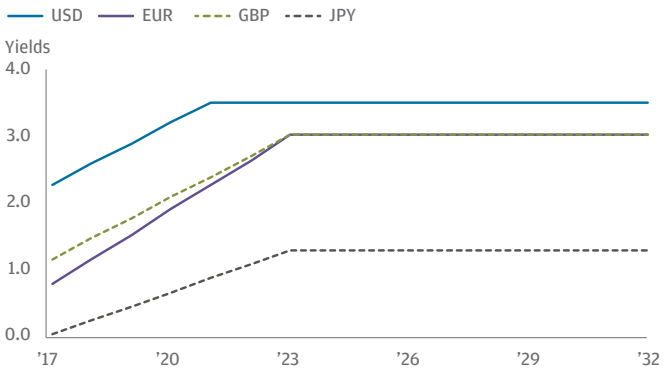
U.S. rates are following a normalization path roughly in line with a hiking cycle lasting around four years. Given this trajectory, we simply roll our baseline normalization assumptions forward by one year and maintain our equilibrium cash rate assumption of 2.25%—the same level as CPI inflation and roughly 25 basis points (bps) above personal consumption expenditures (PCE) inflation.

Of course, there is every likelihood that the terminal rate in this hiking cycle will be above our equilibrium estimate. Nevertheless, once normalization has occurred, we expect U.S. cash rates over the remainder of our forecast horizon to average 2.25%. Even though cash rates will fluctuate around this average with the cycle, we maintain a U.S. 10-year yield estimate of 3.50%, which is 50bps below our forecast of nominal GDP growth and in line with patterns over the last 15 years.

The globalization of bond yields anchors U.S. 10-year yields a little closer to international paths of normalization, in contrast to cash rates, which are more domestically driven (**Exhibits 5** and **6**). However, because normalization has started in the U.S. in the last 12 months, the higher starting point of bond yields results in a modest reversal of the recent spread compression between long-run estimates of cash and 10-year bond returns.

In contrast to cash rates, U.S. 10-year yields are anchored a little closer to international paths of normalization*

EXHIBIT 5: G4 10-YEAR YIELD NORMALIZATION



Source: J.P. Morgan Asset Management; estimates as of September 30, 2017.

EUROZONE RATES

We modestly upgrade our expectations of eurozone real GDP growth, but we do not anticipate normalization of monetary policy to begin until 2019. We expect that inflation will, on average, undershoot targets over our forecast horizon and thus hold our equilibrium yield[3] estimates steady, with cash at 1.75%, the 10-year at 3.00% and the 30-year at 3.25%. In common with U.S. patterns, we've held trajectories for both cash and bond yield normalization static, implying we are one year closer to normalization; even then, we do not expect EUR yields to reach equilibrium until 2023.

[3] We use eurozone yields based on the French government curve as a benchmark.

Lower equilibrium yield and return assumptions reflect expectations of very gradual rate normalization, leading to a lower terminal rate

EXHIBIT 6: DEVELOPED MARKET EQUILIBRIUM YIELD AND RETURN ESTIMATES (10-15 YEAR RETURN ASSUMPTIONS, LOCAL CURRENCY, %)

2018	USD		GBP		EUR		JPY	
	Equilibrium Yield	Return	Equilibrium Yield	Return	Equilibrium Yield	Return	Equilibrium Yield	Return
Inflation	2.25	-	2.00	-	1.50	-	1.00	-
Cash	2.25	2.00	2.25	1.75	1.75	1.25	0.50	0.25
10-year bond	3.50	2.75	3.00	1.75	3.00	1.50	1.25	0.50
30-year bond	3.75	2.50	3.00	1.00	3.25	1.00	1.75	0.25
Gov't bond market*	3.25	3.00	3.00	1.00	3.00	1.50	1.25	0.50
Investment grade credit**	5.00	3.50	4.50	2.50	3.75	2.00	2.00	1.00
High yield	8.25	5.25			6.75	3.50		
Emerging market debt***	6.75	5.25						

Source: J.P. Morgan Asset Management; estimates as of September 30, 2017.

* U.S Intermediate Treasuries, UK Gilts, euro government bonds, Japanese government bonds.

** Investment grade corporate bonds.

*** Emerging market sovereign debt.

UK RATES

The uncertainty created by the Brexit negotiation introduces a number of complicating factors for UK rates this year. Our real growth estimates already reflect a moderate penalty to equilibrium trend growth relative to the eurozone. It has long been common for UK policymakers to rely on pound sterling to act as a shock absorber during times of macro stress, and the aftermath of the UK's vote to leave the EU is no different. This brings some upside risk to inflation, and while we expect UK CPI to find equilibrium close to the Bank of England's 2.00% target, we believe some modest inflation and political risk premium need to be reflected in UK short-end rates. As a result, we expect the UK cash rate to be rather higher than equilibrium real GDP might suggest, and for UK cash rates to normalize a little faster than their eurozone neighbors.

We do not expect meaningful changes in the structural demand for ultra-long dated Gilts. Over our forecast horizon, UK pension and insurance companies represent a significant source of demand for long-dated UK paper; however, in the post-global financial crisis (GFC) period, this demand has diminished. The result is two distinct regimes for the UK long end since the mid 1990s: In the pre-GFC era, an inverted 10s30s curve was commonplace (averaging -20bps between 1996 and 2008), and in the post-GFC period the 10s30s curve was, on average, 80bps positively sloped. We believe the former regime will eventually reassert itself as the management of inflation risk and fund de-risking create ongoing demand for ultra-long dated Gilts—in both inflation-linked and nominal bonds. We thus expect the UK 10s30s curve to be flat in equilibrium, with both 10-year and 30-year Gilts yielding 3.00%. This leaves the UK with by far the flattest yield curve of the developed nations, with an inversion of the long end of the curve a significant risk over our forecast horizon.

JAPANESE RATES

Given Japan's low level of trend growth and our belief that, on average, inflation rates in Japan will fall well short of the 2% target, we expect some form of loose monetary policy throughout our forecast horizon. We therefore reduce our expectation of equilibrium cash rates by 50bps to just 0.50%, resulting in negative real cash rates in equilibrium. We assume longer-dated yields will normalize in line with global trajectories to equilibrium levels of 1.25% for 10-year Japanese government bonds (JGBs) and 1.75% for 30-year JGBs. This implies a steeper curve in Japan than we've seen in recent years, but with real 10-year yields remaining below equilibrium nominal GDP. We infer that the Bank of Japan (BoJ) will need to balance a steeper curve (which aids the domestic financial sector) with equilibrium yields below nominal growth rates (which aid debt sustainability).

GLOBAL CREDIT MARKETS: A BRIGHTER SPOT IN EXTENDED FIXED INCOME

Despite the maturity of the current credit cycle, for a long-term investor credit remains one of the more promising areas in the fixed income universe. Our return estimates naturally reflect the currently compressed level of credit spreads, but we conclude that credit offers an attractive return pickup relative to government bonds, with U.S. investment grade and high yield offering returns of 3.50% and 5.25%, respectively.

The higher level of starting risk-free rates is a consideration across credit markets. IG credit has a much greater duration than HY credit and is therefore more sensitive to this move in the underlying risk-free rates. For both IG and HY credit, the higher starting level of risk-free rates contributes positively to returns, and for investment grade it continues to dominate the slight drag on returns arising from tight IG spread levels. The opposite is true for high yield, where the boost from the risk-free rate is much smaller than the drag on returns coming from the tight prevailing credit spread.

Our estimates of equilibrium credit spread for U.S. investment grade are unchanged from last year, with 10-year IG spreads at 150bps and 30-year IG spreads at 175bps. Combining the spread and duration components leaves us with a return estimate of 3.50% for 10-year U.S. IG corporate credit, a pickup of 25bps over last year's estimate. By contrast, U.S. HY returns drop 50bps from 5.75% to 5.25%.

In last year's edition, we examined the patterns of default and recovery rates across credit markets and concluded that both were remarkably stable in the long term. While discrete credit cycles can be more or less severe, long-term average default rates are strongly mean-reverting to 3.50% and recovery rates to 40%. We also observed that the average level of U.S. high yield spreads in the last 20 years is meaningfully higher than in the 20 years ended immediately before the global financial crisis. While this is commonly explained away as a "liquidity premium," we do not believe that long-term patterns of default and recovery justify the additional post-GFC spread and thus expect the post-GFC premium to gradually accrue back to investors over the longer run. As a result, we maintain our expectation that over our forecast horizon, U.S. HY spreads will, on average, retain a residual 25bps of liquidity premium,[4] leading to an equilibrium spread assumption of 500bps. This is wider than prevailing spreads and thus implies a drag on U.S. HY returns. Nevertheless, compared with other fixed income assets, such a level of return remains attractive (**Exhibit 7**).

[4] The impact of the liquidity premium is explored in our *2017 Long-Term Capital Market Assumptions*, p. 53.

GLOBAL EMERGING MARKET DEBT: CYCLICAL SUPPORT, STRUCTURAL REPAIR, CHINA EMERGENCE

Over the past year, emerging markets have benefited from a modest decline in the U.S. dollar and a broad-based upswing in cyclical growth. Although many EM economies still face a long road to stabilization, the early signs are encouraging. EM external debt remains low, and the current account balances of the more fragile EM nations[5] continue to improve. The EM corporate sector has areas of vulnerability but, in general, is of superior credit quality to U.S. high yield, with roughly two-thirds of the CEMBI broad diversified index made up of investment grade credits. Prevailing spread levels of both sovereign (EMBIG diversified) and corporate EM debt are currently close to our equilibrium estimates of 325bps and 375bps, respectively. This translates to return estimates of 6.25% for EM sovereign debt in local currency, 5.25% for hard currency EM sovereign debt, and 5.25% for EM corporate debt.

China's financial markets will have an increasing presence on the global stage over the next decade or two, a trend that will bear close attention both for EM debt considerations and for the broader tone across global government debt markets.
As Chinese financial markets continue to liberalize, we expect increased access to China's USD 10.8 trillion bond market and USD 9 trillion equity market.[6] We see equilibrium yields of 4.00% for Chinese 10-year sovereign bonds, and 4.50% for Chinese 30-year sovereign bonds. (A description of Chinese bond indices is included in the sidebar, "**Chinese bond market**," and a more detailed paper is available on our website.)

CHINESE BOND MARKET

China's domestic bond market ranks as the third largest in the world, with USD 10.8 trillion (measured by total debt securities outstanding) as of September 30, 2017. The size of the market has increased substantially over the last decade, with an average annual growth rate in excess of 16%.

About 40% of the total debt outstanding—representing 2,190 securities with a market value of USD 4.5 trillion as of September 30, 2017—qualifies for inclusion in the Bloomberg Barclays China Aggregate Index. The index is dominated by government and government-related issuers, including agencies. Corporates, primarily from the financial sector, represent about 14% of the index.

On May 16, the People's Bank of China and Hong Kong Monetary Authority jointly announced the approval of the Bond Connect program, which aims to provide a platform for global investors to directly access China's bond market.

While details of this program are still under discussion, it could help to overcome a key hurdle for the inclusion of the China bond market in major global bond indices. We believe that ownership of Chinese bonds by foreign investors may rise considerably in response to this change, given that they currently own less than 2% of the onshore bond market.

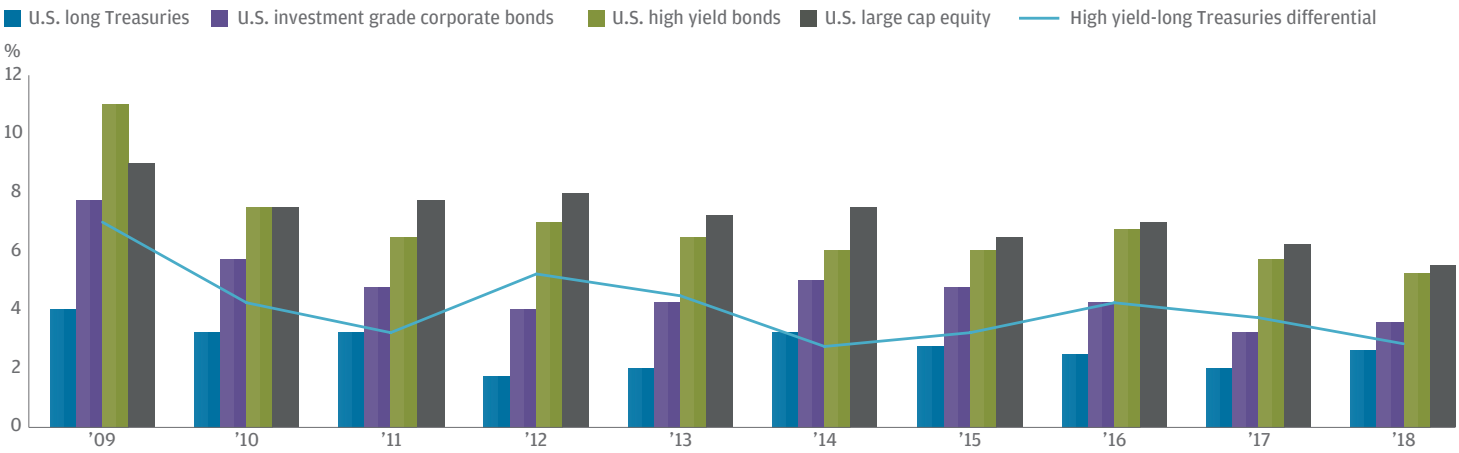
* We discuss the implications of China's ongoing financial liberalization for fixed income investments in "The cost of capital in China's changing markets," featured in our 2018 Long-Term Capital Market Assumptions.

[5] Based on the "fragile five" of Brazil, India, Indonesia, South Africa and Turkey.

[6] Our estimate of aggregated Chinese equity markets, both on and off-shore.

For U.S. high yield, we make an equilibrium spread assumption of 500bps, which is wider than prevailing spreads and implies a slight drag on U.S. high yield returns

EXHIBIT 7: 10-YEAR RETURN ESTIMATES FOR S&P 500, IG, HY; AVERAGE SPREAD BETWEEN THEM SHOWN IN RETURN TERMS



Source: J.P. Morgan Asset Management; estimates as of September 30, 2017. IG: investment grade; HY: high yield

Modestly but steadily lower returns

Patrik Schöwitz, CFA, *Global Strategist, Multi-Asset Solutions*
Stephen Macklow-Smith, *Portfolio Manager, European Equity Group*
Michael Albrecht, CFA, *Global Strategist, Multi-Asset Solutions*
Yann Vestring, CFA, *Quantitative Analyst and Portfolio Manager, Multi-Asset Solutions*
Nika Mosenthal, *Analyst, Multi-Asset Solutions*

IN BRIEF

- Our equity assumptions project lower expected returns in developed and emerging markets. In line with recent years, we see returns over our time horizon falling modestly but steadily behind what historical experience would suggest. The gap between emerging and developed market equity returns narrows somewhat from our last edition in U.S. dollar (USD) terms.
- Another year of strong equity performance has coincided with an expansion of corporate profit margins relative to long-run averages. Across most markets, our return assumptions also continue to face valuation headwinds, notably in the U.S., and anticipated pressure on margins.
- Our view on Japanese equities remains unchanged despite strong performance, as we raise our view of achievable long-term margins and valuations. Despite slow GDP growth, we believe changing corporate behavior in Japan will produce greater capital returns to shareholders. Our euro area assumption falls modestly; our expected U.S. and UK returns fall slightly more.
- Our emerging market (EM) equity return assumptions decline moderately, driven by a fall in emerging Asia return expectations, stemming from our presumption of lower GDP (and thus earnings) growth, as well as higher valuations. In contrast, assumptions for Europe, the Middle East and Africa (EMEA) and Latin America are largely unchanged in aggregate local currency terms, although EMEA USD returns suffer from a foreign exchange downgrade.
- The return of capital to shareholders in the form of dividends and buybacks will be a crucial component of future returns. We continue to forecast that a high proportion of earnings, relative to historical averages, will be distributed.
- We introduce assumptions for global convertible bonds and global credit-sensitive convertible bonds.

MODESTLY LOWER, AGAIN

The message from our equity assumptions for the past several years has been one of expected returns falling steadily further behind historical experience. This year is no exception.

Once again, 2017 was a year when most equity indices rose substantially in excess of our long-term return estimates and of delivered earnings growth. The result of higher starting margins and valuations, combined with a number of country-specific macroeconomic downgrades, is that our returns expectations have broadly declined.

In local currency terms, our expectations for long-term developed market (DM) equity returns have fallen to 5.50% from 6.00% last year, while our expectations for emerging market equity returns have fallen to 8.00% from 8.75%. The expected gap in returns between emerging and developed equities narrows 25 basis points (bps) from last year.

While the magnitude of the downgrade is similar for both blocs, the reasons differ. In developed markets, our downgrade is driven by more challenges for corporate profit margins and slightly higher equity valuations in aggregate. In emerging markets, higher valuations and lower GDP (and thus earnings) growth expectations account for more of the downgrade. But on aggregate, it is predominantly cyclical, not secular.

We continue to expect currency movements to be a major driver of returns for unhedged equity investors. In particular, we expect the USD to weaken moderately over our assumption horizon, boosting the attractiveness of international equity markets (emerging and developed) to U.S. dollar-based investors.

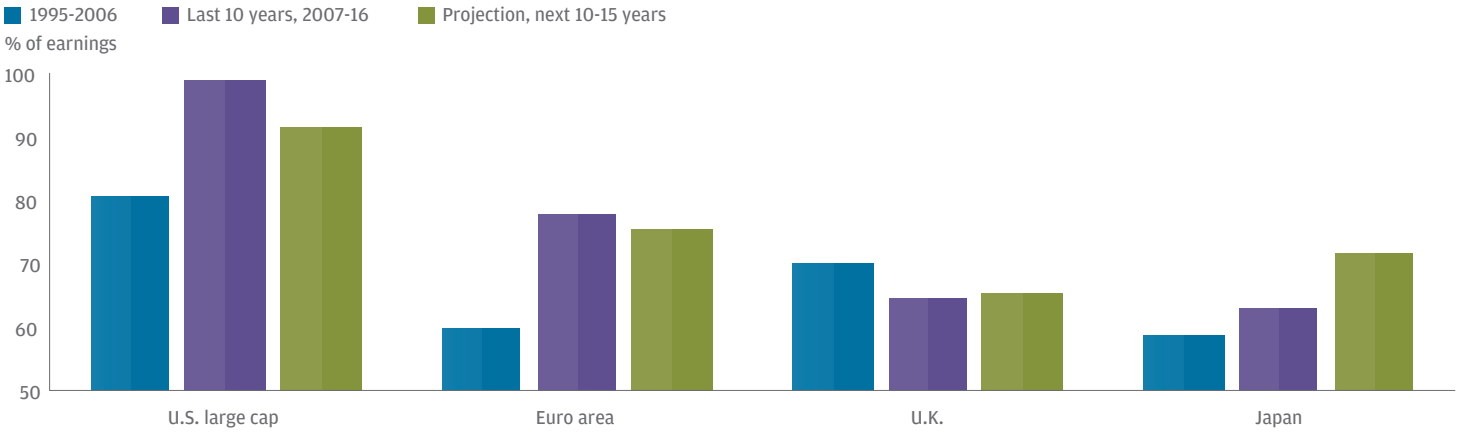
The impact is to lift DM returns to 6.00% in USD, though EM returns remain the same 8.00% as in local terms.

We expect the return of capital to shareholders in the form of dividends and buybacks to be a crucial component of future returns. Our analysis shows that in some markets in recent years more than 100% of earnings were distributed. While we do not expect these extreme payout rates to continue, we forecast that the vast majority of earnings will be distributed (**Exhibit 1**). Our framework is agnostic on whether this behavior arises from a dearth of capital investment opportunities, ultra-low interest rates or a combination of the two. Another intriguing possibility is that investors' demographic profile has shifted and they are now more interested in income than in growth—and with meager levels of income on offer in sovereign debt markets, equities and credit are substitutes.

Developments in banking in the U.S. and Europe may also be part of the explanation for changes in the distribution of earnings. U.S. banks raised a lot of capital very quickly after the financial crisis vs. eurozone banks' rather more drawn-out process. We believe, though, that eurozone banks have now almost completed their capital-raising, and their balance sheets are sufficiently robust to allow for greater distribution of dividends. In the U.S., the results of recent stress tests suggest that distributions from banks should also increase. In the medium term, the much higher level of Tier 1 capital in the banking system, along with other forms of hybrid capital, implies that capital buffers are much more robust. This likely means that in the next growth downturn banking systems on both sides of the Atlantic will have less need to raise new equity capital.

Payout ratios are expected to be elevated relative to history across many developed markets

EXHIBIT 1: PAYOUT RATIO (DIVIDENDS + BUYBACKS, % OF EARNINGS), HISTORICAL AND PROJECTION



Source: Thomson Reuters Datastream, Citigroup, J.P. Morgan Asset Management; data as of August 7, 2017.

BUILDING OUR FORECASTS

We continue to rely on the equity return assumptions methodology we introduced in our 2015 assumptions, summarized in **Exhibit 2**.

Our equity assumptions methodology breaks equity returns into easy-to-forecast return drivers

EXHIBIT 2: BUILDING BLOCKS–ANATOMY OF EQUITY TOTAL RETURNS

1. Aggregate revenue growth
2. × Aggregate earnings growth / revenue growth (margins) = Aggregate earnings growth
3. × Earnings per share (EPS) growth / aggregate earnings growth (net dilution) = EPS growth
4. × Price return / EPS growth (valuations) = Price return
5. + Dividends (carry) = Total return

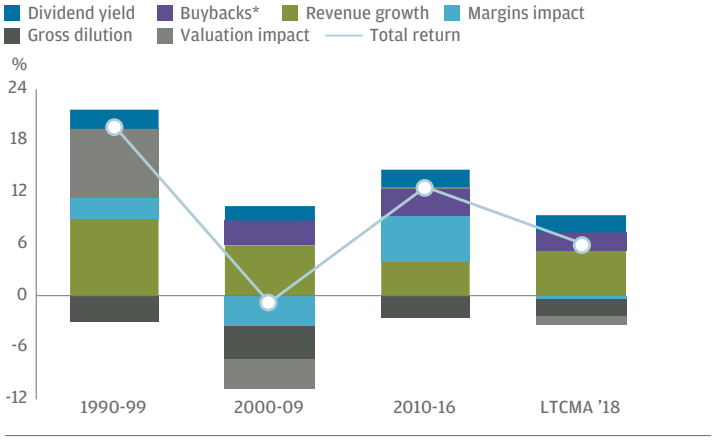
Similar to DuPont analysis, this methodology allows us to decompose total returns structurally into easily forecastable ratios as drivers of returns. It enables us to account explicitly for the global composition of corporate revenues—and how fast different regions are growing—as well as the normalization of profit margins and valuations, and the impact of share buybacks and dilution. Perhaps most important, it ties together complex interrelationships among these factors to ensure that retained earnings and gross dilution imply a future book value that is consistent with projected return on equity and future earnings. This framework—analogous to Robert Higgins' sustainable growth rate (SGR) concept—suggests that higher shareholder payouts, for instance, would come at the expense of slower earnings growth, other things being equal.

DEVELOPED MARKETS EQUITY RETURN ASSUMPTIONS

In the U.S., our expected return for large cap equities falls to 5.50% from 6.25%, due to higher starting valuations and greater headwinds from margin normalization (**Exhibit 3**). Earnings-based valuations for the U.S. now sit comfortably above their long-term average, so our conclusion that valuation is a headwind should not be controversial. Our work on total distribution to shareholders, including both dividends and share buybacks, shows that U.S. public companies have been distributing more than 100% of earnings in recent years. We believe that this is the product of the recent ultra-low interest rate environment and that as interest rates normalize, distribution will decline as a percentage of earnings but remain high.

Slower revenue growth and high valuations subdue U.S. large cap returns relative to history

EXHIBIT 3: CONTRIBUTION TO TOTAL RETURNS, % ANNUAL, FOR U.S. LARGE CAP EQUITIES



Source: Thomson Reuters Datastream, U.S. Bureau of Economic Analysis, Citigroup, J.P. Morgan Asset Management; data as of September 30, 2017.

* Buybacks are included in "gross dilution" before 2000, i.e., as net dilution, due to limited data availability.

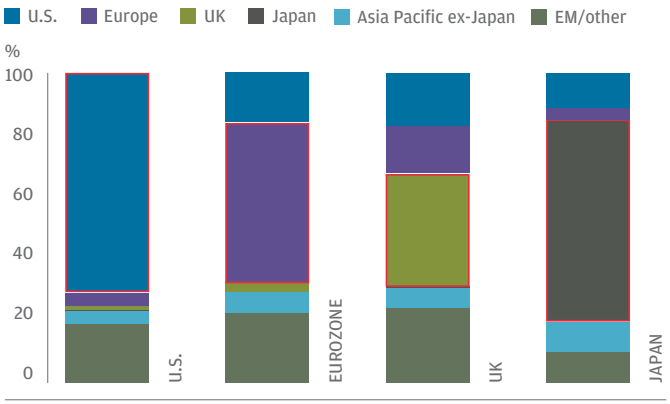
In the euro area, we moderately decrease our expectations for future returns of large cap equities to 5.75% from 6.00%, reflecting much wider starting profit margins, offset to some degree by higher revenue growth as we raise our expectations for nominal euro area GDP, and for a higher level of distribution to shareholders. In recent years, the financial sector has needed to raise a lot of capital. We believe this process is largely complete and therefore, the net effect will be to raise payouts. European companies' valuations have risen since last year, and the return to earnings growth means that margins have already recovered to where they are now a roughly neutral factor for future returns. That stands in contrast to U.S. equities, which only during the late 1990s tech boom were more expensive than they are today, relative to earnings. Europe has seen higher levels of valuation five times in the last 40 years.

Japanese equities continue to face a headwind from slow domestic GDP growth, but the signs of a change in corporate behavior that we have acknowledged in the past remain clear—with greater capital returns to shareholders—and we believe that this will continue. The prolonged de-rating of Japanese equities from their heady 1980s peaks is now over, and we expect earnings-based valuation in the future to be closer to what we see in the rest of the world. Although Japanese equities have delivered strong performance since last year, valuations are little changed as margins have continued to grow since a surge induced by the yen's weakness in 2013-14—one of many signs of a positive change in corporate governance. Accordingly, we have again raised our assumptions for long-run sustainable Japanese valuations and margins, toward levels closer to those in Europe.

The UK market has also performed well since last year. But the data as yet shows no earnings recovery from recent years' downtrend caused by falling commodity prices and financial sector woes. Although the outlook for the UK in the wake of Brexit remains uncertain, the vast majority of the UK equity market is internationally, rather than domestically, focused (**Exhibit 4**). This is another reason our framework continues to assume a recovery in earnings from these depressed levels, even though future profitability will likely remain impaired relative to history, given lower commodity prices. A strengthening currency is another potential margin headwind, although, conversely, reported corporate earnings have so far offered little evidence that sterling's fall has provided a tailwind for earnings (though this may just be a reporting lag). Furthermore, rising margins have historically often gone hand in hand with stronger sterling in the UK. Overall, this combination of factors means that our expected return falls moderately, to 5.50% from 6.25% in last year's report.

Foreign revenue shares vary considerably across major developed markets

EXHIBIT 4: INTERNATIONAL REVENUE BREAKDOWN FOR G4 MARKETS



Source: Thomson Reuters Datastream, J.P. Morgan Asset Management; data as of August 7, 2017.

Our equity assumptions call for modestly lower expected returns, in line with the pattern of recent years

EXHIBIT 5: SELECTED DEVELOPED MARKET EQUITY RETURN ASSUMPTIONS AND BUILDING BLOCKS

Equity assumptions	U.S. large cap	Euro area	UK	Japan
Revenue growth	5.3	4.6	4.5	3.0
+ Margins impact	-0.7	-0.3	0.8	-0.7
Earnings growth	4.5	4.3	5.4	2.3
+ Gross dilution	-2.0	-2.0	-2.0	-2.0
+ Buybacks	2.3	1.6	0.7	2.1
EPS growth	4.8	3.8	4.1	2.3
+ Valuation impact	-1.4	-1.1	-2.1	-0.2
Price return	3.3	2.7	1.9	2.1
+ Dividend yield (DY)	2.0	3.0	3.5	2.5
Total return, local currency	**5.50%**	**5.75%**	**5.50%**	**4.75%**
Change vs. 2017	-75bps	-25bps	-75bps	–

Source: J.P. Morgan Asset Management; estimates are as of September 30, 2017.

EXHIBIT 6: SELECTED EMERGING MARKET EQUITY RETURN ASSUMPTIONS AND BUILDING BLOCKS

Equity assumptions	China (H)	Korea	Taiwan	India	South Africa	Brazil
Revenue growth	8.8	6.3	5.1	13.1	9.6	9.6
+ Margins impact	-0.3	-1.2	-0.5	-0.1	-0.4	0.8
Earnings growth	8.4	5.1	4.6	13.0	9.1	10.5
+ Gross dilution	-3.0	-1.1	-1.0	-2.8	-1.9	-4.3
+ Buybacks	0.3	1.3	0.5	0.3	0.5	0.8
EPS growth	5.4	5.3	4.0	10.1	7.6	6.5
+ Valuation impact	-0.6	0.7	0.6	-2.8	-2.1	-3.3
Price return	4.8	6.1	4.6	7.0	5.3	3.0
+ Dividend yield (DY)	2.8	1.5	3.5	1.5	3.0	3.5
Total return, local currency	**7.75%**	**7.75%**	**8.25%**	**8.75%**	**8.50%**	**6.75%**
Change vs. 2017	-200bps	-25bps	-75bps	–	+50bps	-75bps

Source: J.P. Morgan Asset Management; estimates are as of September 30, 2017.

EMERGING MARKET EQUITY RETURN ASSUMPTIONS

Emerging markets should continue to offer a higher return than developed markets. We expect the gap to developed equities to narrow modestly to 250bps in local currency, as noted above, mostly driven by higher revenue (and thus earnings) growth. From a structural perspective, this higher growth comes courtesy of still-high productivity and the potential for a technology catch-up, as well as emerging economies' generally better demographic picture vs. developed nations, (with the exception of China). Cyclically, many emerging economies are now recovering from the downturn triggered by the collapse in commodity prices in 2015–16, and recent strong performance across EM equity markets suggests the long period of underperformance vs. developed markets has likely drawn to a close. Our expectation that the U.S. dollar will weaken over our forecast period also means that, in the medium term, funding pressures for emerging market sovereign borrowers will dissipate.

We derive our EM equity assumption by applying the same methodology to nine large emerging markets and aggregating by market capitalization weight. The countries we include account for more than 85% of the market capitalization in the MSCI Emerging Markets Index. We once again caution that data history in emerging economies is generally shorter, and data quality less robust, so our confidence in the resulting assumptions is by nature somewhat lower than for developed markets. Despite this reservation, and the variety of cyclical and structural crosscurrents moving through the emerging market universe, we identify a few common themes.

We see a shift among regions: Our local currency assumption for the dominant EM Asia region drops to 8.00% (8.25% in USD) from 9.00% (9.75% in USD), driven mostly by lower GDP growth and higher starting valuations. In contrast, assumptions fall more modestly for EMEA, down only 25bps to 8.50% (7.75% in USD), and in Latin America remain steady at 7.25% (6.75% in USD).

The one percentage point decline in EM Asia returns can be traced to declines in all three of the region's major markets. The return for Chinese equities falls to 7.75% from 9.75%, owing to substantially higher starting valuations and lower expected GDP growth. Our Korea return expectation falls to 7.75% from 8.00%, also driven by higher starting valuations and lower GDP growth, although partly offset by an expected recovery in margins and buybacks. Our Taiwan return assumption drops to 8.25% from 9.00% due to lower GDP growth and an expected fall in margins, partly offset by cheaper valuations vs. last year. Within the relatively stable LatAm and EMEA return expectations, Brazil drops to 6.75% from 7.50%, mostly due to much higher valuations after a year of strong performance. The return assumption for South Africa rises to 8.50% from 8.00% due to a higher GDP growth assumption, slightly offset by more elevated starting margins. All assumptions are in local FX.

In **Exhibits 5** and **6**, we present the building blocks that form the foundation of our DM and EM equity assumptions.

CONVERTIBLE BONDS

For the first time in our LTCMAs' 22-year history, we are adding long-term assumptions for convertible bonds. Although this asset class is new to our publication, our multi-asset team has been running convertible bond strategies since 1995.

Convertible bonds—corporate debt securities that provide the holder with an option to convert into the issuer's stock at a predetermined price—have historically offered investors equity-like returns with lower volatility and downside protection through a fixed income floor. Since Thomson Reuters Global Hedged Convertible Bond Index started in 1994, through the third quarter of 2017, it has outperformed the MSCI World Index. Convertibles are suitable for income-oriented strategies due to their fixed income characteristics and can improve the risk-adjusted returns of balanced stock-bond portfolios due to their asymmetric return profile and diversification benefits. However, like high yield bonds, convertibles have been susceptible to liquidity constraints during periods of market stress.

Our methodology for calculating convertible bond returns accounts for convertibles' similarities to and differences from traditional equity and fixed income, as well as the composition of convertible indices. While the geographic composition of the global convertibles universe is similar to that of the MSCI World, it has historically been biased toward smaller companies and cyclical sectors. We incorporate into our convertible bond assumptions our existing LTCMA numbers for equity and fixed income, along with convertibles' equity sensitivity, credit quality, option premium and the underlying stocks' unique characteristics.

This year, our global convertible bond and global credit-sensitive convertible bond assumptions (hedged into USD) are 5.00% and 4.25%, respectively. Credit-sensitive convertibles are securities whose underlying stock trades significantly below the conversion price, causing them to behave more like debt than equity. For context, we forecast 6.00% for MSCI AC (All Country) World and 3.25% for global credit returns. Our assumptions for convertible bonds (applying our methodology to last year's data) have fallen approximately 50bps this year vs. 2017. This change is consistent with the shifts in our equity and fixed income assumptions, and our outlook for a lower return world over the next 10 to 15 years.

A stable to improving alpha outlook offsets the beta drag

Anthony Werley, *Chief Portfolio Strategist, Endowments and Foundations Group*

IN BRIEF

- We see an improving outlook for alternative strategies relative to public markets—largely due to industry and investment trends expected to favor alpha generation and help offset some of the drag from reduced public market expectations. Changes to our alternative return estimates vs. 2017 run from negative to positive, reflecting the unique fundamentals of each strategy type. As always, manager selection will be a critical determinant of investment success across all alternative strategy classes.
- **Private equity (PE):** Reduced public equity assumptions, historically high PE purchase price multiples and significant stores of dry powder lead to a somewhat more pronounced decline in return estimates for PE vs. other alternative strategy classes. A broader opportunity set may help enhance investors' returns.
- **Direct lending:** Projected returns are up slightly and imply yields meaningfully higher than comparable public market credits. Premiums can be expected to fall as this private market matures.
- **Hedge funds:** We mark up return estimates for most strategies, largely reflecting expectations of a transition from a macro-driven to a more fundamentally driven market environment, supportive of alpha generation.
- **Real estate:** Though return estimates are down slightly, the outlook for real estate remains a relative bright spot. Positive factors include disciplined supply, constrained leverage and the globalization of real estate investment flows. **REIT** returns are based primarily on regional core real asset return assumptions and incorporate leverage.
- **Infrastructure:** The return outlook for infrastructure equity is unchanged, given two opposing forces: a strong bid pushing up project pricing, and investors' expectations of higher illiquidity premiums. Infrastructure debt returns are also unchanged, as a lack of investor experience in these markets is expected to keep illiquidity premiums high.
- **Commodities:** Most current indicators (with the exception of those for the energy sector) continue to point to an upturn in the broad commodity cycle. Our return assumptions imply a 150 basis point (bps) real return over inflation, unchanged from last year. For gold, we anticipate a 25bps premium to commodities.

OVERVIEW

The improving return outlook for alternative strategies vs. public markets results from an upgrade in the investment environment for hedge funds, an incrementally expanded opportunity set in private equity and hedge funds, and investor discipline in core real estate, infrastructure and private debt. All three trends were previously identified in our 2017 alternatives outlook, but in our 2018 assumptions the trade-offs and benefits of private vs. public market execution options move a little closer to the conditions that prevailed prior to the current market cycle. As has been the case historically, the return dispersion among managers across the alternative investment spectrum remains wide; full compensation for the risks taken in alternative investing lies in execution above the average manager's performance.

Despite a markdown of public equity and credit expectations, alternative return expectations are generally flat to slightly down (except for direct lending and most hedge fund strategies, which are slightly up, and small and midsize private equity, which are down somewhat more significantly) relative to last year's assumptions (**Exhibit 1**). A clear exposure to non-U.S. markets—particularly Asia ex-Japan, where we have higher return expectations than for U.S. markets—benefits the private equity and hedge fund assumptions. Likewise, as a more fundamentally driven and less central bank/macro market-driven environment continues to evolve, we would expect hedge funds to be in a clearly better operating environment. Interestingly, while public market valuations and returns have been bid up over the past year, investors have asked for higher upfront compensation in the form of higher starting yields in core real estate, infrastructure equity and private debt.

The coast is still far from all-clear as asset size builds in private equity even as purchase price multiples reach or exceed previous peaks. Hedge funds face competition from smart beta and quantitative liquid market operators. U.S. real estate core supply is subdued but increasing, and the infrastructure regulatory outlook still has a bias toward modest allowed rates of return not attractive enough to induce new capital projects. All things considered, the risk-adjusted outlook for illiquid investing has improved on the margin, at least vs. public market options.

Alternative return assumptions are mostly flat to slightly down, but improved relative to public market returns

EXHIBIT 1: SELECTED ALTERNATIVE STRATEGIES—RETURN ASSUMPTIONS (%)

	2018	2017
PRIVATE EQUITY* (USD)	**7.25**	**8.00**
U.S. private equity – small cap	6.50	7.50
U.S. private equity – mid cap	6.75	7.75
U.S. private equity – large/mega cap	7.50	8.00
PRIVATE DEBT (USD)		
Direct lending	7.00	6.75
HEDGE FUNDS (USD)		
Equity long bias	4.75	4.50
Event-driven	4.75	4.75
Relative value	4.50	4.25
Macro	3.75	4.00
Diversified**	4.25	3.50
Conservative†	3.75	3.00
REAL ESTATE - DIRECT (UNLEVERED, LOCAL CURRENCY)		
U.S. core	5.25	5.50
U.S. value-added	6.50	7.00
European ex-UK prime	4.75	5.00
European ex-UK non-prime	6.50	7.00
UK core	4.75	5.25
Asia Pacific core	5.50	5.50
REITS (LEVERED, LOCAL CURRENCY)††		
U.S. REITs	6.25	
European REITs	7.00	
Asia Pacific REITs	7.00	
Global REITs	6.50	
GLOBAL INFRASTRUCTURE (USD)		
Equity – direct	6.25	6.25
Debt	4.25	4.25
COMMODITIES (USD)	**3.75**	**3.75**
Gold	4.00	4.00

Source: J.P. Morgan Asset Management; estimates as of September 30, 2017, and September 30, 2016.

* The private equity composite is AUM-weighted: 60% large cap and mega cap, 30% mid cap and 10% small cap. Capitalization size categories refer to the size of the asset pool, which has a direct correlation to the size of companies acquired, except in the case of mega cap.

** The diversified assumption now represents the projected return for multi-strategy hedge funds (vs. funds of funds, as in previous LTCMAs).

† "Conservative" represents the projected return for multi-strategy hedge funds that seek to achieve consistent returns and low overall portfolio volatility by primarily investing in lower volatility strategies such as equity market neutral and fixed income arbitrage.

†† 2018 assumptions for REITs are levered; in previous LTCMAs, these assumptions (not shown) were unlevered.

PRIVATE EQUITY

The principal driver of our private equity average return estimates—public equity return assumptions—has been reduced. This reduction, together with historically high PE purchase price multiples and a large store of assets to be invested, leads us to reduce our long-term PE return estimates (**Exhibit 2**). There are, however, some positive developments within the industry. Investment discipline has extended into new, higher growth and less efficient markets, and there is greater opportunity to invest in a more concentrated, less fee-burdened "co-invest" option.

Private equity can still offer the potential to earn a premium over public equity returns, but expectations of premia equivalent to those traditionally associated with private equity are unlikely to be met. As we have said in the past, fair compensation for private equity's additional illiquidity, leverage and overall investment model risk accrues to those who can move up the internal rate of return (IRR) dispersion of PE funds through skillful due diligence and manager access; at the average manager level, expectations are for a very modest premium to public markets (**Exhibit 3**).

Private equity return estimates are down, given lower public equity assumptions and challenging PE industry conditions

EXHIBIT 2: PRIVATE EQUITY RETURN ASSUMPTIONS AND EQUITY BETA BUILDING BLOCKS

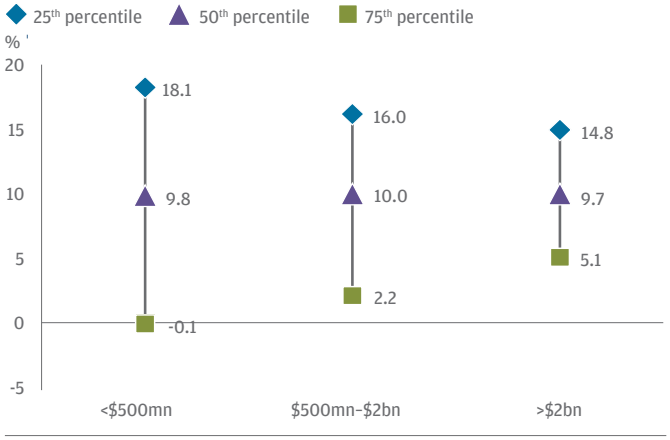
	Small PE (<$500mn)	Mid PE ($500mn-$2bn)	Large/mega PE (>$2bn)	Cap-weighted*
EQUITY BETAS				
Small cap	-0.19			
Mid cap	0.63	0.63	0.27	
Europe			0.21	
Asia ex-Japan			0.36	
Adjusted R^2	0.38	0.57	0.70	
INTERNAL RATE OF RETURN ASSUMPTIONS (USD, %)				
2018	6.50	6.75	7.50	7.25
2017	7.50	7.75	8.00	8.00

Source: J.P. Morgan Asset Management; regression data from June 30, 2006, to December 31, 2016; estimates as of September 30, 2016 and September 30, 2017.

* The private equity composite is AUM-weighted: 60% large cap and mega cap, 30% mid cap and 10% small cap. Capitalization size categories refer to the size of the asset pool, which has a direct correlation to the size of companies acquired, except in the case of mega cap.

Manager choice remains a key determinant of successful PE investing, particularly when investing in smaller funds

EXHIBIT 3: HISTORICAL PRIVATE EQUITY DISPERSION BY SIZE OF FUND,* IRR OF VINTAGE YEARS (2005-15) (%)



Source: Burgiss Private iQ, J.P. Morgan Asset Management; data as of December 2016.
*Includes buyout and expansion capital funds.

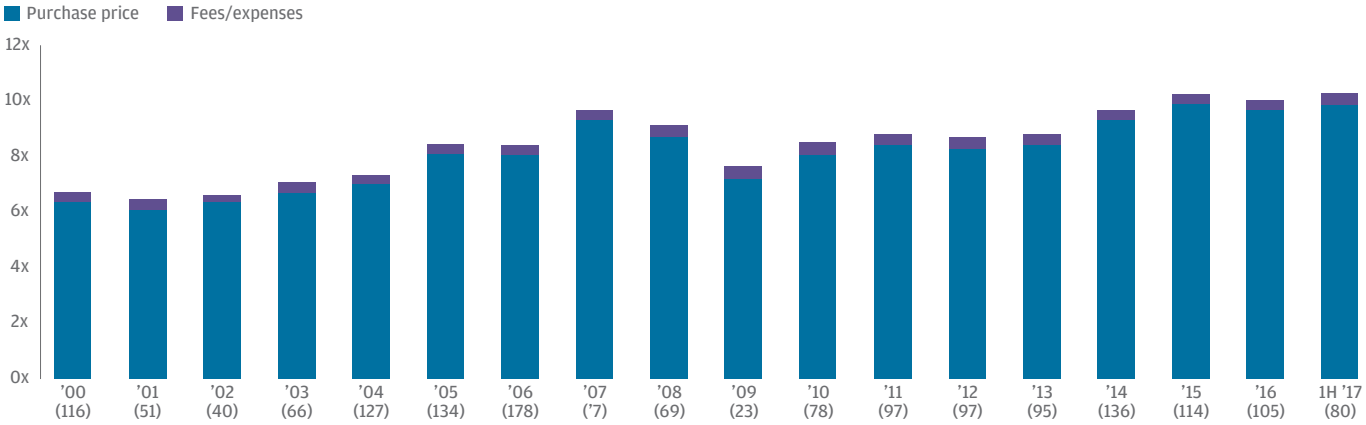
Current market conditions

Along many dimensions, the private equity strategy class currently resembles most of the capital markets: generous valuations, a large volume of assets to be invested and an extension along the risk curve in pursuit of potentially improved returns vs. the traditional portfolio profile. Valuations as measured by purchase price multiples have risen meaningfully since the bottom of the last market cycle and are now at or above the multiples paid at the prior cycle peak (**Exhibit 4**)—not just in the U.S. but generally across the developed markets. As one measure of risk-taking, however, the average debt multiples of issuers are still somewhat below those at the top of the last cycle (**Exhibit 5**).

Regardless of the industry environment, private equity is seen as an antidote to lower expected public equity returns and, as such, portfolio allocations to private equity have risen precipitously over the past few years. A strong distribution environment in recent years is also contributing to the capital available for investment. Fund sponsors have responded in kind by raising ever-larger funds (**Exhibit 6**). Anecdotally, the largest fund size so far this cycle has surpassed the peak fund size of 2007 by approximately 30%. Additional pressure on returns comes from the well-heeled competition of sovereign wealth funds and large pension plans looking to enhance returns by going direct and avoiding fund sponsor fees. Unlike other alternative strategies where historically higher returns have been challenged, there is no expectation of fee abatement within the illiquid equity space.

Purchase price multiples exceed those at the peak of the last cycle ...

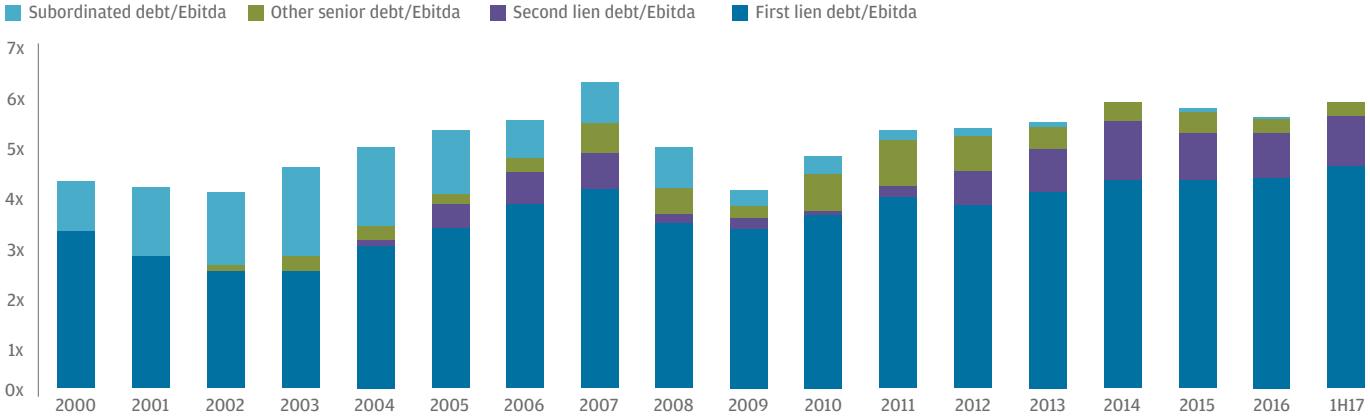
EXHIBIT 4: PRIVATE EQUITY PURCHASE PRICE MULTIPLES



Source: S&P Capital IQ, J.P. Morgan Asset Management; data as of June 30, 2017. Number of deals shown in parentheses.

... while debt multiples are still below the prior cycle's peak

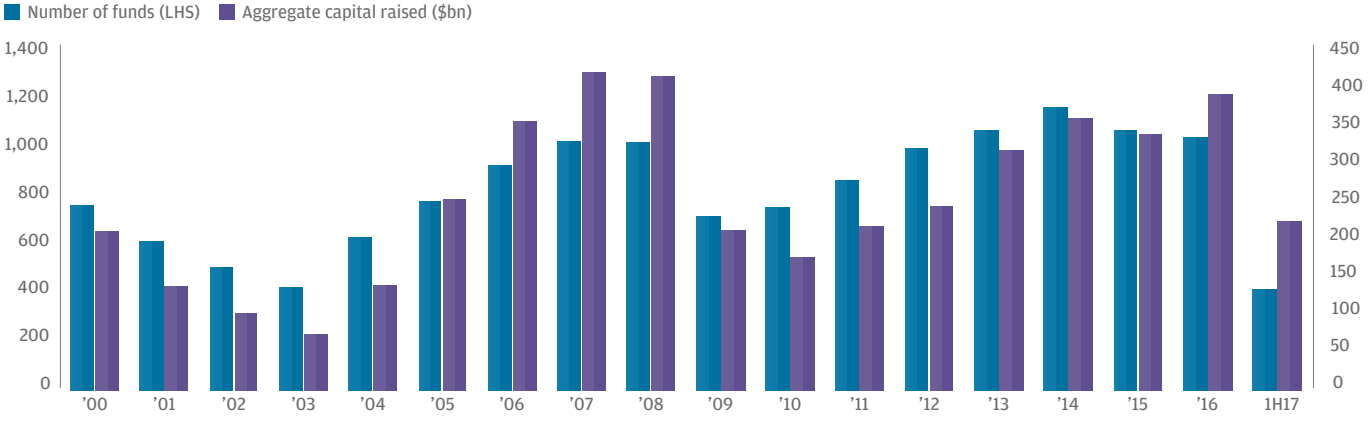
EXHIBIT 5: AVERAGE DEBT MULTIPLE OF ISSUERS (Ebitda > $50M)



Source: S&P Capital IQ, J.P. Morgan Asset Management; data as of June 30, 2017.

Fundraising, driven by increasing private equity allocations, has risen dramatically

EXHIBIT 6: HISTORICAL PRIVATE EQUITY FUNDRAISING BY YEAR



Source: Preqin, J.P. Morgan Asset Management; data as of June 30, 2017.

New opportunities and extensions along the risk curve

Several developments have the potential to enhance private equity returns, including an expansion of the PE opportunity set and new options for accessing PE investments.

Within large/mega and midsize funds, international market exposures, specifically in Europe, have appeared for a number of years. And, for the first time, our 2018 equity beta statistics record a measurable Asia ex-Japan exposure in large/mega funds (see Exhibit 2). Such exposures offer the base case of higher underlying public market returns vs. those of more U.S. domestically focused funds.

Within the growth equity subcomponent of private equity, the higher growth sectors of technology and life sciences offer opportunities for return above the outlook for general GDP-oriented investing. Specifically, cybersecurity, artificial intelligence, disruptive technology, industrial innovation and millennial-focused products and services portend better growth and potential return outlooks.[1]

The most notable development within the past few years is the increasing role of co-investment opportunities—that is, single-company, often reduced-fee investment options—within a diversified private equity portfolio. Clearly, there is potential for higher overall portfolio returns when allocating to fewer, more select, higher conviction opportunities, coupled with a fee reduction. Yet our research indicates that, on average, actual results have not lived up to that premise. These concentrated bets have produced returns in line with, or slightly below, overall portfolio performance. Even so, co-invests have served to put some dry powder to work and have reduced the drag from fees at the margin. As fund sizes increase, however, co-investment opportunities are likely to become less available.

Co-investments serve, once again, to highlight the role that manager and investment selection, not allocation, play in generating excess returns as fund sponsors and investors go farther out on the risk curve through more concentrated portfolios.

The outlook for alpha

Full purchase price multiples, a sizable store of dry powder, increased competition and no discernible return advantage from co-invests, on average, argue for less of a premium above public markets across the fund capitalization spectrum. Our long-term return assumptions are marked down accordingly from last year's, given the lower underlying beta expectation and steady premium over public markets. A marginal exception is made in the large/mega capitalization fund segment to reflect the increased internationalization of portfolio holdings. This is in line with our expectation of higher underlying public market returns, especially in Asia, and the potential, at least, for improved alpha generation vs. the available alpha in U.S. markets.

Finally, it cannot be said too often: Our assumptions represent average manager returns. The true return-enhancing potential of private equity, as demonstrated by top quartile returns, is realized through careful due diligence and selection of top-performing managers.

[1] See "The impact of technology on long-term potential economic growth," J.P. Morgan Asset Management, 2018 Long-Term Capital Market Assumptions for more on this topic.

DIRECT LENDING

Our 2018 long-term return estimate for direct lending is 7.00%, up 25 basis points from last year's estimate (**Exhibit 7**). This increase is due largely to a broadening of the universe we model to incorporate somewhat higher quality borrowers, resulting in a smaller downward adjustment for expected credit losses.

Direct lending/private debt volumes continue to rise strongly, reflecting the benefits to borrowers of speed and certainty of execution, a single counterparty and the flexibility of debt structures that working with a customized provider affords. At the same time, regulatory constraints on bank lending are still in force for the traditional providers of credit to this middle market corporate segment. Current investors receive a significant illiquidity premium for taking on unrated, smaller size loans with a credit profile that is similar to leveraged loans but with a more cyclical bias. As assets and marginal operators are attracted to the space, we anticipate a degradation of both the illiquidity premium received by investors and the historically strong underwriting results experienced by the industry. As direct lending assets grow and become a more institutionalized portfolio allocation, the excess premium to publicly available credit should fall, consistent with the experience of other public-to-private management dynamics, such as private equity.

Composite characteristics

Direct lending characteristics are modeled primarily on the Cliffwater Direct Lending Index (CDLI), a composite of approximately $90 billion of unrated floating rate loans. In developing our assumptions, we have modified the CDLI characteristics to include a slightly broader, higher quality universe, reflecting our assessment of future asset characteristics as this market matures. The assumed debt structure of the enterprise modeled is weighted approximately 65% to first lien and senior secured loans and 35% to second lien and junior securitized loans. For the majority of enterprises, Ebitda falls in the $50 million to $100 million range. Loans are generally a five-year maturity, though through prepayments and refinancing the effective loan life is three years.[2] The current starting terms for the CDLI composite are a 9.25% cash yield and 75bps of original issue discount (OID) and other concessions, with a 1% net credit loss. Our forward assumption suggests a meaningful, though smaller, premium to comparable public market credit options—one we view as more likely to prevail in an excess return, capital-attracting environment like that of the maturing direct lending market.

Direct lending is expected to offer yields meaningfully above comparable public market credits, even as this private market matures

EXHIBIT 7: DIRECT LENDING—RETURN ASSUMPTIONS AND BUILDING BLOCKS (USD, %)

BUILDING BLOCKS	2018	2017
Cash yield (interest income/coupon)	8.00	8.00
OID, prepayment fees, other concessions	0.50	0.50
Credit loss net	-1.50	-1.75
Total return	**7.00**	**6.75**

Source: J.P. Morgan Asset Management; estimates as of September 30, 2016 and September 30, 2017.

[2] Underlying the Cliffwater Direct Lending Index are unrated floating rate loans, selectively extended to middle market companies. The index is weighted approximately 50% to first lien and senior secured loans, 25% to second lien and junior secured loans and 25% to equity, mezzanine and other junior securities. Loans generally have a five-year maturity, reduced through prepayments and refinancing to an average loan life of three years.

HEDGE FUNDS

Our 2018 long-term return assumptions for hedge funds are marked higher vs. our 2017 assumptions for all strategies except event-driven (which is flat) and macro (which is down slightly), even as our beta assumptions across the capital markets are lowered (**Exhibit 8**). These marginally higher returns assume improvements in investment and industry conditions but are based primarily on the premise that the return-corrosive, central bank-driven, massive liquidity conditions of the past several years will give way to a fundamentally driven market environment—one more conducive to alpha generation.

Projecting multi-strategy vs. fund of funds returns

Our definition of diversified hedge funds has changed this year; return assumptions now represent multi-strategy funds vs. funds of funds. The increase in diversified hedge fund return estimates for 2018 vs. 2017 is due largely to the elimination of funds of funds' additional fee level and the higher expected return potential of the more flexible multi-strategy fund structure.

Improving industry conditions

Many of the conditions that depressed hedge fund returns prior to the Great Recession era are still operative—in particular, too large an asset base chasing a diminished opportunity set and competition from non-traditional approaches such as smart beta and other quantitative strategies. On the positive side, changing fee structures and a winnowing-out of the bottom tier of managers owing to waning asset flows and a deterioration of the hedge fund business model should help increase returns.

A more fundamentally driven market is expected to boost returns for most hedge fund strategy types

EXHIBIT 8: HEDGE FUND RETURN ASSUMPTIONS (USD, %)

	2018	2017
Equity long bias	4.75	4.50
Event-driven	4.75	4.75
Relative value	4.50	4.25
Macro	3.75	4.00
Diversified*	4.25	3.50
Conservative**	3.75	3.00

Source: J.P. Morgan Asset Management; estimates as of September 30, 2016 and September 30, 2017.

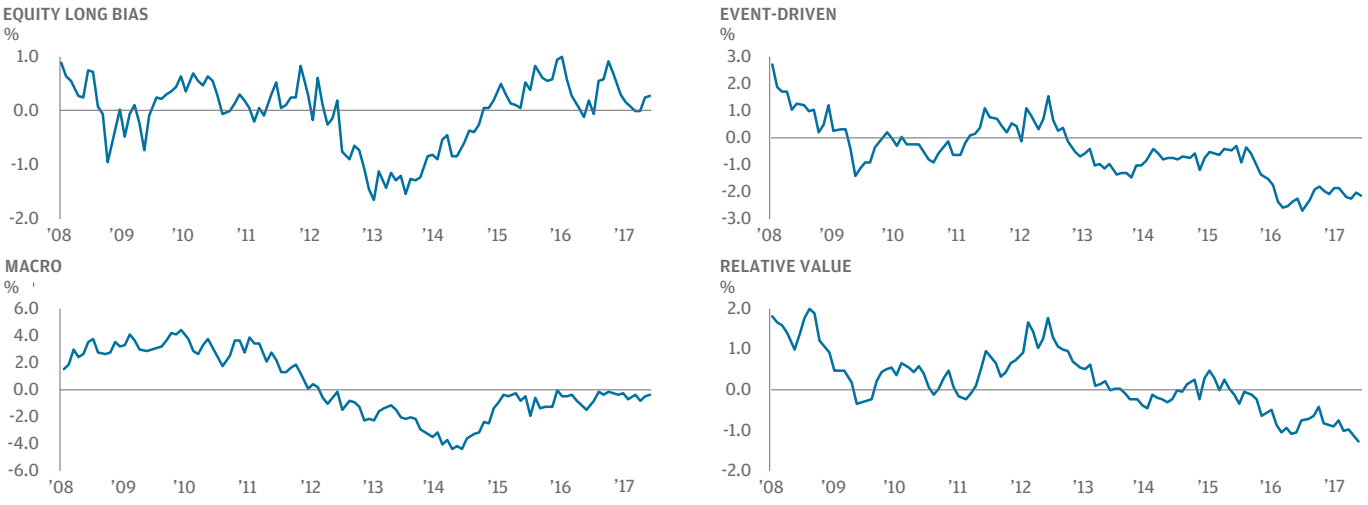
* The diversified assumption now represents the projected return for multi-strategy hedge funds (vs. funds of funds as in previous LTCMAs). ** "Conservative" represents the projected return for multi-strategy hedge funds that seek to achieve consistent returns and low overall portfolio volatility by primarily investing in lower volatility strategies such as equity market neutral and fixed income arbitrage.

Potential for an alpha upturn

Since the Great Recession, the trend for alpha (residual return not described by beta) has been clearly negative, with the exception of equity long bias strategies (**Exhibit 9**). These trends have been consistent with the macro-driven market conditions of the period, characterized by declining interest rates (and an accompanying decline in hedge fund net interest income), rising return correlations, low market volatility and massive liquidity throughout the financial system (which, among other effects, has enabled the survivorship of otherwise less viable entities, hurting the performance of the short book in more fundamentally oriented strategies). Macro—specifically, systematic macro strategies—face a more problematic outlook because the powerful bull market in fixed income has been a key generator of historical macro returns.

We see a bottoming and gradual upturn of negative alpha trends as the industry and market environment improve

EXHIBIT 9: TREND LINES FOR 36-MONTH ROLLING ALPHAS* BY MAJOR HEDGE FUND STRATEGY CLASS



Source: Hedge Fund Research, Bloomberg, J.P. Morgan Asset Management for estimates; data as of May 31, 2017. *Alpha is defined here as the difference between actual composite returns and estimated core beta returns for a given hedge fund strategy. Core beta returns are estimated using J.P. Morgan Asset Management proprietary regression models and actual historical values for the traditional asset class/market drivers of return.

With interest rates at an inflection point, this powerful source of return is, at a minimum, diminished going forward.

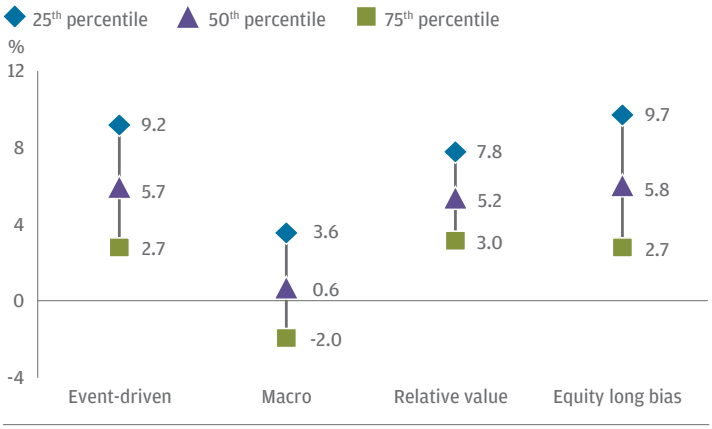
Manager selection matters

As explained in "**Building blocks of hedge fund return estimation (average industry conditions),**" our approach to projecting average hedge fund industry returns incorporates three basic components—core beta returns, alpha trends and alpha potential—but these are *average* return assumptions.

While beta continues to be the overwhelming driver of returns at the average manager level, hedge funds exhibit a high alpha-to-beta ratio vs. traditional asset managers as you move upward through the peer group performance ranking. Likewise, the wide differential in results between top vs. bottom performers is a key risk of the strategy class. Manager selection remains a critical determinant of the extent to which investors realize the potential of hedge funds to generate returns equivalent to a stock-bond combination and to diversify and risk-adjust multi-asset class portfolio performance (**Exhibit 10**).

Manager selection is critical in realizing the investment potential of hedge funds

EXHIBIT 10: DISPERSION OF MANAGER RETURNS (%), JULY 2012-JUNE 2017



Source: Hedge Fund Research, J.P. Morgan Asset Management; data as of June 30, 2017.

BUILDING BLOCKS OF HEDGE FUND RETURN ESTIMATION (AVERAGE INDUSTRY CONDITIONS)

CORE BETA RETURNS: the primary component of our projected hedge fund returns—estimated as the product of beta exposures (from our proprietary regression models; see chart below) and our long-term return assumptions for traditional asset classes

- *Our analysis finds beta exposures increasingly rotating toward higher return non-U.S. markets.*

ALPHA TRENDS: based on historical alpha trends, adjusted for forward-looking expectations (Exhibit 9)

- *We expect the long-running negative alpha trend to moderate as fundamentals increasingly drive performance.*

ALPHA POTENTIAL: further adjustments, based on our interpretation of the impact of industry conditions on the forward-looking alpha potential of each strategy class

- *We anticipate a fee reduction of at least 25bps at the average manager level, industry-wide.*

DERIVED EQUITY BETA EXPOSURES (COEFFICIENTS) AND GOODNESS OF FIT (R^2) STATISTICS

	Long bias	Event-driven	Relative value	Macro	Diversified*	Conservative**
Large cap	-0.18					
Mid cap	0.30	0.13				
Small cap			-0.03	-0.02		
EAFE	0.15		0.10	0.07	0.19	0.12
Japan		0.05				
Asia ex-Japan	0.13	0.05		0.06		
Commodities	0.05	0.06	0.06	0.08	0.07	0.07
U.S. aggregate	-0.40	-0.37		0.18		
U.S. high yield	0.00	0.17	0.23	-0.20	0.03	0.04
World gov. ex-U.S.			-0.16	0.02	-0.20	-0.19
EM corporate			0.11			0.05
Adj. R^2	0.93	0.83	0.84	0.23	0.68	0.67

Source: Bloomberg, J.P. Morgan Asset Management. The time frame for regression analysis is December 31, 2004, through May 31, 2017. *The diversified assumption now represents the projected return for multi-strategy hedge funds (vs. funds of funds as in previous LTCMAs). **The conservative assumption represents the projected return for multi-strategy hedge funds that seek to achieve consistent returns and low overall portfolio volatility by primarily investing in lower volatility strategies such as equity market neutral and fixed income arbitrage. For further details on our methodology, please see J.P. Morgan Asset Management, *2017 Long-Term Capital Market Assumptions*, pp. 65-66.

REAL ESTATE

We see a neutral to positive outlook for real estate relative to most other asset classes, varying by real estate sector. We expect current supply discipline to support returns above levels typical of this later stage in the real estate cycle, contributing to this relative performance over the long term. Our 2018 Long-Term Capital Market Assumptions (LTCMAs) for real estate are, however, revised slightly downward from last year's projections, save for Asia Pacific core (**Exhibit 11**).

Real estate return expectations are reduced, but still strong relative to most asset classes

EXHIBIT 11: REAL ESTATE RETURN ASSUMPTIONS DIRECT (UNLEVERED, LOCAL CURRENCY, %)

	2018	2017
U.S. core	5.25	5.50
U.S. value-added	6.50	7.00
Europe ex-UK prime	4.75	5.00
Europe ex-UK non-prime	6.50	7.00
UK core	4.75	5.25
Asia Pacific core	5.50	5.50

Source: J.P. Morgan Asset Management; estimates as of September 30, 2016 and September 30, 2017.

Global real estate market trends

A number of common themes—the globalization of real estate investment flows, more modest loan to value vs. past cycles and historically attractive spreads vs. public market credit—are recurring globally across real estate markets. While the implications of these trends for returns may differ from region to region and city to city, in general, variations are likely to be muted. Over our investment horizon, changing demographics and online vs. in-store purchasing will likely be global phenomena impacting traditional patterns of asset utilization. The supply discipline of the current U.S. and European cycles and greater anticipated constraint in developed Asia Pacific economies dominate the long-term outlook for real estate returns compared with most other investment options, despite the relatively low current absolute cap rates in many parts of the industry. Leverage is generally constrained even as net operating incomes (NOIs) remain healthy for this stage of the cycle. The increased globalization of real estate flows may exert a modest measure of return harmonization across regions, somewhat akin to the dynamics of the global fixed income markets. Within the industry, generally, there exists a wide dispersion of sectoral return outlooks, bounded on the upside by the relatively controlled development pace and low leverage of core office markets and on the downside by the disruption in the brick and mortar retail segment.

U.S. markets

A general tone of caution and regulation in core real estate development and lending this cycle continues to define the attractive relative return expectation in the space vs. most other asset class return assumptions. Investors' shift away from core to value-added has softened pricing and raised core cap rates and forward-looking underwriting internal rates of return by about 60bps to 75bps over the past two years (**Exhibit 12**). Leverage for core assets has remained inexpensive as rates and spreads have stayed relatively low even as the aversion to leverage remains high. Notably for this late stage in the cycle, NOI growth has outpaced asset appreciation (**Exhibit 13**).

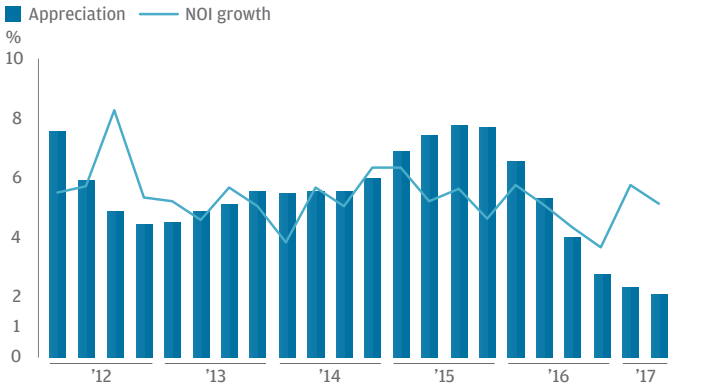
U.S. core real estate is increasingly attractive vs. comparable public credit

EXHIBIT 12: U.S. CORE REAL ESTATE IRRs VS. BBB CORPORATE BOND YIELD TO MATURITY (%)

Source: J.P. Morgan Asset Management; data as of June 30, 2017.
*IRRs refer to forward-looking underwriting internal rates of return.

NOI growth is outpacing appreciation for core U.S. real estate

EXHIBIT 13: FOUR-QUARTER NCREIF ODCE* UNLEVERED PROPERTY APPRECIATION VS. NOI GROWTH



Source: National Council of Real Estate Investment Fiduciaries (NCREIF); data as of June 30, 2017. *ODCE is an abbreviation for open end diversified core equity.

Over the past six months, a step-up in development activity has slightly reduced this cycle's supply discipline, but at the same time, an upturn in corporate earnings and improved business outlook may provide further absorption power, as business expectations drive office leasing more than immediate space needs would indicate. However, the recent uptick in IRRs and overall tone of the cycle have moderated downside expectations for the end of this cycle, producing a better compounding effect over the term of the projection despite marginally lower current cap rates vs. long-term equilibrium.

Our basic model for projecting U.S. core returns begins with current starting yields, adds estimated growth in yields over the term and deducts standard industry fees. A final calculation—the exit yield adjustment—is made to reflect the impact of a rising or falling yield environment on asset valuation (**Exhibit 14**).

Attractive relative return expectations characterize U.S. core eal estate

EXHIBIT 14: U.S. UNLEVERED CORE REAL ESTATE ASSUMPTIONS AND BUILDING BLOCKS (USD, %)

BUILDING BLOCKS	
Starting yield	5.00
Net cash flow growth	2.50
Exit yield adjustment	-1.55
Standard industry fees	-0.70
IRR assumption	**5.25**

Source: J.P. Morgan Asset Management; estimates as of September 30, 2017.

Sectoral considerations

OFFICE: Supply discipline, modest levels of leverage, lower financing rates and extended debt maturities characterize this segment, setting up less onerous expectations in the downside of the cycle. Absorption rates have been slower than expected but are likely to improve along with business confidence.

INDUSTRIAL: The torrid pace of gains, primarily driven by fulfillment centers, should moderate, but unmet demand for logistics facilities remains robust. We expect the impact of direct-to-consumer distribution to moderate in the next few years, as the entire logistics chain is now focused on reducing inventory overhang.

RETAIL: Rumors of the demise of brick and mortar retailers may be exaggerated. Macroeconomic data supports further rationalization of existing facilities rather than more extreme outcomes. Material risk exists within the mall space from approximately 500 weaker malls that may not be able to navigate the move from "goods distribution" to "placemaking and services delivery."[3]

MULTI-FAMILY: Rents are still at a constructive 3% trend line growth despite significant new development. Value resides in suburban markets even as urban luxury apartment rent growth has recently turned negative.

VALUE-ADDED: Flows to value-added strategies are strong at this stage of the cycle. As this dry powder gets invested, expect a compression in returns and convergence between core and value-added returns.

Europe ex-UK

European ex-UK real estate trends are generally in line with the global themes of supply constraint, flow of funds impacting local prices, meaningfully lower leverage vs. the past cycle and an overall positive tone for the duration of the current cycle. Likewise, European cap rates are by historical standards expensive, but spreads to interest rates are historically wide and the global yield quest may yet keep returns from reverting to long-term equilibriums.

The bifurcation of markets into prime and non-prime continues, with the core/primary cities experiencing better demand and more aggressive pricing than non-prime/tier two cities. As risk appetites increase and the European economy continues its expansion, we would expect a catch-up in pricing for the non-prime sector of the market and a compression in the spread between the two tiers.

UK

Longer-term projections for pan-European real estate trends should include a Brexit dynamic that creates a modest return differential between the fortunes of Continental assets and those in the UK. While UK transaction volumes are down precipitously since the June 2016 Brexit referendum, returns have been buffered by the arrival of global investors, particularly from China. London cap rates have risen modestly over the past year, while Continental cap rates are down. The pace and outlook for rent growth have slowed more markedly vs. Continental assets. However, with healthy fundamentals (including low vacancy levels and a somewhat constrained supply in the pipeline), the UK real estate market remains resilient, though a "wait and see" attitude prevails as the Brexit process unfolds.

[3] "Placemaking" is a multi-faceted approach to the planning, design and management of public spaces, capitalizing on a local community's assets, inspiration and potential to create public spaces that promote health, happiness and well-being.

Asia Pacific

The 10- to 15-year outlook for APAC real estate has a slightly healthier tone than that for real estate in the U.S. or European developed markets. This outlook reflects an APAC economic growth rate that, while structurally slowing, is still anticipated to exceed the rate of growth for these developed markets. Slower but still increasing urbanization, changing demographics and a rising middle income population are expected to drive this APAC growth advantage. A stronger web of intra-APAC economic linkages, especially with China, and fewer linkages with a slower-growing, developed U.S. economy should help sustain growth.

Consistent with Asian growth cyclically reaccelerating later than U.S. economic growth, APAC markets, while quite diversified, are likely still in the mid-cycle stage. Commercial real estate supply is decelerating from the stepped-up pace of the last three years even as demand is expected to remain firm going forward. Capital inflows should continue, reflecting healthy fundamentals and the underexposure of U.S. and EMEA institutional investors to the region.

The developing services sector is expected to grow faster than overall GDP, particularly in the China and India markets. Together with increasing urbanization, this should continue to drive commercial real estate growth. The changing complexion of the demographics in the region, both from a growing number of millennials and an aging population, should increasingly impact traditional real estate utilization assumptions. Diminished overcapacity, primarily in China, is expected to drive more efficient use of both office and logistic assets.

Real estate investment trusts (REITs)

Publicly traded real estate prices ultimately converge to the underlying value of the real assets in the REIT index. Our methodology for determining a regional REIT return assumption starts with that region's core real asset return assumption. The regional core assumption is then adjusted for three factors, measured at the regional level, specifically impacting REIT returns:

- net REIT leverage
- discount or premium to NAV amortized to its historical average
- sectoral differences in the composition of the regional REIT index vs. the core real estate composite

Given that our methodology uses regional core real estate assumptions as a starting point, our REIT and core estimates reflect the same regional real estate fundamentals. The adjustments fine-tune these estimates. For example, 20% of underlying assets in regional REIT indices vary from the assets in that region's core real estate composite; the slightly higher growth potential for this 20% adds an incremental return to our REIT assumptions. Our 2018 methodology differs from previous years primarily by the inclusion of average industry leverage, which can also add to REIT returns and have a differential impact across regions. (**Exhibit 15**).

REIT return estimates assume convergence to the value of the underlying real assets and incorporate leverage

EXHIBIT 15: REIT RETURN ASSUMPTIONS AND BUILDING BLOCKS (LEVERED, LOCAL CURRENCY, %)

REITS	U.S.	Europe*	Asia Pacific	Global
Core real asset assumption	5.25	5.50	5.50	5.33
Net leverage benefit	0.40	1.25	1.10	0.66
NAV amortization	0.35	0.25	0.40	0.35
REIT vs. real asset composite difference	0.25	0.00	0.00	0.17
Total return	**6.25**	**7.00**	**7.00**	**6.50**

Source: J.P. Morgan Asset Management; estimates as of September 30, 2017.

* Includes European core prime and non-prime asset assumptions.

INFRASTRUCTURE EQUITY

Our long-term outlook is for infrastructure equity returns of 6.25%. While unchanged from 2017, our 2018 assumption reflects a slight but offsetting shift in the building blocks of return: We anticipate a decline in valuation impact as strong demand bids up project pricing, and expect an equivalent increase in average yield from investors requiring a higher illiquidity premium for these long-term investments (**Exhibit 16**).

No change in infrastructure equity returns, but a shift in components

EXHIBIT 16: OECD INFRASTRUCTURE EQUITY—RETURN ASSUMPTIONS AND BUILDING BLOCKS (USD, %)

	2018	2017
Valuation impact	1.00	1.25
Average yield	3.50	3.25
OECD/developed inflation	1.75	1.75
Total return	**6.25**	**6.25**

Source: J.P. Morgan Asset Management; estimates as of September 30, 2016 and September 30, 2017.

Core outlook

The attractiveness of infrastructure as an investment lies in its potential to provide stable and relatively high core returns augmented by the inflation pass-through accorded selected sectors. The overall economic growth and inflation outlook—modest and steady—should continue to be the primary determinant of core infrastructure returns and their stability over much of our forecast period.

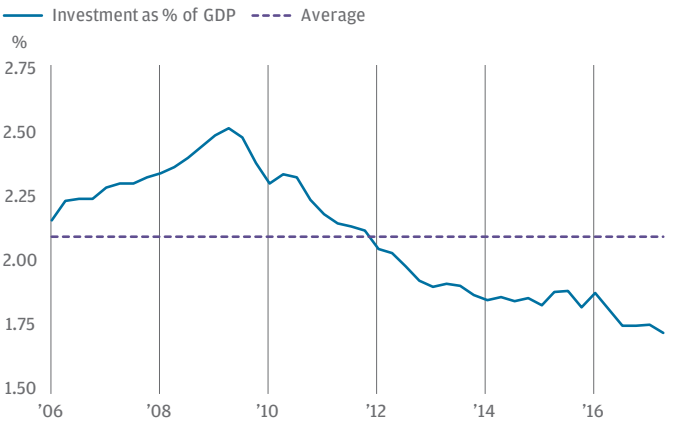
The asset class outlook reflects the same underlying intermediate themes as our 2017 Long-Term Capital Market Assumptions—an expectation that regulators will become less reluctant to authorize capital expenditures at higher rates of return as the necessity of a replacement cycle, particularly in the U.S., becomes more acute. An accumulating capital spending deficit is hard to deny, though its expected size depends on the source of the estimate (**Exhibits 17A** and **17B**). At the same time, the ongoing surge in demand continues for stable high cash flow assets attractive to multiple investor types—from sovereign wealth funds to pensions and sophisticated individual investors. Nevertheless, higher returns are likely to be required to galvanize funding for this plethora of infrastructure projects as they come on line. There are, however, challenges to catalyzing momentum in the short term, as well as elements of uncertainty in the longer term.

In the short term, the outlook for regulatory cycle improvement and a meaningful acceleration of infrastructure spending appears to be on hold. Consistent with the breakout of populist politics, the tone of the regulatory environment has gotten tougher on the margin and allowed returns on equity (ROEs) have been stable to down, though still consistent with a lower weighted average cost of capital.

At the far end of our 10- to 15-year LTCMA time frame, the view is clouded by the difficulty of anticipating the various ways in which technological innovation, populist sentiment and the inclusion of public-private partnerships (PPPs) may impact infrastructure economics.

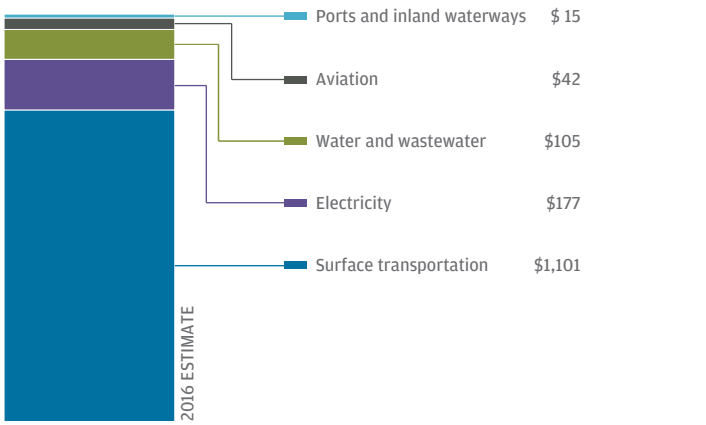
Delayed investment in aging infrastructure portends a very significant capital spending gap

EXHIBIT 17A: U.S. STATE AND LOCAL INVESTMENT IN CAPITAL PROJECTS AS A PERCENTAGE OF GDP (%)



Source: U.S. Bureau of Economic Analysis; data as of June 30, 2017.

EXHIBIT 17B: ESTIMATED U.S. INFRASTRUCTURE INVESTMENT GAP FOR 2016–25 PERIOD (CUMULATIVE GAPS, BILLIONS OF CONSTANT 2015 DOLLARS)



Source: American Society of Civil Engineers, 2016 Failure to Act analysis.

A surge in activity based on the injection of private capital into the infrastructure demand/supply mix appears unlikely for the time being, at least in the U.S. The sale of, and contractual agreements related to, taxpayer assets are not always well received by the stakeholders, such as affected employees, labor unions and the public utilizing the asset, and fair sharing of the risks and rewards is often seen through a political lens. In short, while the potential for infrastructure asset growth is significant, it is difficult to insert private equity ownership and terms into the existing structure of regulation even before the emotional obstacles of populism and partisan politics come into play.

Regulated power

The most stable part of the infrastructure complex—electric distribution—is undergoing a longer-term adjustment as the industry begins to feel the impact of technological and societal change. Consider the small yet growing impact of local sources of alternative power generation feeding into utilities' power grids. Utilities are under pressure to make regulator-approved capital improvements and expenditures in order to bring supply from distributed generation and renewables, especially solar, onto the grid. Yet their ability to recoup these investments—through, for example, "smart metering"—may be necessary to allow the industry to transition from the current system. On the positive side, renewable energy is projected to expand its role as a leading source for electricity generation (**Exhibit 18**). Upgrade of the distribution grid is necessary longer term to accommodate the new sources of power, general obsolescence and growth. This should result in an uptick in regulator-allowed returns on those new assets.

Transportation

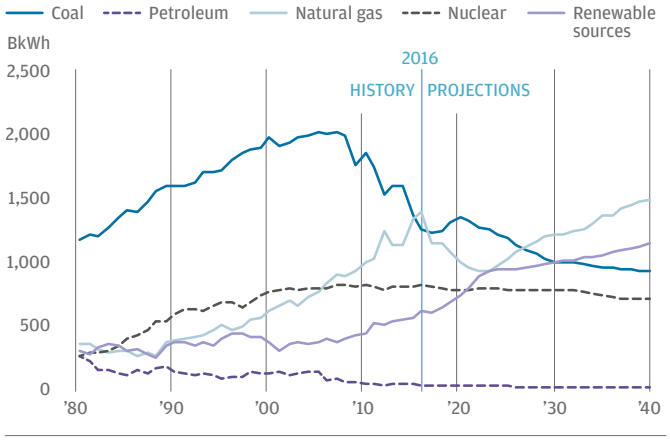
This sector is directly impacted by the consumer outlook, as the improved cyclical economic conditions and lower oil prices are passing through to a better pace of demand for toll roads and consumer-related transport generally. Seaports are experiencing a slower demand outlook as China's growth trajectory slows and global trade has decelerated.

Contracted power

In an industry where the term of contracts is a key value indicator, the recent lengthening of contract terms is a distinct positive, as the percentage of the time an asset is owned outside of the contract term exposes the operator to price risk. The renewables boom, however, is lowering the average cost of power generation and consequently driving down revenue growth.

Renewable energy is expanding its role as a major source for electricity generation

EXHIBIT 18: U.S. NET ELECTRICITY GENERATION BY FUEL (BILLION KILOWATT HOURS)



Source: U.S. Energy Information Administration Annual Energy Outlook 2017, J.P. Morgan Asset Management.

INFRASTRUCTURE DEBT

Our long-term return assumption for infrastructure debt is unchanged from last year's projection.

We view infrastructure debt as essentially an A credit (based on long-term credit loss statistics from rating agency data) with a BBB yield. The spread above the extrapolated credit rating represents a premium demanded by investors for the relative illiquidity of infrastructure debt with more than seven years to maturity. The illiquidity spread emanates from the original sourcing of debt as project finance loans underwritten by banks and generally kept on their books. The increasing secondary market liquidity and secondary market issuance of these loans may eventually reduce the required illiquidity premium, but until there is broader investment experience with these strategies, the required illiquidity premium should remain somewhat elevated at approximately 100bps (**Exhibit 19**).

Infrastructure debt—an A credit with a BBB yield

EXHIBIT 19: GLOBAL INFRASTRUCTURE DEBT—RETURN ASSUMPTIONS AND BUILDING BLOCKS (USD, %)

	2018	2017
A rated credit total return assumption	3.25	3.25
Required illiquidity premium	1.00	1.00
Total return	**4.25**	**4.25**

Source: J.P. Morgan Asset Management; estimates as of September 30, 2016 and September 30, 2017.

COMMODITIES

Our 2018 long-term compound annual commodity return assumption of 3.75% implies a positive real return of 150 basis points over our U.S inflation outlook (2.25%). Projected returns (real and nominal) are unchanged from last year's assumptions. In fact, all of the building blocks we use in constructing our commodity assumptions, starting with the U.S. inflation outlook, are unchanged from 2017 (see "**Building blocks of commodity returns**").

Current state of the commodity cycle

Most current indicators continue to point to an upturn in the broad commodity cycle following its turnaround from the bottoming of the commodity supercycle over a year ago. However, the energy sector, accounting for roughly 30% of the Bloomberg Commodity Total Return Index, presents an exception. While an uptick in global economic activity has stabilized energy demand and the OPEC production agreement of November 2016 is helping to constrain supply, the innovative and low cost U.S. fracking industry has seen these developments as an invitation to loosen production discipline. As a consequence, the energy segment has now taken on late-cycle characteristics in terms of supply outpacing demand, falling prices, easy access to expansion capital and energy operators' seeming expectation of permanent demand absorption.

We see the fracking industry's response as delaying and muting the energy sector's cyclical upturn, but only in the initial years of our forecast period. Arguably, fracking price curves (**Exhibits 20A** and **20B**) enable the industry to produce more oil and gas at a declining cost per barrel, but the incentive to add to current

BUILDING BLOCKS OF COMMODITY RETURNS*

We build our assumptions for commodity returns on the long-term record of the Bloomberg Commodity Total Return Index (a collateralized, investible index). We start with our LTCMA for U.S. inflation and adjust for:

(1) the differential between the 25-year collateralized commodity index return and inflation in the U.S. (which we estimate netted to 0.00 for the 1991-2015 period, despite interim differentials)

(2) where we are in the current commodity cycle (pricing theories based on the economics of non-renewable resources in finite supply are not embedded in our estimates)

(3) a scaling effect to account for the absolute increment in commodity usage of key marginal consumers (namely, emerging Asian and frontier economies)

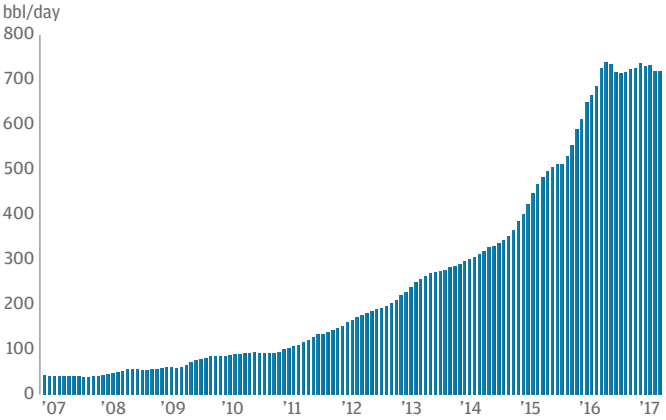
(4) the inverse relationship between commodity returns and the U.S. trade-weighted dollar

(5) the potential contribution from roll yields (which we found for the 1994-2015 period to be inconsistent and statistically negligible; we expect a zero contribution from this source during the 10- to 15-year time frame of our assumptions.)

* For further details on our methodology, please see J.P. Morgan Asset Management, *2017 Long-Term Capital Market Assumptions*, pp. 71-73.

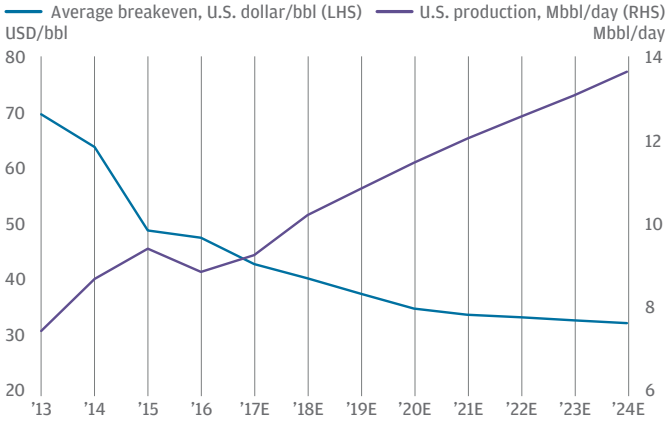
Shale drilling innovation enables more oil production per rig at a decreasing cost per barrel

EXHIBIT 20A: U.S. NEW-WELL OIL PRODUCTION PER RIG



Source: U.S. Energy Information Administration; data as of June 2017.

EXHIBIT 20B: OIL PRODUCTION—KEY U.S. SHALE PRODUCERS VS. AVERAGE SHALE WTI BREAKEVENS



Source: Company reports, U.S. Department of Energy, U.S. Energy Information Administration, J.P. Morgan Asset Management; data as of July 2017.

excess supply assumes sufficient demand to absorb these increases at an attractive price. Current demand/supply conditions seem inconsistent with higher oil prices on a cyclical basis unless the economic cycle grows past the excesses of current supply. In our view, that growth will materialize, absorbing current excess supply and allowing the energy cycle to resume its upturn.

On balance, considering Chinese basic metals capacity shutdowns, OPEC supply constraint and U.S. fracking, among other factors, the outlook for the broad commodities market continues to be one of modest supply rationalization. The supply rationalization process, as indicated by our Commodity Event Index (see "**The Commodity Event Index—Capturing producers' supply constraint sentiment**"), while not quite as robust as it appeared last year, is still essentially operative relative to the demand outlook. As such, we make the same incremental adjustment (+.25bps) as we did last year to our commodity return assumption for where we are in the current commodity cycle (**Exhibit 21**).

Refining the estimation process

The Bloomberg Commodity Total Return Index is basically unchanged from its level at the time of last year's LTCMA publication—masking widely divergent sectoral returns. In examining the component pieces of the index over the past year, we find both rapidly changing cyclical and long-term drivers behind the pattern of recent returns. Analyzing the reasons behind short-term cyclical volatility presents additional insight into the estimation methodology and points to potential refinements to the estimation procedure.

For example, we have made slight adjustments to our Commodity Event Index, which seeks to capture the underlying drivers of supply rationalization as a key element in projecting long-term cycle dynamics. Since the technological innovation within the U.S. shale industry is having a heightened impact on global oil production and the overall commodity change cycle, a reweighting of the component pieces of the index, including an increase in the weighting of the explicit energy rig count factor, is warranted. In effect, with the reweighting of the index, the new commodity cycle appears slightly less robust in turning the corner on past excesses.

Our commodity return assumption is 1.50% in excess of U.S. inflation

EXHIBIT 21: COMMODITIES—RETURN ASSUMPTIONS AND BUILDING BLOCKS (USD, %)

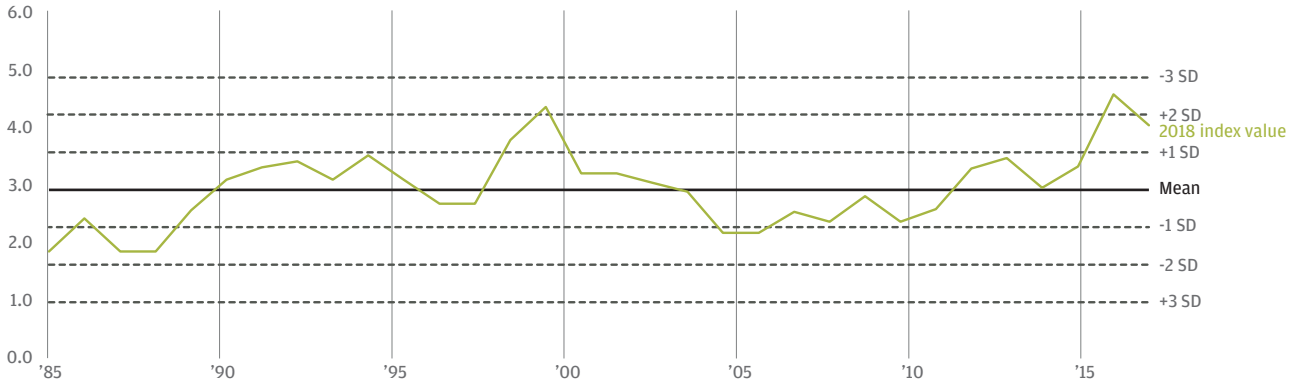
	2018	2017
U.S. inflation assumption	2.25	2.25
Adjustment for historical 25-year investible index return above inflation	0.00	0.00
Position in current cycle (premium/discount)	0.25	0.25
Scaling function adjustment for emerging and developing Asian economies	0.25	0.25
USD decline impact (projected incremental annual decline vs. historical base period)	1.00*	1.00
Impact of roll yield	0.00	0.00
Total return	**3.75**	**3.75**

Source: J.P. Morgan Asset Management; estimates as of September 30, 2016 and September 30, 2017.

* Rounded up from 0.90.

THE COMMODITY EVENT INDEX—CAPTURING PRODUCERS' SUPPLY CONSTRAINT SENTIMENT

THE COMMODITY EVENT INDEX



COMMODITY EVENT INDEX COMPONENTS

The Commodity Event Index is designed to capture producer sentiment around the loosening/tightening of production constraints within commodity markets. Higher index values indicate a more constrained environment, supportive of increasing commodity prices.

The event index utilizes a component weight scheme in which four components have 11.1% weightings, while three components that we deem more important receive an 18.5% weighting, as indicated below. Components were added as available (inclusion date in parentheses) for our universe of energy and materials companies, including:

Index component	Component weight %	Observed change to index component	Impact on index value
Credit rating (1985)	11.1	lower	higher
Age of capital stock (1985)	11.1	older	higher
Financial leverage (1985)	11.1	higher	higher
Volume of bankruptcies, takeovers, debt-for-equity swaps (2004)	11.1	higher	higher
Capital expenditure to sales (1985)	18.5	higher	higher
Oil rig count (1991)	18.5	higher	lower
CEO turnover (2007)	18.5	higher	higher

Source: Baker Hughes, Bloomberg, U.S. Bureau of Economic Analysis, J.P. Morgan Asset Management; Commodity Event Index estimation as of May 31, 2017.

Gold

The return for gold is driven by many of the same factors as general commodity returns but primarily by U.S. inflation, the direction of the trade-weighted U.S. dollar and a scaling factor that reflects the increasingly important developing economy impact on gold consumption. Consumption per capita can be expected to fall in China and India. However, since the two highest per capita gold consumers (with roughly twice the per capita consumption of developed economies) are also the two fastest-growing economies, we expect the net effect to be an increase in the absolute demand for gold. Another small increment to demand is assumed from an erratic but still long-term accumulation of gold for investment purposes. Within the last few years, central banks have ceased liquidating their gold reserves and have started accumulating once again. We project a 25bps gold return premium to broad commodities (equivalent to last year's), implying a 4.00% return for gold.

The tide has turned for the U.S. dollar

Michael Feser, CFA, *Portfolio Manager, Multi-Asset Solutions*
Jonathon Griggs, *Head of Applied Research, Global Fixed Income, Currency & Commodities*

IN BRIEF

- Overvaluation of the U.S. dollar, which had reflected divergences in the cyclical positions between the U.S. and other economies, has begun to unwind amid low inflation and a Federal Reserve moving in slow motion. Unwinding USD strength historically takes around seven years, and we see continued USD weakness over our forecast horizon, even after the retracement from last year's levels.
- While the euro has moved off its cyclical lows, it remains well below fair value. We expect that eurozone economic data—strengthening growth, current account surplus and inflation below the U.S. level—will boost the euro over our forecast horizon.
- Uncertainty surrounding the outcome of UK negotiations to exit the European Union (EU) suggests that forecasts for sterling should reflect a modest increase in Brexit-related risk premia as well as an increase in the downside risks to the UK economy over the medium term. We have slightly lowered our long-term fair value assumption for sterling.

FAIR VALUE AND SECULAR INFLATION AND GROWTH TRENDS

Compared with last year's Long-Term Capital Market Assumptions (LTCMAs), in this year's edition the longer-term secular inflation and growth trends, impacting the future fair value of currency exchange rates, have generally remained well entrenched, both on an absolute level for each countryas well as on a relative basis between countries.

As in prior years, we have determined today's fair value exchange rates for G10 currencies through a relative purchasing power parity (PPP) approach, based on the long-term average of each currency's real exchange rate. To calculate the fair value for emerging market (EM) currency exchange rates, we take an absolute PPP-based approach that uses "actual individual consumption estimates," based on the analysis conducted by the World Bank and the Organization for Economic Co-operation and Development for their international price comparison program.

To arrive at a given exchange rate projection over the assumption horizon, we have adjusted today's fair value exchange rate using our assumptions for inflation and growth. For G10 currencies, we reflect the expected change in a country's terms of trade over the assumptions horizon by adjusting today's fair value for the inflation rate differential between the countries. For emerging markets, we also make an additional adjustment for the expected differential in the GDP per capita growth.

In our growth assumptions, we project that deteriorating demographics, smaller total factor productivity improvements and lower levels of human capital development will continue to hold back developed market (DM) economies. Emerging markets in aggregate will continue to grow faster than their DM counterparts, given larger increases in the size and quality of their labor forces, although with a wide dispersion. Russia, Taiwan and China, in particular, are likely to experience labor force shrinkage in the coming years.

We continue to assume that over the LTCMA horizon developed market central banks will generally come close to achieving their inflation targets, with shorter-term fluctuations occurring within a narrow band. Even for emerging market economies, we expect a relatively stable inflation environment, albeit at levels somewhat above their respective central bank targets.

The primarily political threats to our assumptions for the eurozone and the U.S. appear to have receded since last year's edition. However, Brexit has clouded the UK's prospects, and China's ability to transition smoothly from an investment-led to a more balanced growth model is far from assured.

As a consequence, most of our fair value exchange rate assumptions are little changed from last year, even if considerable adjustments may be required in future years, depending on the actual economic trajectory of the UK and China.

LONG-TERM CURRENCY EXCHANGE RATE ASSUMPTIONS

In last year's edition, we noted that the significant rise of the U.S. dollar was not supported by a change in its long-term fair value, but was rather a result of divergences in the cyclical positions between the U.S. and other developed and emerging market economies. We also expected that those divergences were close to their peak and that the Federal Reserve (Fed) would move very slowly and carefully when normalizing policy rates.

Over the last 12 months, those divergences have declined modestly as the synchronization of global growth dynamics has rapidly gathered pace, developed market growth has come in well above potential, and labor market slack has been diminishing quickly. At the end of the third quarter, both global indicators and financial conditions remained supportive for labor markets to tighten further.

The Fed's hiking cycle is clearly more advanced than other central banks', but global central bank language, especially from the European Central Bank (ECB), has taken on a more hawkish tone.

Somewhat surprisingly, core CPI inflation has remained low and is not responding to labor market tightening in the manner traditional central bank models would predict. With the notable exception of the UK, G4 central bankers have recently lowered their inflation forecasts, voicing concern that inflation will struggle to reach their targets. We therefore continue to expect the path of normalization in all economies to be both slow and shallow.

As a result, and a little earlier than we had expected, this dynamic has allowed the overvaluation of the U.S. dollar to begin to unwind—a process that historically tends to last, on average, around seven years (**Exhibit 1**). Stronger growth in EM economies, coupled with a Fed in slow motion, is also bullish for EM currencies. With domestic reforms unfolding gradually in Latin America, most of the emerging market growth surprises are coming from Asia.

Sterling, impaired by political uncertainty and fears over a hard Brexit, was the exception to this trend—it weakened in the aftermath of June 8 parliamentary elections.

Our assumptions continue to point toward future U.S. dollar weakness, even after the retracement from last year's levels

EXHIBIT 1: ASSUMPTIONS FOR SELECTED CURRENCY EXCHANGE RATES—NEXT 10-15 YEARS

(According to market convention, CURRENCY A/CURRENCY B means one unit of CURRENCY A is worth the stated number of units of CURRENCY B. EUR/USD = 1.30 means EUR 1.00 is worth USD 1.30.)

		Current levels	2018		2017
Currency		September 30, 2017	Per annum % appreciation vs. USD	FX rate assumptions	FX rate assumptions
Euro	EUR/USD	1.18	+1.00	1.34	1.31
Japanese yen	USD/JPY	112.51	+1.50	93	89
Swiss franc	USD/CHF	0.97	+0.75	0.88	0.88
British pound	GBP/USD	1.34	+0.75	1.47	1.52
Canadian dollar	USD/CAD	1.25	+0.75	1.14	1.12
Australian dollar	AUD/USD	0.78	-0.75	0.71	0.74
Chinese renminbi	USD/CNY	6.65	+1.00	5.87	6.07
Brazilian real	USD/BRL	3.16	-1.00	3.59	3.94
Mexican peso	USD/MXN	18.26	+1.25	15.63	16.65

Source: Bloomberg, J.P. Morgan Asset Management; estimates as of September 29, 2017.

*For consistency and ease of conversion, we have assumed that the forecast horizon for the per annum change in percentage terms is 12.5 years.

Euro

Using an expanded array of monetary tools, the ECB has achieved a significant reduction in funding costs, materially improving the fiscal position of the EU region's governments and aiding the cyclical economic recovery. As a result, and contrary to the expectations of many market participants, the euro area is following the U.S. recovery road map, with about a three- or four-year lag. Delayed by a second recession after the Great Recession, the euro area's economic growth cycle is gaining traction and is increasingly self-reinforcing, including in much of the periphery. Pro-EU election results, particularly in France, have reduced political uncertainty to a considerable extent and have provided political capital to focus on institution-building and domestic reforms.

Not surprisingly, ECB rhetoric now signals a less dovish approach, with an initial focus on ending the use of the central bank's politically most controversial policy tool, quantitative easing (QE). Actual interest rate normalization appears some ways off, as inflation levels remain subdued and well below the ECB's target.

As a result, the euro has recovered further from its cyclical lows, but it is still well below fair value at EUR/USD 1.18 as of the end of September. Over the assumption horizon, however, we expect that the eurozone's current account surplus, coupled with an inflation rate below the U.S. level, will result in a 1.00% annual appreciation of the euro to the equivalent of a EUR/USD 1.34 exchange rate.

Japanese yen

Japanese real economic growth remains at the lower end of the developed market range as a challenging demographic outlook dominates recent improvements in productivity. In the past year, the Bank of Japan (BoJ) broke new policy ground by shifting toward a more targeted monetary policy, using yield curve control as its central tool to maintain an extremely easy monetary regime.

Record overall employment implies an economy close to full capacity even with an apparent low level of GDP growth. We therefore expect that Japanese inflation rates will, on average, fall well short of the BoJ's 2% target. Financial repression will therefore still be necessary to erode Japan's high level of sovereign debt throughout our forecast horizon.

As a result, the yen has unwound some of its prior strength and at its current level remains significantly below our estimate for its long-term fair value. Given the need for an easy monetary policy environment throughout our forecast horizon, we expect the yen to trade closer to, but below its fair value at USD/JPY 93.

Swiss franc

The Swiss franc has continued to trade in a narrow range just above our long-term fair value estimate. Over the LTCMA horizon, we expect the Swiss franc to continue to benefit from a relatively more benign inflation outlook than the U.S., suggesting a rise at a long-term annualized rate of 0.75% against the dollar to USD/CHF 0.88.

Sterling

Sterling is the most difficult of the G10 currencies to assess, given the range of potential outcomes for Brexit negotiations. Although we have not changed our long-term growth and inflation projections for the UK from last year, we note that these represent a central case scenario and that the risk distribution on both sides has continued to widen. This suggests that investors should continue to attach a larger than normal risk premium on sterling whatever the actual data for relative inflation or growth over the medium term.

In recent years, our estimates for the prevailing PPP-based fair value for GBP/USD have been close to 1.60. Because our macro assumptions imply no underlying inflation differential with the U.S. over the next 10 to 15 years, our forward-looking PPP assumption therefore remains close to the 1.60 level as well. Last year we incorporated a small Brexit-related negative risk premium for sterling into our calculations and acknowledged the risk that a weaker shorter-term economic outlook would depress sterling for a more prolonged period.

Developments since the UK election in June 2017 suggest that the Brexit-related risk premium on sterling should be increased a little further, and that the downside risks to the economy in the medium term have also increased. We have therefore lowered our long-term fair value assumption modestly to 1.47. From current levels, this implies a smaller 0.75% rise in sterling over our forecast horizon, compared with the 1.25% rise incorporated in last year's LTCMAs.

Commodity currencies

As commodity prices and inflation have bottomed out, the Canadian dollar has recovered from some of its prior underperformance relative to the U.S. dollar. Nevertheless, there is still a need for domestic rebalancing in an economy that accumulated substantial amounts of household credit. Preparing a soft landing for a highly overheated housing market is another unresolved challenge. The Canadian dollar may therefore have to trade at a discount relative to fair value for some time longer. In fact, the loonie continues to trade below our long-term fair value assumption of USD/CAD 1.14, and we therefore expect it to appreciate by 0.75% per annum.

Despite its exposure to the Chinese economic slowdown, elevated house prices and typical sensitivity to a change in the U.S. rate cycle, the Australian dollar is trading at the upper end of its narrow range, close to its 2003 levels and somewhat above our long-term assumption of AUD/USD 0.71. A near-term undershoot to the downside, similar to that already experienced by the Canadian dollar, has become less likely, but still presents a risk, given the domestic economic imbalances.

Brazil faces a new round of political turmoil as its focus shifts from dealing with the economic fallout from the decline in commodity prices over 2014-15. We have moderately improved our expected inflation trajectory, but currency markets continue to discount substantially more progress on the inflation front than we consider sustainable over the LTCMA forecast horizon. We therefore expect a somewhat weaker Brazilian real, falling to a rate of USD/BRL 3.59 vs. the current spot level of 3.16.

BUILDING BLOCKS–CURRENCY EXCHANGE RATES

The annualized compound rate of change expresses the difference between two currencies' current exchange rate and our estimate of their fair value exchange rate at the end of our assumptions horizon—for consistency we use 12½ years.

A DEVELOPED MARKETS

- Starting fair value exchange rate based on the theory of purchasing power parity (PPP)
  - + Expected future inflation rate differential between domestic economies
  - + Review qualitatively and adjust currencies selectively to ensure internal consistency and incorporate secular factors and trends other than relative inflation that would otherwise not be captured
  - + The prevailing spot exchange rate level on September 29, 2017

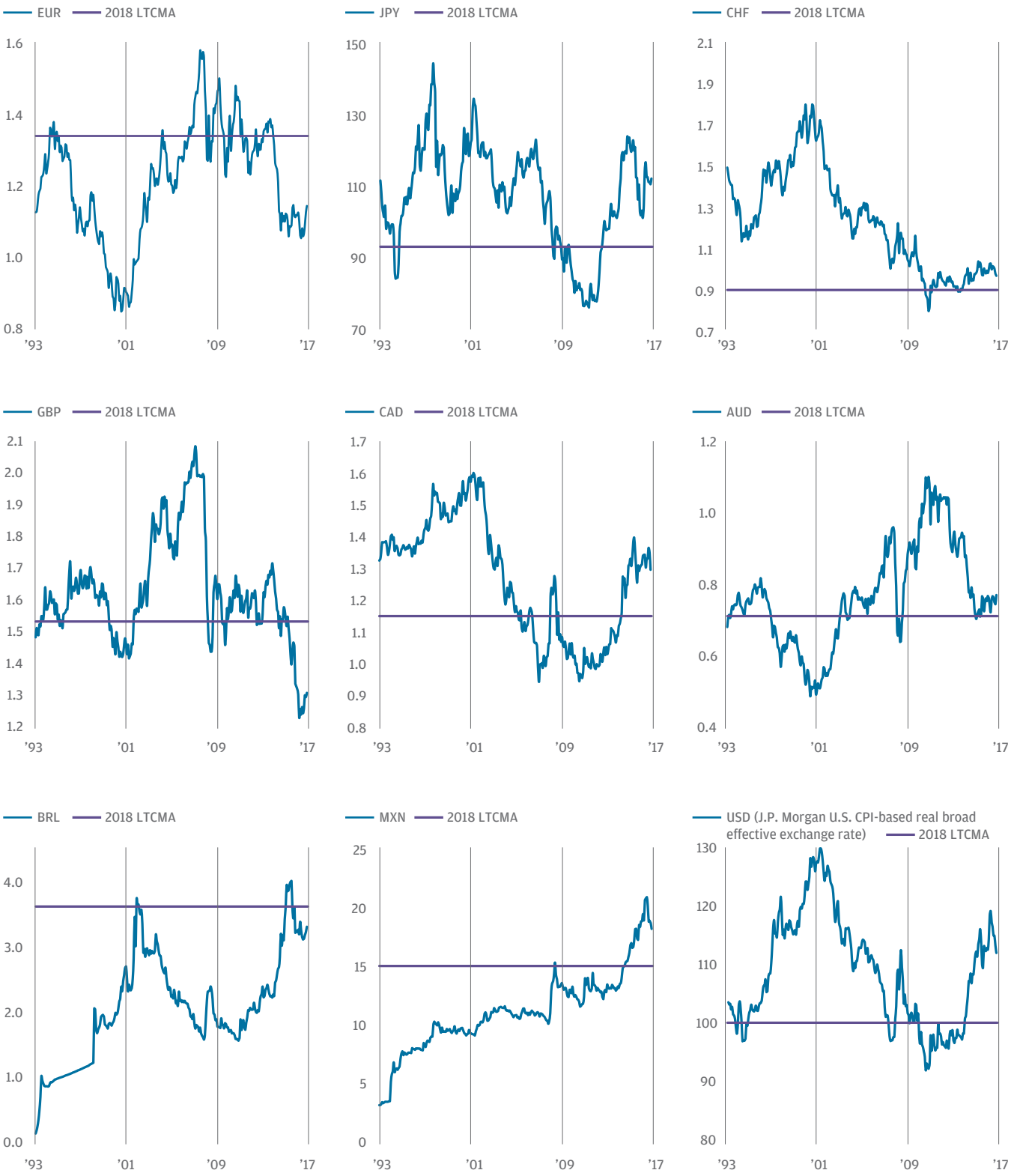
B EMERGING MARKETS

- Starting fair value exchange rate based on the theory of purchasing power parity (PPP)
  - + Expected future inflation rate differentials and GDP per capita growth differentials* between domestic economies
  - + Review qualitatively and adjust currencies selectively to ensure internal consistency and incorporate secular factors and trends other than relative inflation that would otherwise not be captured
  - + The prevailing spot exchange rate level on September 29, 2017

* Academic studies suggest real equilibrium exchange rates in emerging economies are enhanced via the convergence process of higher productivity and trend growth rates. This can be proxied by GDP per capita. See Choudri and Khan (2004), "Real Exchange Rates in Developing Countries: Are Balassa-Samuelson Effects Present?", IMF Working Papers. Kravis and Lipsey (1983), "Toward an Explanation of National Price Levels," Princeton Studies in International Finance.

In **Exhibit 2**, we present selected exchange rate histories relative to our 2018 LTCMAs.

EXHIBIT 2: SELECTED EXCHANGE RATE HISTORIES RELATIVE TO 2018 LTCMAs



Source: Bloomberg, J.P. Morgan Asset Management; data as of September 30, 2017.

The annualized compound rate of change expresses the difference between the two currencies' current exchange rate and our estimate of their fair value exchange rate at the end of our assumptions horizon-for consistency we use 12 ½ years.

Volatility: Cyclically lower, structurally unchanged

Grace Koo, Ph.D., *Quantitative Analyst and Portfolio Manager, Multi-Asset Solutions*
Nandini Srivastava, *Quantitative Analyst, Multi-Asset Solutions*
Livia Wu, *Quantitative Analyst, Multi-Asset Solutions*

IN BRIEF

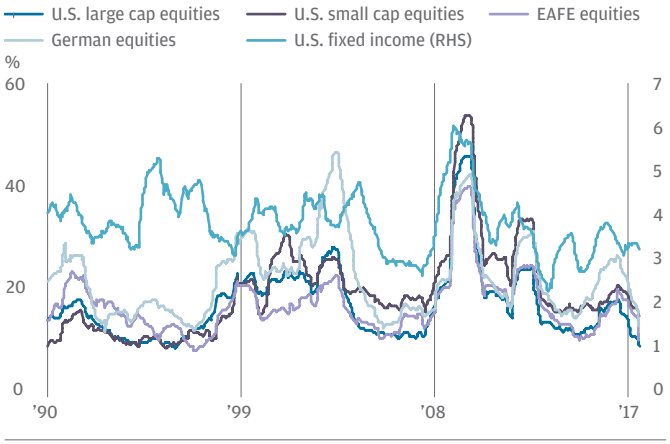
- Our long-term volatility assumptions are largely unchanged from 2017, despite the low level of asset volatility across markets generally.
- In our view, the low levels of volatility across asset classes are consistent with the late stage of the business cycle and not the result of a structural change or thematic shift. Therefore, we do not adjust our volatility assumptions downward relative to last year's estimates.
- Based on our long-term return and volatility assumptions, Sharpe ratios, in general, are projected to fall marginally for equities and credit while increasing for government bonds. Despite the decline, credit continues to rank well in expected risk-adjusted return terms, closely followed by equities. The risk-adjusted return for government bonds remains considerably below its historical average.
- This year we introduce two enhancements to our process for estimating volatility, designed to ensure that our assumptions process has the flexibility to incorporate our forward-looking expectations, whether those views are in line with or deviate from historical business cycle length and composition.

LITTLE CHANGE IN RISK ASSUMPTIONS

Our 2018 Long-Term Capital Market Assumptions (LTCMA) volatility projections are generally unchanged from 2017 estimates, despite a currently low asset volatility environment. Clearly, volatility in financial markets has been running at historically low levels, particularly for risk assets and most notably for equities (**Exhibit 1**). This low volatility may prompt some to ask if structural changes in asset volatility have taken place. As we will show, we find little evidence to support this conjecture. In our view, currently low asset volatility levels are in line with the late phase of the business cycle we are in—and we see little need to adjust our forward-looking estimates downward.

Asset volatility is running at historical lows—especially in equities

EXHIBIT 1: ONE-YEAR ROLLING REALIZED VOLATILITY OF GLOBAL EQUITIES AND FIXED INCOME (%)*



Source: Bloomberg Barclays, Deutsche Börse AG, FTSE Russell, MSCI, Standard & Poor's, J.P. Morgan Asset Management; data as of July 31, 2017.

*U.S. large cap equities based on S&P 500 returns; U.S. small cap equities based on Russell 2000 returns; EAFE equities based on MSCI EAFE returns; German equities based on DAX returns; U.S. fixed income based on Bloomberg Barclays U.S. Aggregate returns.

Where history may not be the best guide

For most of the assets in our LTCMA opportunity set, including equities, we expect long-term volatilities to be in line with history. However, there are several fixed income sectors for which our risk estimates are different (mostly higher) than what the past decade or so of history may suggest.

The credit quality of **U.S. and European investment grade (IG) corporate bond** issuers has been gradually declining over the past 10 years, with AAA rated companies becoming a rarity. In the U.S. and elsewhere, the majority of IG bonds had an A rating in the early 2000s, whereas the majority now have a BBB rating. We adjust our forward-looking volatility estimates upward relative to historical levels for these fixed income sectors.

We also adjust our assumptions for **emerging market debt (EMD)** volatility upward vs. its historical trend. This reflects our expectation that the credit rating migration of many emerging markets from below investment grade to above investment grade witnessed over the past decade may partially reverse itself during our forecast period.

Short-duration instruments have been abnormally stable in recent years as central bank interventions created distortion in the market. As central bank stimulus is gradually removed and policy rates rise, the subdued volatility of short-duration instruments will likely revert to longer-term levels, above what recent history would suggest.

In contrast, we expect **European high yield** debt to be *less* volatile going forward. The quality of the market has improved in recent years, and fallen angels are expected to regain their investment grade status over our LTCMA forecast period.

Implications for risk-adjusted returns across asset classes

Combining our LTCMA risk and return assumptions, we compare the expected return per unit of risk taken (as measured by the Sharpe ratio)[1] among asset classes. Since we developed last year's LTCMAs, we have seen a strong rally in equities and risky assets and a mild move up in rates. With these starting points, this year's return assumptions are generally lower for equities and credit and slightly higher for government bonds. Given the negligible movement in volatility assumptions, Sharpe ratios, in general, are projected to fall marginally for equities and credit while increasing for government bonds. Despite the decline, credit continues to rank well in expected risk-adjusted return terms, closely followed by equities. The risk-adjusted return for government bonds remains considerably below its historical average.

WHY RECENT LOW ASSET VOLATILITY DOES NOT CHANGE OUR LONG-RUN EXPECTATIONS

A historical examination of asset volatility suggests to us that recently low volatility levels are not indicative of a structural change or thematic shift requiring adjustments to our long-term assumptions.

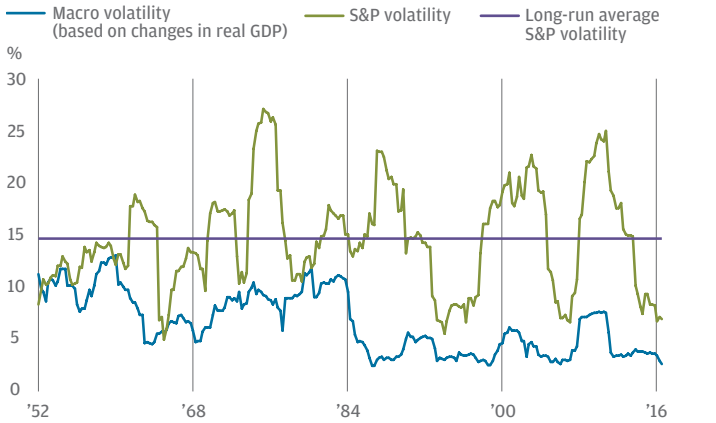
Volatility in the macroeconomic environment (as measured by changes in real GDP) has been declining for several decades, smoothed by improvements in monetary policy, broader availability of consumer credit and the effects of globalization.

[1] The Sharpe ratio is a measure used to examine the performance of an investment by adjusting for its risk. The Sharpe ratio is the return in excess of the risk-free rate per unit of risk.

However, as **Exhibit 2** suggests, the likelihood of asset bubbles and financial stress is not necessarily diminished by a smoother macro environment. Despite the downtrend in macro volatility since the 1980s, market volatility has stayed close to its long-run average.

Asset volatility remains near its long-run historical average, despite a downtrend in macro volatility

EXHIBIT 2: MACRO AND MARKET VOLATILITY, THREE-YEAR ROLLING QUARTERLY CHANGES (%)



Source: Bloomberg, U.S. Bureau of Economic Analysis, Standard & Poor's, J.P. Morgan Asset Management; data as of July 31, 2017.

In fact, benign macroeconomic volatility could create risks of overvaluation in asset classes, an environment that could lend itself to creation of asset price bubbles and potentially generate greater volatility, offsetting concurrent low macro volatility. What's more, the extraordinary measures taken by global central banks may be contributing to a more gradual and smooth recovery, but any misstep in their unwinding could result in greater asset volatility.

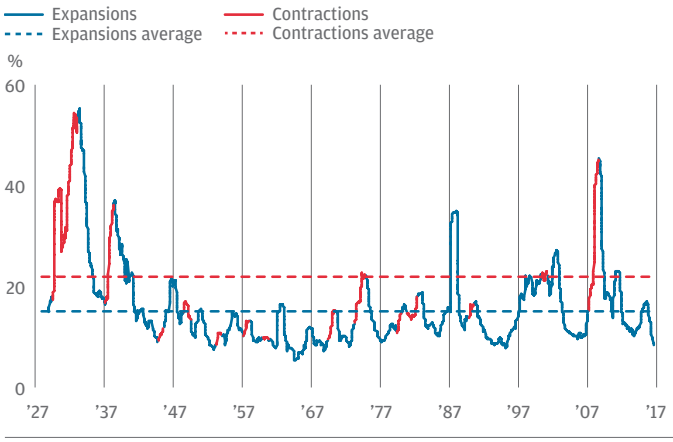
In our view, the recent reduction in asset volatility is consistent with the current economic environment, absent any significant and persistent signs of stress or leverage that could create risks of contagion. Ninety years of history shows that volatility is typically 6 percentage points lower during expansions—averaging 15%—than during contractions (**Exhibit 3**).

In addition, we see little evidence that the current low asset volatility regime (as measured by the CBOE Volatility Index [VIX])[2] has unduly dampened the response of the asset markets to events. That is, despite the fact that the VIX has been running at a historically low level, the expected volatility of volatility (as measured by the CBOE VVIX Index[3]—the option-implied volatility of VIX) has remained pronounced and dynamic, responding at the first signs of stress (**Exhibit 4**).

In short, the recent low asset volatility environment may have edged our long-term forecasts a touch lower for some asset classes, but, on balance, the broad outlook remains the same as last year's.

Realized volatility in expansions is markedly lower than during contractions

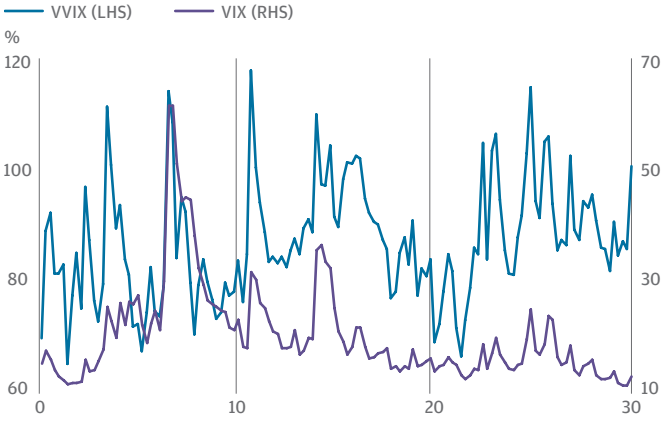
EXHIBIT 3: S&P 500 12-MONTH REALIZED VOLATILITY (%)



Source: Bloomberg, National Bureau of Economic Research, Standard & Poor's, J.P. Morgan Asset Management; data as of July 31, 2017.

Asset volatility may be low, but the volatility of volatility is not

EXHIBIT 4: AVERAGE 30-DAY SPX VOLATILITY INDEX (VIX) AND NEAR-TERM EXPECTED VOLATILITY OF VIX (VVIX) (%)



Source: Bloomberg, Chicago Board Options Exchange (CBOE), J.P. Morgan Asset Management; data as of July 31, 2017.

[2] The CBOE Volatility Index (VIX) is a measure of forward-looking near-term (30-day) market volatility and investor sentiment. Values greater than 30 are generally associated with a high level of volatility and investor fear; values less than 20 generally correspond to a less stressful market environment.

[3] The CBOE VVIX Index is an indicator of the expected volatility of the 30-day forward price of the VIX.

WHAT IF THE LOW ASSET VOLATILITY ENVIRONMENT PERSISTS?

Most forecasters would agree that the probability of a major economy starting to contract is low over the next 12 to 24 months, suggesting a further lengthening of the current expansion. We have traditionally relied on the most recent 10 years of return data to anchor our forward-looking risk expectations. We chose 10 years as our historical window because that period is recent enough for relevancy and data availability and long enough to include at least one whole business cycle. However, given the current extended recovery, it is possible that a 10-year window will soon be too short to cover an entire cycle. This means that historical volatility may begin to understate future volatility as periods of contraction (and high volatility, or "stress") roll off and periods of recovery (low volatility, or "calm") are added on.[4]

Exhibit 5 attempts to simulate the impact of a prolonged expansion on historical volatility measures based on a fixed data window. We start with a current 10-year period (mid-2007 to mid-2017) and roll forward (to mid-2008 to mid-2018 and then to mid-2009 to mid-2019). Early contractionary periods roll off, replaced by our estimates, which are based on simulated scenarios reflecting a continued expansion. The result is an increasing proportion of calm periods in the sample set and a marked decline in volatility, especially looking two to three years out.

Expanding the data window helps mitigate this impact. Additional analysis shows that, in general, including one incremental year of data (i.e., moving from 10 to 11 years, 11 to 12 years, etc.) would lead to a more gradual decline in volatility of approximately 0.5 percentage points with each additional year.

AN ALTERNATIVE WAY TO ANCHOR FORWARD-LOOKING EXPECTATIONS

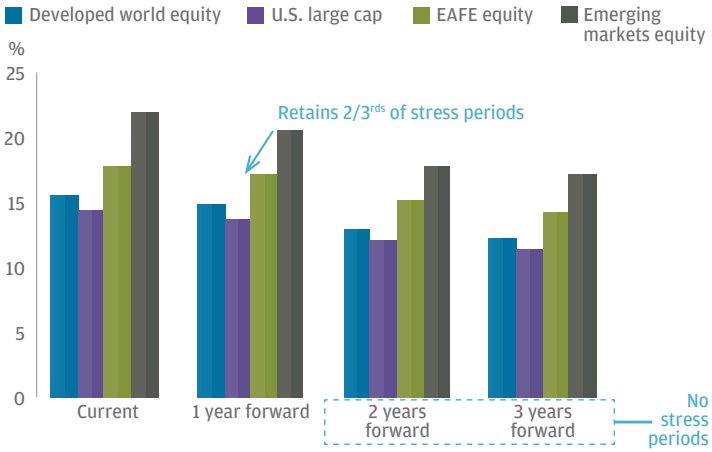
The expected prolonged business cycle leaves us with two questions:

- Is 10 years long enough to capture full business cycle dynamics?
- Even if 10 years is long enough, does the proportion of high volatility (stressed) to low volatility (calm) periods during that historical interval reflect what we anticipate for the future?

[4] We define periods of stress (contraction) and calm (expansion) based on the National Bureau of Economic Research (NBER) business cycle reference dates.

Historical asset volatilities are expected to decline as periods of stress roll-off, replaced by periods of calm

EXHIBIT 5: DECLINE IN ASSET VOLATILITIES ASSUMING A CONTINUED PROLONGED ECONOMIC EXPANSION (VOLATILITY OF ROLLING 10-YEAR MONTHLY RETURNS, %)*



Source: MSCI, Standard & Poor's, J.P. Morgan Asset Management; data as of June 30, 2017.

* Developed world equity based on MSCI World returns; U.S. large cap equity based on S&P 500 returns; EAFE equity based on MSCI EAFE returns; emerging market equity based on MSCI EM returns.

To ensure our process has the flexibility to adapt to expectations regardless of the historical business cycle length and composition (periods of contraction vs. expansion),we incorporate an alternative way to anchor our forward-looking expectations in addition to using simple historical inputs. This modification provides a more stable volatility forecast when the long-term risk expectation is for little change. It serves as an additional tool to enhance the consistency of our process.

This year we initiate the expansion of our data window, starting with one incremental year, and explicitly incorporate our forward-looking expectations of how frequently stress periods will occur. In essence, we identify the historical periods of higher relevance and overweight these data points to create an anchor that better reflects our forward-looking view. (For more technical details, please see "**Volatility and correlation assumptions methodology**.")

As discussed in prior sections, we expect the long-term risk environment to persist because we see little evidence of structural changes. Our simple historical (equally weighted) and our alternative (relevancy-weighted) anchors provide similar insights this year, as our forward-looking frequency of stress periods is in line with the 10-year history. If our expectation of a continued expansion materializes over the next one to two years, we would emphasize the stress/high volatility periods to ensure risk does not get underestimated, given the cyclical dynamics.

VOLATILITY ASSUMPTIONS METHODOLOGY

Long-term asset class volatilities and correlations tend to exhibit stability when measured over multiple cycles. As such, we use the following process in estimating risk assumptions for the main asset classes:

1. Start with monthly historical return data

- In prior estimates, we used 10 years of historical data as the anchor. This year we increase the data window from 10 years to 11 years.

2. Filter data outliers

- Extreme data outliers are filtered to improve robustness. This is done by winsorizing* historical raw data.
- For extreme data points exceeding the 99.5% threshold of a normal distribution (a standard deviation of 2.58), we adjust the return data by setting it at the 99.5% threshold.

3. Construct anchor matrix

- We leverage the historical experience to help anchor our forward-looking expectations, focusing on:
  - simple historical return series (with each data point equally weighted)
  - historical return series with each data point weighted by "relevance" (the expected frequency of stress vs. calm periods)**
- Variance-covariance matrix is calculated using the filtered data set.
  - After filtering the data, we demean each data point by the average of the full sample.
  - We multiply the weighted demeaned return time series matrix to calculate the covariance matrix.
  - Volatility and correlation are extracted from the covariance matrix. The monthly volatility is then annualized by the industry standard square root of 12 factor.

4. Adjust for key themes and structural changes

- Key themes and structural changes that are expected in the forecast horizon, such as those highlighted in this article, are reflected in the long-term risk forecast accordingly.

A few things to keep in mind: First, the standard deviation calculation is not subject to sequence risk. Thus, our assigned aggregate weighting of stress periods matters, but not the order of the data points or the continuity of the stress periods. Second, for consistency, the weights are applied to all the various currency matrices we publish. The forward-looking periods and the treatment of historical data are identical across regions and assets. Third, the volatility estimates capture the likely movement of the return around our central return forecasts. However, they do not incorporate distribution elements such as tail risk of the assets and other upper moments. It is particularly important for investors that hold assets known to have fat tails—such as high yield bonds, emerging market debt, convertible bonds, etc.—to account for risk aspects in addition to volatility.

For further discussion of our volatility and correlation process, please see:

"Creating more robust forward-looking risk statistics," Daniel J. Scansaroli, and Michael Feser, J.P. Morgan Asset Management, 2015 Long-Term Capital Market Return Assumptions.

"Focusing on hedge fund volatility: Keeping alpha with the beta," Daniel J. Scansaroli, Ph.D., J.P. Morgan Asset Management, November 2016.

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* Winsorization applies a cap and a floor to extreme data values to remove the impact of potentially spurious outlier data on statistical results.

** We define stress periods based on NBER recession periods and assign them a long-run average probability of 15%. We apply these weights on a global basis. Although one may argue that in the future the U.S. may not be the sole dominant economy, over the historical sample period there was no instance in which an economic contraction in the U.S. left the global financial markets unaffected. Analysis based on a market definition of stress yields a similar outcome. Once we have adjusted for periods of stress/calm, we incorporate further forward-looking adjustments if needed.

III Assumptions matrices

HOW TO USE THE NUMBERS

Our assumptions can be used to:

- Develop or review a strategic asset allocation
- Understand the risk and return trade-offs across and within asset classes and regions
- Assess the risk characteristics of a strategic asset allocation
- Review relative value allocation decisions

The assumptions are not designed to inform short-term tactical allocation decisions. Our assumptions process is carefully calibrated and constructed to aid investors with strategic asset allocation or policy-level decisions over a 10- to 15-year investment horizon.

		Compound Return 2017 (%)	Annualized Volatility	Arithmetic Return 2018 (%)	Compound Return 2018 (%)	Inflation	U.S. Cash	U.S. Intermediate Treasuries	U.S. Long Treasuries	TIPS	U.S. Aggregate Bonds	U.S. Short Duration Government/Credit	U.S. Long Duration Government/Credit	U.S. Inv Grade Corporate Bonds	U.S. Long Corporate Bonds	U.S. High Yield Bonds	U.S. Leveraged Loans	World Government Bonds hedged	World Government Bonds	World ex-U.S. Government Bonds hedged	World ex-U.S. Government Bonds	Emerging Markets Sovereign Debt	Emerging Markets Local Currency Debt	Emerging Markets Corporate Bonds
FIXED INCOME	Inflation	2.25	2.26	1.25	2.25	1.00																		
	U.S. Cash	2.00	2.00	0.50	2.00	0.08	1.00																	
	U.S. Intermediate Treasuries	3.00	3.07	3.75	2.25	-0.17	0.23	1.00																
	U.S. Long Treasuries	2.50	3.28	12.75	2.00	-0.23	0.04	0.78	1.00															
	TIPS	2.75	2.90	5.50	3.50	0.07	0.07	0.65	0.51	1.00														
	U.S. Aggregate Bonds	3.25	3.32	3.75	3.00	-0.12	0.10	0.81	0.78	0.78	1.00													
	U.S. Short Duration Government/Credit	3.50	3.52	2.00	3.25	-0.09	0.41	0.76	0.41	0.67	0.74	1.00												
	U.S. Long Duration Government/Credit	3.25	3.68	9.50	3.25	-0.17	0.00	0.68	0.89	0.64	0.91	0.50	1.00											
	U.S. Inv Grade Corporate Bonds	3.50	3.67	6.00	3.25	-0.12	-0.04	0.41	0.46	0.64	0.82	0.60	0.79	1.00										
	U.S. Long Corporate Bonds	3.75	4.23	10.00	3.75	-0.16	-0.06	0.39	0.58	0.57	0.81	0.47	0.88	0.96	1.00									
	U.S. High Yield Bonds	5.25	5.59	8.50	5.75	0.12	-0.10	-0.26	-0.27	0.31	0.19	0.15	0.12	0.57	0.47	1.00								
	U.S. Leveraged Loans	5.00	5.28	7.75	5.00	0.32	-0.14	-0.50	-0.46	0.06	-0.07	-0.10	-0.10	0.33	0.24	0.80	1.00							
	World Government Bonds hedged	2.50	2.54	3.00	1.75	-0.26	0.10	0.83	0.85	0.52	0.81	0.58	0.80	0.52	0.56	-0.19	-0.42	1.00						
	World Government Bonds	2.50	2.71	6.50	2.00	-0.01	0.13	0.66	0.48	0.66	0.71	0.68	0.59	0.58	0.54	0.17	-0.14	0.58	1.00					
	World ex-U.S. Government Bonds hedged	2.25	2.29	3.00	1.75	-0.27	0.07	0.71	0.75	0.43	0.72	0.50	0.72	0.50	0.54	-0.14	-0.36	0.97	0.51	1.00				
	World ex-U.S. Government Bonds	2.25	2.56	8.00	2.00	0.02	0.11	0.56	0.37	0.61	0.62	0.62	0.50	0.55	0.50	0.24	-0.07	0.48	0.99	0.42	1.00			
	Emerging Markets Sovereign Debt	5.25	5.70	9.75	5.50	0.00	-0.02	0.22	0.16	0.58	0.60	0.46	0.50	0.76	0.68	0.72	0.40	0.28	0.55	0.29	0.57	1.00		
	Emerging Markets Local Currency Debt	6.25	6.94	12.25	6.50	0.12	0.12	0.15	0.02	0.46	0.41	0.41	0.31	0.56	0.48	0.61	0.30	0.14	0.59	0.13	0.63	0.82	1.00	
	Emerging Markets Corporate Bonds	5.25	5.57	8.25	5.50	0.05	-0.06	0.10	0.02	0.50	0.51	0.45	0.40	0.78	0.67	0.75	0.54	0.13	0.43	0.14	0.46	0.89	0.73	1.00
	U.S. Muni 1-15 Yr Blend	2.50	2.55	3.25	2.50	-0.06	0.03	0.46	0.47	0.52	0.66	0.45	0.57	0.58	0.53	0.26	0.10	0.52	0.43	0.49	0.38	0.51	0.27	0.39
	U.S. Muni High Yield	4.50	4.73	7.00	4.25	0.21	-0.12	0.00	0.06	0.31	0.30	0.08	0.27	0.41	0.34	0.43	0.54	0.11	0.10	0.13	0.11	0.43	0.23	0.39
EQUITIES	U.S. Large Cap	5.50	6.41	14.00	6.25	0.05	-0.06	-0.31	-0.35	0.06	0.00	-0.04	-0.03	0.27	0.23	0.69	0.55	-0.24	0.14	-0.18	0.21	0.52	0.59	0.55
	U.S. Mid Cap	5.75	6.93	16.00	6.75	0.07	-0.08	-0.34	-0.35	0.07	-0.01	-0.05	-0.04	0.29	0.24	0.74	0.59	-0.26	0.10	-0.20	0.17	0.52	0.58	0.56
	U.S. Small Cap	5.75	7.35	18.75	7.00	0.04	-0.08	-0.37	-0.38	-0.02	-0.10	-0.12	-0.11	0.18	0.15	0.65	0.51	-0.29	0.03	-0.23	0.10	0.42	0.51	0.46
	U.S. Large Cap Value	5.75	6.75	14.75	6.25	0.04	-0.07	-0.32	-0.35	0.02	-0.02	-0.05	-0.04	0.26	0.22	0.68	0.53	-0.23	0.13	-0.17	0.20	0.50	0.59	0.54
	U.S. Large Cap Growth	5.25	6.19	14.25	6.25	0.07	-0.06	-0.32	-0.36	0.09	0.00	-0.04	-0.04	0.28	0.22	0.71	0.58	-0.26	0.12	-0.20	0.20	0.52	0.57	0.55
	Euro area Large Cap	6.75	8.91	22.00	7.25	0.04	0.03	-0.21	-0.30	0.14	0.09	0.12	0.02	0.36	0.29	0.69	0.50	-0.19	0.32	-0.15	0.39	0.61	0.70	0.61
	Japanese Equity	6.25	7.25	14.75	5.75	0.02	-0.09	-0.25	-0.21	0.12	0.08	0.05	0.09	0.38	0.34	0.60	0.46	-0.18	0.17	-0.14	0.23	0.49	0.57	0.55
	Hong Kong Equity	6.50	8.39	20.50	7.50	-0.01	0.08	-0.18	-0.24	0.17	0.14	0.15	0.10	0.44	0.38	0.64	0.50	-0.15	0.23	-0.12	0.29	0.61	0.68	0.65
	UK Large Cap	6.25	7.61	17.25	7.50	0.09	-0.01	-0.30	-0.36	0.12	0.05	0.05	0.00	0.38	0.31	0.73	0.63	-0.26	0.25	-0.20	0.33	0.60	0.66	0.64
	EAFE Equity hedged	6.25	7.12	13.75	6.50	0.00	-0.04	-0.40	-0.35	-0.03	-0.03	-0.08	-0.02	0.31	0.27	0.69	0.61	-0.26	-0.03	-0.18	0.03	0.52	0.54	0.57
	EAFE Equity	6.25	7.61	17.25	6.75	0.05	0.00	-0.24	-0.30	0.16	0.10	0.11	0.06	0.42	0.35	0.74	0.56	-0.20	0.31	-0.16	0.39	0.65	0.74	0.67
	Emerging Markets Equity	8.00	10.04	21.50	9.25	0.08	0.08	-0.19	-0.26	0.25	0.14	0.18	0.08	0.44	0.36	0.73	0.55	-0.17	0.32	-0.14	0.39	0.68	0.81	0.69
	AC Asia ex-Japan Equity	8.25	10.20	21.00	9.25	0.01	0.06	-0.18	-0.22	0.24	0.16	0.18	0.11	0.46	0.39	0.72	0.53	-0.13	0.30	-0.10	0.36	0.66	0.76	0.68
	AC World Equity	6.00	7.10	15.50	6.75	0.06	-0.02	-0.28	-0.34	0.14	0.06	0.06	0.02	0.38	0.31	0.76	0.59	-0.23	0.25	-0.18	0.33	0.63	0.72	0.66
	Global Convertible hedged	5.00	5.45	9.75	-	0.03	-0.04	-0.33	-0.34	0.14	0.09	0.07	0.03	0.45	0.36	0.82	0.67	-0.23	0.12	-0.16	0.19	0.64	0.62	0.71
	Global Credit Sensitive Convertible hedged	4.25	4.44	6.25	-	0.14	-0.07	-0.12	-0.19	-0.01	-0.01	-0.03	0.01	0.19	0.18	0.28	0.33	-0.10	0.08	-0.06	0.12	0.19	0.23	0.28
ALTERNATIVES	Private Equity	7.25	9.21	21.00	8.00	0.06	-0.03	-0.25	-0.30	0.10	0.04	0.03	0.00	0.30	0.25	0.65	0.51	-0.20	0.19	-0.16	0.25	0.51	0.57	0.53
	U.S. Direct Real Estate	5.25	5.79	10.75	5.50	-0.01	-0.02	-0.04	-0.05	0.04	0.05	0.00	0.04	0.11	0.10	0.23	0.14	0.00	0.08	0.01	0.10	0.19	0.22	0.15
	U.S. Value Added Real Estate	6.50	7.37	13.75	7.00	-0.01	-0.03	-0.05	-0.06	0.04	0.05	0.00	0.03	0.11	0.10	0.25	0.15	-0.01	0.09	0.01	0.10	0.20	0.23	0.16
	European Direct Real Estate	5.75	6.72	14.50	6.25	-0.03	-0.01	-0.21	-0.19	-0.08	-0.08	-0.10	-0.08	0.05	0.03	0.28	0.25	-0.16	-0.08	-0.13	-0.06	0.17	0.18	0.17
	Asia Core Real Estate	5.50	6.07	11.00	5.50	-0.01	0.05	-0.14	-0.15	-0.02	-0.06	-0.05	-0.06	0.04	0.03	0.23	0.16	-0.12	0.05	-0.10	0.08	0.14	0.25	0.10
	U.S. REITs	6.25	7.42	16.00	6.00	-0.05	-0.07	-0.02	0.00	0.21	0.27	0.09	0.25	0.44	0.42	0.62	0.36	0.10	0.29	0.13	0.32	0.56	0.59	0.47
	Global Infrastructure	6.25	6.89	11.75	6.25	0.10	-0.01	-0.10	-0.11	0.03	0.00	-0.02	-0.01	0.08	0.06	0.22	0.19	-0.08	0.05	-0.06	0.07	0.16	0.19	0.16
	Infrastructure Debt	4.25	4.41	5.75	4.25	-0.05	-0.04	0.44	0.51	0.67	0.81	0.57	0.78	0.92	0.88	0.47	0.32	0.54	0.49	0.51	0.45	0.65	0.39	0.67
	Diversified Hedge Funds	4.25	4.52	7.50	3.50	0.19	0.08	-0.41	-0.40	0.06	-0.10	-0.07	-0.10	0.22	0.16	0.60	0.65	-0.35	-0.04	-0.29	0.02	0.36	0.39	0.44
	Event Driven Hedge Funds	4.75	5.13	9.00	4.75	0.23	-0.02	-0.46	-0.50	0.05	-0.11	-0.06	-0.15	0.27	0.19	0.77	0.76	-0.41	0.02	-0.35	0.11	0.47	0.52	0.58
	Long Bias Hedge Funds	4.75	5.27	10.50	4.50	0.14	-0.01	-0.41	-0.47	0.08	-0.08	-0.01	-0.12	0.30	0.21	0.75	0.67	-0.38	0.10	-0.32	0.19	0.53	0.62	0.61
	Relative Value Hedge Funds	4.50	4.73	7.00	4.25	0.26	-0.02	-0.40	-0.42	0.16	0.01	0.03	-0.04	0.40	0.30	0.84	0.85	-0.34	0.01	-0.28	0.09	0.55	0.54	0.64
	Macro Hedge Funds	3.75	4.02	7.50	4.00	-0.10	0.18	0.12	0.10	0.26	0.20	0.27	0.19	0.27	0.24	0.17	0.06	0.18	0.31	0.20	0.31	0.23	0.31	0.20
	Direct Lending	7.00	7.46	10.00	6.75	-0.04	-0.07	0.29	0.33	0.61	0.74	0.53	0.70	0.97	0.91	0.68	0.47	0.40	0.49	0.39	0.48	0.77	0.57	0.81
	Commodities	3.75	5.06	16.75	3.75	0.26	0.08	-0.11	-0.27	0.27	0.05	0.18	-0.02	0.24	0.17	0.46	0.37	-0.24	0.35	-0.25	0.41	0.39	0.54	0.43
	Gold	4.00	5.58	18.50	4.00	0.04	0.08	0.37	0.24	0.50	0.42	0.41	0.32	0.37	0.30	0.11	-0.08	0.25	0.53	0.19	0.52	0.35	0.40	0.33

U.S. DOLLAR ASSUMPTIONS

Note: All estimates on this page are in U.S. dollar terms. Given the complex risk-reward trade-offs involved, we advise clients to rely on judgment as well as quantitative optimization approaches in setting strategic allocations to all of these asset classes and strategies. Please note that all information shown is based on qualitative analysis. Exclusive reliance on this information is not advised. This information is not intended as a recommendation to invest in any particular asset class or strategy or as a promise of future performance. Note that these asset class and strategy assumptions are passive only-they do not consider the impact of active management. References to future returns are not promises or even estimates of actual returns a client portfolio may achieve. Assumptions, opinions and estimates are provided for illustrative purposes only. They should not be relied upon as recommendations to buy or sell securities. Forecasts of financial market trends that are based on current market conditions constitute our judgment and are subject to change without notice. We believe the information provided here is reliable, but do not warrant its accuracy or completeness. This material has been prepared for information purposes only and is not intended to provide, and should not be relied on for, accounting, legal or tax advice.

Source: J.P. Morgan Asset Management; data as of September 30, 2017, except hedge funds, private equity, real estate and infrastructure, as of June 30, 2017. Alternative asset classes (including hedge funds, private equity, real estate, direct lending and infrastructure) are unlike other asset categories shown above in that there is no underlying investible index. The return estimates for these alternative asset classes and strategies are estimates of the industry average, net of manager fees. The dispersion of return among managers of these asset classes and strategies is typically significantly wider than that of traditional asset classes. Return estimates for direct real estate are unlevered. We have refined our REIT estimates for 2018 to reflect: net REIT leverage; REIT vs. core composite sector differentials and a more granular treatment of currency differentials. Estimates shown for 2017 do not reflect these refinements. U.S. Intermediate Treasuries reflect the 1 to 10 years sector of the market instead of the 7 to 10 years sector in prior years. Diversified hedge funds and conservative hedge funds are multi-strategy hedge funds instead of funds-of-funds in prior years. Hong Kong Equity is represented by the MSCI Hong Kong index instead of the Hang Seng index in prior years. Correlation figures shown are rounded to two significant figures, which may cause a loss of information. All returns are nominal. For reference index information, please visit our website.

	U.S. Muni 1-15 Yr Blend	U.S. Muni High Yield	U.S. Large Cap	U.S. Mid Cap	U.S. Small Cap	U.S. Large Cap Value	U.S. Large Cap Growth	Euro area Large Cap	Japanese Equity	Hong Kong Equity	UK Large Cap	EAFE Equity hedged	EAFE Equity	Emerging Markets Equity	AC Asia ex-Japan Equity	AC World Equity	Global Convertible hedged	Global Credit Sensitive Convertible hedged	Private Equity	U.S. Direct Real Estate	U.S. Value Added Real Estate	European Direct Real Estate	Asia Core Real Estate	U.S. REITs	Global Infrastructure	Infrastructure Debt	Diversified Hedge Funds	Event Driven Hedge Funds	Long Bias Hedge Funds	Relative Value Hedge Funds	Macro Hedge Funds	Direct Lending	Commodities	Gold
U.S. Muni 1-15 Yr Blend	1.00																																	
U.S. Muni High Yield	0.59	1.00																																
U.S. Large Cap	-0.01	0.20	1.00																															
U.S. Mid Cap	0.01	0.21	0.96	1.00																														
U.S. Small Cap	-0.08	0.09	0.90	0.95	1.00																													
U.S. Large Cap Value	-0.03	0.17	0.98	0.95	0.91	1.00																												
U.S. Large Cap Growth	0.02	0.22	0.98	0.96	0.89	0.92	1.00																											
Euro area Large Cap	0.05	0.18	0.85	0.83	0.74	0.83	0.85	1.00																										
Japanese Equity	0.01	0.15	0.68	0.67	0.60	0.66	0.68	0.70	1.00																									
Hong Kong Equity	0.05	0.22	0.68	0.66	0.58	0.64	0.70	0.73	0.62	1.00																								
UK Large Cap	0.04	0.29	0.86	0.82	0.72	0.83	0.86	0.90	0.70	0.78	1.00																							
EAFE Equity hedged	-0.01	0.24	0.88	0.86	0.78	0.86	0.87	0.88	0.79	0.73	0.87	1.00																						
EAFE Equity	0.05	0.22	0.88	0.86	0.76	0.85	0.88	0.97	0.81	0.80	0.95	0.91	1.00																					
Emerging Markets Equity	0.06	0.27	0.76	0.77	0.68	0.73	0.78	0.82	0.66	0.89	0.82	0.76	0.87	1.00																				
AC Asia ex-Japan Equity	0.08	0.26	0.75	0.75	0.66	0.71	0.77	0.79	0.65	0.92	0.79	0.75	0.84	0.98	1.00																			
AC World Equity	0.02	0.23	0.95	0.93	0.85	0.93	0.95	0.94	0.77	0.80	0.94	0.91	0.97	0.89	0.87	1.00																		
Global Convertible hedged	0.09	0.31	0.86	0.88	0.78	0.83	0.88	0.86	0.73	0.79	0.87	0.90	0.90	0.85	0.84	0.92	1.00																	
Global Credit Sensitive Convertible hedged	-0.01	0.22	0.37	0.34	0.29	0.37	0.35	0.38	0.31	0.35	0.44	0.41	0.41	0.31	0.30	0.40	0.39	1.00																
Private Equity	0.03	0.19	0.82	0.82	0.76	0.80	0.81	0.80	0.62	0.63	0.79	0.78	0.82	0.72	0.69	0.84	0.78	0.33	1.00															
U.S. Direct Real Estate	0.05	0.07	0.30	0.31	0.31	0.31	0.29	0.26	0.20	0.18	0.23	0.25	0.26	0.21	0.21	0.28	0.24	0.07	0.25	1.00														
U.S. Value Added Real Estate	0.05	0.08	0.33	0.33	0.33	0.34	0.31	0.27	0.21	0.19	0.25	0.27	0.28	0.23	0.22	0.30	0.26	0.07	0.27	0.95	1.00													
European Direct Real Estate	-0.03	0.07	0.40	0.39	0.38	0.39	0.39	0.40	0.30	0.27	0.36	0.45	0.39	0.30	0.29	0.39	0.38	0.15	0.35	0.30	0.30	1.00												
Asia Core Real Estate	-0.07	0.04	0.33	0.33	0.32	0.32	0.34	0.32	0.25	0.36	0.30	0.32	0.33	0.38	0.40	0.36	0.31	0.09	0.29	0.40	0.39	0.21	1.00											
U.S. REITs	0.21	0.24	0.74	0.76	0.74	0.76	0.70	0.64	0.52	0.48	0.59	0.63	0.66	0.56	0.56	0.71	0.62	0.18	0.63	0.40	0.43	0.32	0.29	1.00										
Global Infrastructure	0.00	0.08	0.30	0.30	0.28	0.30	0.29	0.25	0.20	0.19	0.26	0.26	0.26	0.23	0.22	0.29	0.25	0.11	0.25	0.30	0.29	0.16	0.17	0.25	1.00									
Infrastructure Debt	0.62	0.45	0.08	0.11	0.00	0.06	0.11	0.16	0.20	0.27	0.21	0.13	0.21	0.26	0.28	0.17	0.29	0.11	0.13	0.04	0.03	-0.04	-0.05	0.25	0.02	1.00								
Diversified Hedge Funds	-0.06	0.37	0.66	0.69	0.58	0.61	0.71	0.65	0.59	0.61	0.73	0.74	0.71	0.68	0.66	0.73	0.79	0.43	0.61	0.13	0.14	0.30	0.27	0.34	0.20	0.15	1.00							
Event Driven Hedge Funds	-0.07	0.36	0.80	0.83	0.76	0.78	0.81	0.76	0.66	0.69	0.83	0.81	0.82	0.78	0.75	0.85	0.87	0.51	0.72	0.20	0.22	0.34	0.29	0.51	0.25	0.15	0.88	1.00						
Long Bias Hedge Funds	-0.07	0.28	0.86	0.89	0.81	0.83	0.89	0.83	0.72	0.80	0.87	0.85	0.89	0.89	0.86	0.93	0.92	0.42	0.78	0.22	0.24	0.35	0.35	0.55	0.26	0.13	0.87	0.94	1.00					
Relative Value Hedge Funds	0.07	0.49	0.68	0.72	0.62	0.66	0.70	0.68	0.63	0.68	0.77	0.75	0.75	0.75	0.73	0.76	0.84	0.44	0.64	0.17	0.18	0.29	0.25	0.45	0.22	0.33	0.85	0.92	0.86	1.00				
Macro Hedge Funds	0.11	0.15	0.21	0.21	0.12	0.17	0.25	0.28	0.23	0.25	0.31	0.23	0.31	0.35	0.32	0.30	0.31	0.14	0.23	0.04	0.04	0.08	0.13	0.14	0.05	0.22	0.54	0.30	0.37	0.29	1.00			
Direct Lending	0.56	0.46	0.32	0.35	0.24	0.30	0.34	0.39	0.41	0.48	0.43	0.36	0.45	0.49	0.51	0.42	0.52	0.21	0.34	0.12	0.12	0.07	0.06	0.45	0.10	0.93	0.30	0.37	0.38	0.52	0.24	1.00		
Commodities	-0.09	0.12	0.44	0.46	0.38	0.44	0.45	0.48	0.34	0.49	0.60	0.34	0.54	0.61	0.52	0.55	0.47	0.28	0.44	0.10	0.10	0.09	0.18	0.26	0.15	0.13	0.52	0.57	0.61	0.55	0.41	0.27	1.00	
Gold	0.25	0.11	-0.02	0.01	-0.04	-0.03	0.02	0.07	-0.02	0.18	0.11	-0.12	0.09	0.23	0.19	0.08	0.10	0.01	0.04	0.00	0.00	-0.11	0.00	0.06	0.00	0.36	0.10	0.06	0.14	0.09	0.41	0.33	0.46	1.00

		Compound Return 2017 (%)																									
		Annualized Volatility																									
		Arithmetic Return 2018 (%)																									
		Compound Return 2018 (%)				UK Inflation	UK Cash	U.S. Aggregate Bonds hedged	Euro Aggregate Bonds hedged	U.S. Inv Grade Corporate Bonds hedged	Euro Inv Grade Corp Bonds hedged	UK Inv Grade Corporate Bonds	U.S. High Yield Bonds hedged	European High Yield Bonds	U.S. Leveraged Loans hedged	Euro Government Bonds hedged	UK Gilts	I-L Bonds	World Government Bonds hedged	World Government Bonds	World ex-UK Government Bonds hedged	World ex-UK Government Bonds	Emerging Markets Sovereign Debt hedged	Emerging Markets Local Currency Debt
FIXED INCOME	UK Inflation	2.00	2.01	1.25	2.00	1.00																		
	UK Cash	1.75	1.75	0.75	1.75	-0.09	1.00																	
	U.S. Aggregate Bonds hedged	3.00	3.07	3.75	2.75	-0.19	0.16	1.00																
	Euro Aggregate Bonds hedged	2.25	2.32	3.75	2.25	-0.19	0.06	0.66	1.00															
	U.S. Inv Grade Corporate Bonds hedged	3.25	3.42	6.00	3.00	-0.16	0.03	0.82	0.59	1.00														
	Euro Inv Grade Corp Bonds hedged	2.50	2.60	4.50	2.75	-0.09	-0.09	0.53	0.72	0.78	1.00													
	UK Inv Grade Corporate Bonds	2.50	2.79	7.75	2.50	-0.01	-0.16	0.57	0.56	0.75	0.77	1.00												
	U.S. High Yield Bonds hedged	5.00	5.34	8.50	5.50	0.03	-0.12	0.18	0.04	0.55	0.56	0.43	1.00											
	European High Yield Bonds	3.75	4.33	11.00	4.25	-0.01	-0.06	0.24	0.13	0.52	0.51	0.46	0.77	1.00										
	U.S. Leveraged Loans hedged	4.75	5.03	7.75	4.75	0.18	-0.24	-0.09	-0.14	0.30	0.41	0.33	0.79	0.56	1.00									
	Euro Government Bonds hedged	2.00	2.09	4.25	2.00	-0.18	0.09	0.61	0.97	0.47	0.56	0.45	-0.10	0.03	-0.27	1.00								
	UK Gilts	1.00	1.22	6.75	1.00	-0.13	0.08	0.68	0.58	0.43	0.26	0.57	-0.18	-0.06	-0.35	0.60	1.00							
	I-L Bonds	0.50	0.88	8.75	0.25	-0.10	-0.03	0.55	0.34	0.42	0.26	0.51	0.18	0.23	0.04	0.32	0.69	1.00						
	World Government Bonds hedged	2.25	2.29	3.00	1.50	-0.21	0.19	0.82	0.83	0.53	0.39	0.44	-0.19	-0.05	-0.42	0.86	0.82	0.51	1.00					
	World Government Bonds	1.75	2.17	9.25	0.75	-0.23	0.22	0.49	0.43	0.19	-0.01	0.12	-0.34	0.02	-0.53	0.49	0.61	0.38	0.68	1.00				
	World ex-UK Government Bonds hedged	2.25	2.29	3.00	1.50	-0.22	0.20	0.82	0.84	0.53	0.40	0.41	-0.18	-0.04	-0.42	0.87	0.77	0.47	1.00	0.67	1.00			
	World ex-UK Government Bonds	1.75	2.21	9.75	0.75	-0.23	0.23	0.47	0.41	0.18	-0.02	0.10	-0.34	0.03	-0.53	0.48	0.59	0.36	0.67	1.00	0.66	1.00		
	Emerging Markets Sovereign Debt hedged	5.00	5.45	9.75	5.25	-0.08	0.04	0.59	0.39	0.76	0.65	0.56	0.71	0.69	0.38	0.29	0.21	0.31	0.29	0.05	0.29	0.04	1.00	
	Emerging Markets Local Currency Debt	5.50	6.09	11.25	5.25	-0.10	0.17	0.45	0.33	0.46	0.36	0.36	0.32	0.54	0.03	0.30	0.30	0.37	0.36	0.48	0.36	0.48	0.65	1.00
	Emerging Markets Corporate Bonds hedged	5.00	5.32	8.25	5.25	-0.12	0.02	0.50	0.32	0.78	0.71	0.57	0.73	0.70	0.51	0.18	0.09	0.23	0.14	-0.08	0.14	-0.09	0.89	0.53
EQUITIES	UK All Cap	5.50	6.32	13.25	6.25	0.14	-0.16	0.08	0.07	0.38	0.45	0.45	0.68	0.72	0.53	-0.02	-0.08	0.16	-0.14	-0.14	-0.15	-0.14	0.59	0.49
	UK Large Cap	5.50	6.32	13.25	6.25	0.14	-0.15	0.10	0.08	0.38	0.45	0.45	0.66	0.72	0.51	0.00	-0.06	0.18	-0.11	-0.10	-0.12	-0.10	0.60	0.52
	UK Small Cap	5.75	6.93	16.00	6.75	0.14	-0.21	-0.03	0.00	0.29	0.42	0.37	0.65	0.61	0.55	-0.10	-0.16	0.05	-0.24	-0.30	-0.24	-0.30	0.48	0.27
	U.S. Large Cap	4.75	5.60	13.50	5.00	0.07	-0.18	0.04	0.08	0.19	0.28	0.30	0.47	0.56	0.32	0.04	0.06	0.25	-0.04	0.14	-0.05	0.14	0.38	0.56
	U.S. Large Cap hedged	5.25	6.16	14.00	6.00	0.14	-0.21	-0.02	-0.03	0.25	0.39	0.32	0.69	0.63	0.54	-0.11	-0.21	0.05	-0.25	-0.33	-0.25	-0.33	0.51	0.34
	Euro area Large Cap	6.00	7.64	19.00	6.00	0.03	-0.08	0.11	0.06	0.34	0.36	0.39	0.61	0.78	0.39	0.01	-0.04	0.19	-0.08	-0.02	-0.08	-0.02	0.58	0.55
	Euro area Large Cap hedged	6.25	7.53	16.75	6.75	0.07	-0.19	-0.02	0.04	0.29	0.44	0.41	0.67	0.59	0.57	-0.05	-0.18	0.07	-0.23	-0.35	-0.23	-0.35	0.49	0.30
	Euro area Small Cap	6.25	8.10	20.25	6.50	0.03	-0.12	0.09	0.04	0.34	0.37	0.38	0.63	0.80	0.42	-0.02	-0.09	0.15	-0.11	-0.03	-0.11	-0.03	0.56	0.51
	Euro area Small Cap hedged	6.50	7.93	17.75	7.25	0.08	-0.23	-0.04	0.01	0.30	0.44	0.41	0.68	0.63	0.61	-0.08	-0.22	0.03	-0.26	-0.36	-0.26	-0.36	0.47	0.26
	Japanese Equity	5.50	6.35	13.50	4.50	-0.04	-0.13	0.09	0.11	0.30	0.31	0.31	0.38	0.42	0.24	0.07	0.02	0.22	-0.01	0.11	-0.01	0.11	0.33	0.47
	Japanese Equity hedged	6.25	7.84	18.75	5.75	0.12	-0.21	-0.22	-0.09	0.11	0.27	0.21	0.49	0.36	0.47	-0.16	-0.33	-0.04	-0.38	-0.55	-0.38	-0.55	0.26	0.11
	AC Asia ex-Japan Equity	7.50	9.08	18.75	8.00	-0.01	-0.01	0.20	0.13	0.44	0.42	0.36	0.62	0.68	0.39	0.06	0.03	0.21	0.00	0.02	0.00	0.02	0.62	0.66
	Emerging Markets Equity	7.25	8.87	19.00	8.00	0.05	0.00	0.18	0.08	0.42	0.40	0.34	0.64	0.73	0.42	0.01	-0.01	0.22	-0.04	0.01	-0.05	0.01	0.65	0.70
	AC World Equity	5.25	6.10	13.50	5.50	0.07	-0.13	0.11	0.09	0.34	0.38	0.39	0.61	0.72	0.41	0.03	0.01	0.25	-0.05	0.07	-0.06	0.07	0.56	0.65
	AC World ex-UK Equity	5.25	6.10	13.50	5.50	0.06	-0.12	0.11	0.09	0.33	0.37	0.38	0.60	0.71	0.39	0.04	0.02	0.25	-0.04	0.09	-0.05	0.09	0.55	0.65
	Developed World Equity	5.25	6.07	13.25	5.25	0.07	-0.14	0.10	0.09	0.31	0.37	0.38	0.59	0.70	0.39	0.04	0.02	0.25	-0.05	0.08	-0.06	0.08	0.53	0.62
	Global Convertible hedged	4.75	5.18	9.50	-	0.04	-0.12	0.06	0.05	0.44	0.53	0.40	0.82	0.73	0.66	-0.06	-0.22	0.04	-0.24	-0.38	-0.23	-0.38	0.63	0.34
	Global Credit Sensitive Convertible hedged	4.00	4.19	6.25	-	0.13	-0.27	-0.04	0.08	0.17	0.33	0.36	0.26	0.29	0.32	-0.01	-0.14	-0.07	-0.13	-0.16	-0.12	-0.16	0.17	0.08
ALTERNATIVES	Private Equity	6.50	8.48	21.00	6.75	0.07	-0.13	0.08	0.05	0.28	0.32	0.33	0.55	0.63	0.38	0.00	0.00	0.21	-0.07	0.02	-0.08	0.03	0.47	0.51
	U.S. Direct Real Estate	4.50	5.23	12.50	4.25	0.01	-0.06	0.10	0.07	0.14	0.13	0.16	0.20	0.20	0.10	0.06	0.08	0.14	0.07	0.06	0.06	0.06	0.18	0.22
	European Direct Real Estate	5.00	5.82	13.25	5.00	0.03	-0.07	-0.01	-0.02	0.10	0.13	0.15	0.28	0.27	0.21	-0.04	-0.05	0.06	-0.09	-0.10	-0.09	-0.10	0.21	0.17
	European Non-Prime Real Estate	6.75	7.85	15.50	7.00	0.03	-0.07	-0.01	-0.02	0.11	0.13	0.15	0.29	0.27	0.21	-0.05	-0.06	0.06	-0.10	-0.11	-0.10	-0.11	0.21	0.17
	UK Core Real Estate	4.75	5.67	14.00	5.25	0.06	-0.06	0.00	-0.02	0.10	0.12	0.10	0.26	0.28	0.19	-0.04	-0.07	0.05	-0.08	-0.04	-0.08	-0.03	0.21	0.22
	U.S. REITs	5.50	6.83	17.00	4.75	0.00	-0.15	0.28	0.22	0.36	0.35	0.43	0.47	0.49	0.24	0.19	0.25	0.37	0.21	0.22	0.19	0.22	0.44	0.57
	European REITs	7.25	8.91	19.25	6.25	0.03	-0.18	0.23	0.23	0.40	0.47	0.49	0.57	0.62	0.32	0.18	0.10	0.23	0.10	0.01	0.10	0.00	0.56	0.47
	Global Infrastructure	5.50	6.35	13.50	5.00	0.10	-0.06	0.02	0.02	0.06	0.09	0.11	0.15	0.17	0.11	0.01	0.02	0.08	-0.01	0.03	-0.01	0.03	0.12	0.17
	Diversified Hedge Funds hedged	4.00	4.27	7.50	3.25	0.22	-0.13	-0.13	-0.10	0.19	0.34	0.31	0.59	0.49	0.64	-0.20	-0.30	0.02	-0.36	-0.50	-0.36	-0.50	0.34	0.10
	Event Driven Hedge Funds hedged	4.50	4.88	9.00	4.50	0.22	-0.19	-0.14	-0.13	0.24	0.41	0.32	0.76	0.63	0.75	-0.25	-0.38	-0.03	-0.43	-0.52	-0.43	-0.52	0.46	0.19
	Long Bias Hedge Funds hedged	4.50	5.02	10.50	4.25	0.17	-0.14	-0.10	-0.13	0.27	0.39	0.29	0.74	0.66	0.65	-0.24	-0.34	-0.03	-0.40	-0.48	-0.39	-0.48	0.51	0.27
	Relative Value Hedge Funds hedged	4.25	4.48	7.00	4.00	0.17	-0.14	-0.01	-0.05	0.38	0.50	0.39	0.83	0.64	0.85	-0.18	-0.34	0.04	-0.35	-0.52	-0.34	-0.52	0.54	0.21
	Macro Hedge Funds hedged	3.50	3.77	7.50	3.75	0.02	0.21	0.20	0.21	0.26	0.21	0.25	0.15	0.24	0.04	0.18	0.18	0.20	0.19	0.12	0.18	0.11	0.22	0.23
	Commodities	3.00	3.96	14.25	2.50	0.16	0.03	0.10	-0.11	0.19	0.07	0.08	0.30	0.39	0.20	-0.14	-0.08	0.15	-0.08	0.09	-0.08	0.10	0.31	0.41
	Gold	3.25	4.93	19.00	2.75	-0.15	0.17	0.43	0.20	0.29	0.07	0.13	-0.07	0.10	-0.25	0.20	0.37	0.27	0.40	0.51	0.39	0.50	0.22	0.43

STERLING ASSUMPTIONS

Note: All estimates on this page are in sterling terms. Given the complex risk-reward trade-offs involved, we advise clients to rely on judgment as well as quantitative optimization approaches in setting strategic allocations to all of these asset classes and strategies. Please note that all information shown is based on qualitative analysis. Exclusive reliance on this information is not advised. This information is not intended as a recommendation to invest in any particular asset class or strategy or as a promise of future performance. Note that these asset class and strategy assumptions are passive only-they do not consider the impact of active management. References to future returns are not promises or even estimates of actual returns a client portfolio may achieve. Assumptions, opinions and estimates are provided for illustrative purposes only. They should not be relied upon as recommendations to buy or sell securities. Forecasts of financial market trends that are based on current market conditions constitute our judgment and are subject to change without notice. We believe the information provided here is reliable, but do not warrant its accuracy or completeness. This material has been prepared for information purposes only and is not intended to provide, and should not be relied on for, accounting, legal or tax advice.

Source: J.P. Morgan Asset Management; data as of September 30, 2017, except hedge funds, private equity, real estate and infrastructure, as of June 30, 2017. Alternative asset classes (including hedge funds, private equity, real estate, direct lending and infrastructure) are unlike other asset categories shown above in that there is no underlying investible index. The return estimates for these alternative asset classes and strategies are estimates of the industry average, net of manager fees. The dispersion of return among managers of these asset classes and strategies is typically significantly wider than that of traditional asset classes. Return estimates for direct real estate are unlevered. We have refined our REIT estimates for 2018 to reflect: net REIT leverage; REIT vs. core composite sector differentials and a more granular treatment of currency differentials. Estimates shown for 2017 do not reflect these refinements. Diversified hedge funds and conservative hedge funds are multi-strategy hedge funds instead of funds-of-funds in prior years. Correlation figures shown are rounded to two significant figures, which may cause a loss of information. All returns are nominal. For reference index information, please visit our website.

	Emerging Markets Corporate Bonds hedged	UK All Cap	UK Large Cap	UK Small Cap	U.S. Large Cap	U.S. Large Cap hedged	Euro area Large Cap	Euro area Large Cap hedged	Euro area Small Cap	Euro area Small Cap hedged	Japanese Equity	Japanese Equity hedged	AC Asia ex-Japan Equity	Emerging Markets Equity	AC World Equity	AC World ex-UK Equity	Developed World Equity	Global Convertible hedged	Global Credit Sensitive Convertible hedged	Private Equity	U.S. Direct Real Estate	European Direct Real Estate	European Non-Prime Real Estate	UK Core Real Estate	U.S. REITs	European REITs	Global Infrastructure	Diversified Hedge Funds hedged	Event Driven Hedge Funds hedged	Long Bias Hedge Funds hedged	Relative Value Hedge Funds hedged	Macro Hedge Funds hedged	Commodities	Gold
Emerging Markets Corporate Bonds hedged	1.00																																	
UK All Cap	0.60	1.00																																
UK Large Cap	0.59	0.99	1.00																															
UK Small Cap	0.54	0.84	0.79	1.00																														
U.S. Large Cap	0.37	0.78	0.78	0.62	1.00																													
U.S. Large Cap hedged	0.54	0.85	0.84	0.76	0.79	1.00																												
Euro area Large Cap	0.55	0.89	0.88	0.75	0.76	0.80	1.00																											
Euro area Large Cap hedged	0.53	0.87	0.85	0.79	0.66	0.84	0.88	1.00																										
Euro area Small Cap	0.56	0.86	0.83	0.84	0.69	0.74	0.93	0.80	1.00																									
Euro area Small Cap hedged	0.54	0.84	0.80	0.89	0.59	0.77	0.81	0.92	0.89	1.00																								
Japanese Equity	0.36	0.58	0.58	0.45	0.62	0.47	0.57	0.52	0.55	0.50	1.00																							
Japanese Equity hedged	0.35	0.59	0.57	0.59	0.45	0.65	0.55	0.69	0.52	0.65	0.69	1.00																						
AC Asia ex-Japan Equity	0.61	0.73	0.73	0.61	0.66	0.65	0.73	0.63	0.72	0.63	0.53	0.44	1.00																					
Emerging Markets Equity	0.63	0.76	0.76	0.63	0.67	0.68	0.76	0.64	0.76	0.65	0.53	0.45	0.97	1.00																				
AC World Equity	0.55	0.90	0.90	0.73	0.94	0.84	0.89	0.78	0.84	0.74	0.69	0.55	0.82	0.85	1.00																			
AC World ex-UK Equity	0.54	0.88	0.88	0.72	0.94	0.83	0.89	0.77	0.84	0.72	0.70	0.55	0.83	0.85	1.00	1.00																		
Developed World Equity	0.52	0.90	0.90	0.72	0.96	0.84	0.89	0.78	0.83	0.73	0.70	0.55	0.77	0.79	1.00	0.99	1.00																	
Global Convertible hedged	0.70	0.86	0.83	0.83	0.63	0.85	0.80	0.86	0.81	0.86	0.51	0.69	0.75	0.77	0.79	0.77	0.77	1.00																
Global Credit Sensitive Convertible hedged	0.27	0.38	0.39	0.32	0.21	0.36	0.31	0.40	0.30	0.40	0.19	0.27	0.20	0.22	0.28	0.26	0.28	0.38	1.00															
Private Equity	0.46	0.79	0.78	0.67	0.80	0.74	0.79	0.70	0.76	0.67	0.56	0.47	0.66	0.68	0.85	0.85	0.85	0.69	0.24	1.00														
U.S. Direct Real Estate	0.13	0.24	0.24	0.19	0.30	0.25	0.24	0.21	0.23	0.19	0.19	0.11	0.21	0.21	0.29	0.29	0.29	0.19	0.03	0.26	1.00													
European Direct Real Estate	0.20	0.38	0.37	0.33	0.32	0.36	0.40	0.41	0.37	0.38	0.24	0.28	0.29	0.29	0.37	0.36	0.37	0.35	0.12	0.33	0.30	1.00												
European Non-Prime Real Estate	0.20	0.39	0.38	0.34	0.33	0.37	0.41	0.42	0.38	0.39	0.25	0.29	0.29	0.30	0.38	0.37	0.38	0.36	0.12	0.34	0.30	0.98	1.00											
UK Core Real Estate	0.20	0.40	0.40	0.31	0.35	0.35	0.36	0.34	0.34	0.31	0.24	0.22	0.30	0.31	0.38	0.38	0.38	0.33	0.11	0.33	0.35	0.21	0.21	1.00										
U.S. REITs	0.33	0.58	0.59	0.45	0.76	0.58	0.59	0.49	0.56	0.44	0.48	0.25	0.52	0.52	0.72	0.73	0.74	0.45	0.06	0.64	0.40	0.28	0.29	0.29	1.00									
European REITs	0.48	0.71	0.69	0.68	0.58	0.64	0.75	0.68	0.74	0.67	0.40	0.38	0.50	0.51	0.66	0.65	0.66	0.61	0.27	0.61	0.28	0.32	0.32	0.29	0.68	1.00								
Global Infrastructure	0.11	0.24	0.24	0.19	0.30	0.25	0.23	0.20	0.21	0.18	0.18	0.14	0.20	0.20	0.28	0.28	0.29	0.19	0.06	0.25	0.30	0.14	0.15	0.16	0.26	0.20	1.00							
Diversified Hedge Funds hedged	0.43	0.66	0.64	0.69	0.41	0.66	0.55	0.69	0.61	0.76	0.37	0.63	0.53	0.57	0.55	0.54	0.54	0.78	0.42	0.49	0.08	0.26	0.27	0.23	0.17	0.35	0.13	1.00						
Event Driven Hedge Funds hedged	0.57	0.75	0.72	0.77	0.51	0.79	0.65	0.76	0.70	0.82	0.38	0.64	0.60	0.65	0.65	0.63	0.63	0.86	0.51	0.58	0.14	0.30	0.31	0.28	0.31	0.47	0.16	0.88	1.00					
Long Bias Hedge Funds hedged	0.60	0.80	0.77	0.78	0.56	0.86	0.72	0.79	0.75	0.83	0.44	0.68	0.72	0.76	0.73	0.72	0.70	0.92	0.42	0.63	0.15	0.32	0.33	0.31	0.34	0.49	0.18	0.87	0.93	1.00				
Relative Value Hedge Funds hedged	0.63	0.68	0.66	0.68	0.40	0.67	0.56	0.69	0.60	0.75	0.36	0.60	0.58	0.63	0.56	0.55	0.54	0.84	0.44	0.50	0.12	0.26	0.27	0.24	0.27	0.43	0.13	0.85	0.92	0.86	1.00			
Macro Hedge Funds hedged	0.19	0.29	0.30	0.19	0.13	0.19	0.25	0.20	0.27	0.24	0.16	0.08	0.29	0.33	0.25	0.25	0.23	0.29	0.13	0.19	0.03	0.08	0.08	0.10	0.07	0.12	0.04	0.52	0.28	0.35	0.27	1.00		
Commodities	0.32	0.38	0.40	0.22	0.31	0.29	0.30	0.14	0.32	0.18	0.15	0.04	0.39	0.48	0.40	0.40	0.38	0.31	0.17	0.33	0.08	0.08	0.08	0.17	0.21	0.17	0.10	0.35	0.37	0.41	0.36	0.38	1.00	
Gold	0.16	-0.04	-0.02	-0.14	0.00	-0.21	-0.05	-0.26	-0.02	-0.21	-0.04	-0.42	0.13	0.16	0.03	0.04	0.01	-0.10	-0.11	0.00	0.03	-0.09	-0.09	-0.02	0.10	-0.04	-0.01	-0.11	-0.18	-0.11	-0.13	0.35	0.44	1.00

		Compound Return 2017 (%)																				
		Annualized Volatility																				
		Arithmetic Return 2018 (%)																				
		Compound Return 2018 (%)				Euro Inflation	Euro Cash	U.S. Aggregate Bonds hedged	Euro Aggregate Bonds	U.S. Inv Grade Corporate Bonds hedged	Euro Inv Grade Corp Bonds	U.S. High Yield Bonds hedged	European High Yield Bonds	U.S. Leveraged Loans hedged	Euro Government Bonds	Euro Govt Inflation-Linked	World Government Bonds hedged	World Government Bonds	World ex-Euro Government Bonds hedged	World ex-Euro Government Bonds	Emerging Markets Sovereign Debt hedged	Emerging Markets Local Currency Debt
FIXED INCOME	Euro Inflation	1.50	1.52	1.75	1.50	1.00																
	Euro Cash	1.25	1.25	0.50	1.00	0.01	1.00															
	U.S. Aggregate Bonds hedged	2.50	2.57	3.75	2.00	-0.23	0.14	1.00														
	Euro Aggregate Bonds	1.75	1.82	3.75	1.50	-0.20	0.07	0.66	1.00													
	U.S. Inv Grade Corporate Bonds hedged	2.75	2.92	6.00	2.25	-0.22	0.03	0.83	0.59	1.00												
	Euro Inv Grade Corp Bonds	2.00	2.11	4.75	2.00	-0.18	-0.08	0.53	0.72	0.78	1.00											
	U.S. High Yield Bonds hedged	4.50	4.84	8.50	4.75	0.00	-0.11	0.18	0.05	0.56	0.57	1.00										
	European High Yield Bonds	3.50	3.91	9.25	4.25	-0.04	-0.21	0.05	0.11	0.48	0.66	0.87	1.00									
	U.S. Leveraged Loans hedged	4.25	4.57	8.25	4.00	0.05	-0.21	-0.07	-0.12	0.32	0.43	0.81	0.88	1.00								
	Euro Government Bonds	1.50	1.59	4.25	1.25	-0.17	0.08	0.61	0.97	0.46	0.57	-0.10	-0.05	-0.26	1.00							
	Euro Govt Inflation-Linked	1.50	1.62	5.00	1.75	-0.05	0.09	0.57	0.76	0.60	0.67	0.33	0.30	0.09	0.72	1.00						
	World Government Bonds hedged	1.75	1.79	3.00	0.75	-0.19	0.17	0.82	0.83	0.52	0.39	-0.20	-0.26	-0.41	0.86	0.58	1.00					
	World Government Bonds	1.50	1.78	7.50	0.75	-0.23	0.12	0.34	0.46	0.14	0.11	-0.36	-0.29	-0.31	0.48	0.15	0.57	1.00				
	World ex-Euro Government Bonds hedged	1.75	1.79	3.00	0.50	-0.17	0.22	0.83	0.60	0.48	0.21	-0.25	-0.37	-0.45	0.64	0.40	0.94	0.54	1.00			
	World ex-Euro Government Bonds	1.50	2.01	10.25	0.25	-0.23	0.10	0.25	0.32	0.06	0.02	-0.37	-0.30	-0.28	0.33	0.03	0.45	0.99	0.45	1.00		
	Emerging Markets Sovereign Debt hedged	4.50	4.95	9.75	4.50	-0.01	0.04	0.59	0.40	0.76	0.66	0.71	0.56	0.40	0.28	0.56	0.28	-0.19	0.23	-0.27	1.00	
	Emerging Markets Local Currency Debt	5.25	5.65	9.25	5.25	-0.02	0.07	0.33	0.35	0.46	0.51	0.40	0.37	0.29	0.27	0.40	0.23	0.28	0.15	0.25	0.55	1.00
	Emerging Markets Corporate Bonds hedged	4.50	4.82	8.25	4.50	-0.06	0.01	0.50	0.32	0.78	0.72	0.74	0.68	0.54	0.18	0.47	0.13	-0.22	0.08	-0.27	0.89	0.51
EQUITIES	European Large Cap	5.50	6.47	14.50	5.75	0.07	-0.27	-0.02	0.06	0.32	0.49	0.68	0.74	0.63	-0.04	0.29	-0.23	-0.31	-0.34	-0.32	0.49	0.43
	European Small Cap	5.75	6.96	16.25	6.50	0.09	-0.26	-0.04	0.00	0.30	0.45	0.69	0.73	0.61	-0.10	0.25	-0.27	-0.44	-0.35	-0.45	0.49	0.28
	U.S. Large Cap	4.50	5.32	13.25	5.00	0.08	-0.30	-0.14	0.04	0.10	0.34	0.46	0.52	0.52	-0.03	0.15	-0.22	0.03	-0.32	0.04	0.19	0.47
	U.S. Large Cap hedged	4.75	5.67	14.00	5.25	0.17	-0.25	-0.02	-0.02	0.26	0.40	0.68	0.62	0.54	-0.10	0.23	-0.25	-0.52	-0.31	-0.54	0.51	0.28
	Euro area Large Cap	5.75	7.04	16.75	6.00	0.09	-0.24	-0.01	0.05	0.30	0.45	0.66	0.70	0.57	-0.04	0.32	-0.22	-0.40	-0.32	-0.42	0.50	0.36
	Euro area Small Cap	6.00	7.40	17.50	6.50	0.06	-0.27	-0.03	0.03	0.31	0.45	0.68	0.73	0.61	-0.07	0.28	-0.25	-0.42	-0.34	-0.43	0.48	0.30
	UK Large Cap	5.25	6.19	14.25	6.25	0.02	-0.27	-0.05	0.04	0.30	0.49	0.63	0.73	0.67	-0.07	0.21	-0.27	-0.17	-0.37	-0.17	0.41	0.46
	UK Large Cap hedged	5.00	5.82	13.25	5.50	0.07	-0.19	0.10	0.08	0.39	0.45	0.66	0.60	0.51	0.00	0.31	-0.12	-0.40	-0.18	-0.43	0.60	0.37
	Japanese Equity	5.25	6.23	14.50	4.50	-0.05	-0.23	-0.06	0.07	0.21	0.34	0.36	0.43	0.41	-0.01	0.17	-0.16	0.12	-0.25	0.14	0.16	0.47
	Japanese Equity hedged	5.75	7.31	18.50	5.00	0.12	-0.25	-0.21	-0.09	0.11	0.28	0.48	0.52	0.48	-0.15	0.15	-0.38	-0.52	-0.47	-0.54	0.26	0.23
	Emerging Markets Equity	7.00	8.39	17.50	8.00	0.10	-0.12	0.06	0.05	0.38	0.48	0.68	0.68	0.61	-0.06	0.29	-0.19	-0.23	-0.26	-0.24	0.55	0.64
	AC Asia ex-Japan Equity	7.25	8.63	17.50	8.00	0.03	-0.13	0.08	0.11	0.40	0.49	0.64	0.65	0.56	0.00	0.30	-0.13	-0.15	-0.22	-0.16	0.51	0.62
	AC World Equity	5.00	5.76	12.75	5.50	0.07	-0.28	-0.07	0.06	0.26	0.47	0.63	0.69	0.63	-0.04	0.25	-0.24	-0.12	-0.35	-0.11	0.39	0.55
	AC World ex-EMU Equity	5.00	5.76	12.75	5.50	0.07	-0.28	-0.08	0.06	0.24	0.45	0.60	0.66	0.62	-0.04	0.22	-0.24	-0.06	-0.34	-0.06	0.36	0.57
	Developed World Equity	5.00	5.76	12.75	5.25	0.07	-0.30	-0.08	0.05	0.23	0.44	0.60	0.66	0.61	-0.04	0.23	-0.24	-0.09	-0.35	-0.09	0.35	0.52
	Global Convertible hedged	4.25	4.68	9.50	-	0.05	-0.14	0.06	0.06	0.44	0.54	0.81	0.78	0.67	-0.06	0.33	-0.24	-0.50	-0.33	-0.53	0.63	0.35
	Global Credit Sensitive Convertible hedged	3.50	3.67	6.00	-	0.03	-0.31	-0.02	0.09	0.19	0.34	0.28	0.39	0.31	0.00	0.08	-0.11	-0.20	-0.16	-0.21	0.20	0.12
ALTERNATIVES	Private Equity	6.25	8.23	21.00	6.75	0.07	-0.25	-0.06	0.03	0.22	0.39	0.57	0.61	0.56	-0.06	0.21	-0.22	-0.16	-0.31	-0.16	0.34	0.42
	U.S. Direct Real Estate	4.25	5.20	14.25	4.25	0.00	-0.09	0.08	0.08	0.13	0.16	0.19	0.17	0.14	0.07	0.14	0.05	0.04	0.02	0.04	0.14	0.21
	European Direct Real Estate	4.75	5.25	10.25	5.00	0.06	-0.11	-0.05	-0.05	0.06	0.10	0.24	0.24	0.21	-0.07	0.08	-0.12	-0.16	-0.15	-0.16	0.16	0.13
	European Non-Prime Real Estate	6.50	7.47	14.50	7.00	0.06	-0.11	-0.05	-0.05	0.06	0.10	0.25	0.25	0.22	-0.07	0.08	-0.13	-0.17	-0.15	-0.17	0.16	0.14
	U.S. REITs	5.25	6.33	15.25	4.75	-0.01	-0.21	0.21	0.22	0.34	0.41	0.46	0.41	0.34	0.18	0.34	0.13	0.14	0.06	0.13	0.35	0.55
	Global ex-U.S. REITs	7.00	8.39	17.50	4.50	-0.02	-0.33	0.14	0.24	0.39	0.55	0.59	0.63	0.47	0.15	0.36	0.01	-0.15	-0.11	-0.19	0.48	0.39
	Global Infrastructure	5.25	6.40	15.75	5.00	0.10	-0.09	-0.03	0.01	0.04	0.10	0.15	0.16	0.15	-0.01	0.06	-0.05	0.00	-0.08	0.00	0.08	0.16
	Diversified Hedge Funds hedged	3.50	3.77	7.50	2.50	0.09	-0.16	-0.12	-0.09	0.21	0.34	0.61	0.68	0.64	-0.20	0.15	-0.36	-0.45	-0.41	-0.45	0.36	0.23
	Event Driven Hedge Funds hedged	4.00	4.39	9.00	3.75	0.14	-0.22	-0.13	-0.12	0.26	0.42	0.77	0.79	0.75	-0.25	0.17	-0.43	-0.54	-0.48	-0.54	0.47	0.28
	Long Bias Hedge Funds hedged	4.00	4.52	10.50	3.50	0.15	-0.18	-0.10	-0.13	0.28	0.39	0.75	0.72	0.66	-0.24	0.19	-0.40	-0.60	-0.44	-0.61	0.52	0.28
	Relative Value Hedge Funds hedged	3.75	3.98	7.00	3.25	0.06	-0.14	0.00	-0.04	0.40	0.51	0.84	0.86	0.85	-0.18	0.23	-0.35	-0.43	-0.41	-0.43	0.56	0.38
	Macro Hedge Funds hedged	3.00	3.27	7.50	3.00	-0.04	0.18	0.20	0.21	0.27	0.21	0.15	0.14	0.05	0.17	0.30	0.18	-0.02	0.16	-0.06	0.22	0.16
	Commodities	2.75	3.68	14.00	2.50	0.04	-0.07	-0.05	-0.15	0.13	0.13	0.33	0.30	0.37	-0.21	0.07	-0.24	-0.06	-0.22	-0.02	0.16	0.30
	Gold	3.00	4.52	18.00	2.75	-0.23	0.15	0.33	0.19	0.24	0.12	-0.08	-0.10	-0.12	0.16	0.06	0.29	0.43	0.33	0.44	0.10	0.32

EURO ASSUMPTIONS

Note: All estimates on this page are in euro terms. Given the complex risk-reward trade-offs involved, we advise clients to rely on judgment as well as quantitative optimization approaches in setting strategic allocations to all of these asset classes and strategies. Please note that all information shown is based on qualitative analysis. Exclusive reliance on this information is not advised. This information is not intended as a recommendation to invest in any particular asset class or strategy or as a promise of future performance. Note that these asset class and strategy assumptions are passive only-they do not consider the impact of active management. References to future returns are not promises or even estimates of actual returns a client portfolio may achieve. Assumptions, opinions and estimates are provided for illustrative purposes only. They should not be relied upon as recommendations to buy or sell securities. Forecasts of financial market trends that are based on current market conditions constitute our judgment and are subject to change without notice. We believe the information provided here is reliable, but do not warrant its accuracy or completeness. This material has been prepared for information purposes only and is not intended to provide, and should not be relied on for, accounting, legal or tax advice.

Source: J.P. Morgan Asset Management; data as of September 30, 2017, except hedge funds, private equity, real estate and infrastructure, as of June 30, 2017. Alternative asset classes (including hedge funds, private equity, real estate, direct lending and infrastructure) are unlike other asset categories shown above in that there is no underlying investible index. The return estimates for these alternative asset classes and strategies are estimates of the industry average, net of manager fees. The dispersion of return among managers of these asset classes and strategies is typically significantly wider than that of traditional asset classes. Return estimates for direct real estate are unlevered. We have refined our REIT estimates in 2018 to reflect: net REIT leverage; REIT vs. core composite sector differentials and a more granular treatment of currency differentials. Estimates shown for 2017 do not reflect these refinements. Diversified hedge funds and conservative hedge funds are multi-strategy hedge funds instead of funds-of-funds in prior years. Correlation figures shown are rounded to two significant figures, which may cause a loss of information. All returns are nominal. For reference index information, please visit our website.

	Emerging Markets Corporate Bonds hedged	European Large Cap	European Small Cap	U.S. Large Cap	U.S. Large Cap hedged	Euro area Large Cap	Euro area Small Cap	UK Large Cap	UK Large Cap hedged	Japanese Equity	Japanese Equity hedged	Emerging Markets Equity	AC Asia ex-Japan Equity	AC World Equity	AC World ex-EMU Equity	Developed World Equity	Global Convertible hedged	Global Credit Sensitive Convertible hedged	Private Equity	U.S. Direct Real Estate	European Direct Real Estate	European Non-Prime Real Estate	U.S. REITs	Global ex-U.S. REITs	Global Infrastructure	Diversified Hedge Funds hedged	Event Driven Hedge Funds hedged	Long Bias Hedge Funds hedged	Relative Value Hedge Funds hedged	Macro Hedge Funds hedged	Commodities	Gold
Emerging Markets Corporate Bonds hedged	1.00																															
European Large Cap	0.54	1.00																														
European Small Cap	0.56	0.89	1.00																													
U.S. Large Cap	0.28	0.77	0.62	1.00																												
U.S. Large Cap hedged	0.54	0.83	0.80	0.72	1.00																											
Euro area Large Cap	0.53	0.97	0.89	0.68	0.84	1.00																										
Euro area Small Cap	0.55	0.90	0.98	0.60	0.77	0.92	1.00																									
UK Large Cap	0.49	0.93	0.77	0.80	0.73	0.83	0.77	1.00																								
UK Large Cap hedged	0.59	0.86	0.82	0.61	0.84	0.85	0.80	0.79	1.00																							
Japanese Equity	0.26	0.59	0.45	0.65	0.37	0.51	0.48	0.63	0.39	1.00																						
Japanese Equity hedged	0.36	0.70	0.65	0.55	0.66	0.69	0.65	0.63	0.57	0.73	1.00																					
Emerging Markets Equity	0.60	0.75	0.70	0.61	0.67	0.71	0.70	0.73	0.69	0.50	0.55	1.00																				
AC Asia ex-Japan Equity	0.57	0.73	0.67	0.63	0.62	0.67	0.67	0.71	0.63	0.53	0.54	0.97	1.00																			
AC World Equity	0.47	0.91	0.78	0.94	0.80	0.84	0.78	0.91	0.76	0.71	0.68	0.81	0.80	1.00																		
AC World ex-EMU Equity	0.45	0.87	0.74	0.95	0.77	0.78	0.73	0.90	0.71	0.73	0.65	0.80	0.80	1.00	1.00																	
Developed World Equity	0.43	0.91	0.77	0.96	0.79	0.83	0.76	0.91	0.74	0.72	0.67	0.75	0.74	1.00	0.99	1.00																
Global Convertible hedged	0.71	0.85	0.88	0.59	0.85	0.86	0.87	0.76	0.83	0.45	0.69	0.79	0.75	0.78	0.74	0.75	1.00															
Global Credit Sensitive Convertible hedged	0.28	0.43	0.39	0.24	0.37	0.41	0.41	0.40	0.40	0.20	0.29	0.29	0.26	0.34	0.32	0.33	0.40	1.00														
Private Equity	0.41	0.82	0.73	0.80	0.72	0.77	0.72	0.79	0.69	0.57	0.58	0.65	0.64	0.85	0.84	0.86	0.70	0.31	1.00													
U.S. Direct Real Estate	0.12	0.23	0.19	0.28	0.23	0.21	0.19	0.21	0.21	0.18	0.13	0.18	0.18	0.27	0.27	0.27	0.18	0.05	0.24	1.00												
European Direct Real Estate	0.16	0.39	0.35	0.30	0.34	0.40	0.36	0.33	0.34	0.21	0.28	0.27	0.26	0.34	0.32	0.34	0.32	0.13	0.32	0.30	1.00											
European Non-Prime Real Estate	0.16	0.40	0.36	0.31	0.35	0.41	0.37	0.33	0.35	0.21	0.28	0.28	0.26	0.35	0.33	0.35	0.33	0.14	0.33	0.30	0.98	1.00										
U.S. REITs	0.30	0.57	0.46	0.71	0.55	0.52	0.46	0.53	0.51	0.46	0.32	0.45	0.46	0.67	0.68	0.69	0.44	0.11	0.61	0.40	0.26	0.26	1.00									
Global ex-U.S. REITs	0.46	0.77	0.74	0.57	0.63	0.74	0.74	0.69	0.65	0.42	0.46	0.50	0.49	0.67	0.63	0.67	0.64	0.34	0.62	0.27	0.30	0.30	0.66	1.00								
Global Infrastructure	0.09	0.23	0.19	0.30	0.23	0.21	0.19	0.23	0.19	0.19	0.17	0.19	0.19	0.28	0.28	0.29	0.18	0.07	0.24	0.30	0.14	0.14	0.26	0.19	1.00							
Diversified Hedge Funds hedged	0.45	0.73	0.77	0.51	0.66	0.69	0.77	0.70	0.64	0.43	0.63	0.69	0.63	0.68	0.66	0.66	0.79	0.42	0.60	0.10	0.26	0.27	0.23	0.48	0.15	1.00						
Event Driven Hedge Funds hedged	0.58	0.78	0.83	0.55	0.79	0.75	0.82	0.73	0.72	0.40	0.65	0.73	0.66	0.73	0.70	0.70	0.87	0.51	0.66	0.14	0.29	0.30	0.34	0.56	0.17	0.88	1.00					
Long Bias Hedge Funds hedged	0.61	0.79	0.85	0.54	0.86	0.79	0.83	0.72	0.77	0.40	0.69	0.80	0.74	0.74	0.71	0.70	0.92	0.42	0.66	0.14	0.30	0.31	0.34	0.53	0.17	0.87	0.94	1.00				
Relative Value Hedge Funds hedged	0.65	0.73	0.75	0.50	0.66	0.68	0.74	0.72	0.65	0.44	0.60	0.75	0.68	0.69	0.67	0.65	0.84	0.43	0.61	0.13	0.25	0.25	0.32	0.53	0.15	0.85	0.92	0.85	1.00			
Macro Hedge Funds hedged	0.20	0.23	0.24	0.03	0.20	0.21	0.25	0.21	0.31	0.06	0.09	0.29	0.24	0.17	0.16	0.15	0.30	0.13	0.14	0.01	0.06	0.07	0.03	0.12	0.01	0.53	0.28	0.35	0.27	1.00		
Commodities	0.26	0.28	0.20	0.28	0.22	0.17	0.19	0.41	0.26	0.18	0.13	0.43	0.36	0.37	0.39	0.34	0.29	0.19	0.29	0.05	0.06	0.07	0.13	0.14	0.08	0.45	0.42	0.40	0.46	0.32	1.00	
Gold	0.11	-0.20	-0.23	-0.10	-0.28	-0.27	-0.23	-0.07	-0.16	-0.08	-0.39	0.03	0.03	-0.10	-0.06	-0.12	-0.14	-0.09	-0.12	0.00	-0.12	-0.13	0.00	-0.15	-0.04	-0.04	-0.15	-0.14	-0.06	0.30	0.37	1.00

IV Appendices

GLOSSARY

ARTIFICIAL INTELLIGENCE (AI) The capability of a machine to imitate human behavior.

ASYMMETRIC RETURNS Investment returns skewed toward the upside, or where upside potential is greater than downside risk.

BENCHMARK INTEREST RATE The core cost of capital in an economy. Investors often reference such a rate to determine the minimum interest rate they will require to part with their capital for a short period of time.

BETA EXPOSURE Risk taken in the public market.

BLOCKCHAIN TECHNOLOGY A decentralized database and peer-to-peer network, introduced in 2008, that stores a registry of transactions; a distributed ledger of economic transactions (blocks) recorded, managed and hosted on a network of millions of computers (nodes or blockchain administrators).

BUY AND MAINTAIN STRATEGY A strategy in which a bond portfolio is constructed to align with an investor's funding profile. Bonds are selected based on the issuer's ability to service its debt until maturity and are intended to be held to maturity unless the probability of default for a particular bond held rises to unacceptable levels (in which case it is sold and replaced).

CAPITAL DEEPENING A rise in the ratio of capital to labor; an increase in capital intensity.

CLOUD COMPUTING The use of a remote network of internet servers (rather than a local host or personal computer) to store data.

COMMODITY SUPERCYCLE The rise and fall of primary commodities prices over an extended period around a slow-moving underlying trend; often in reference to 2000s commodities boom, when oil and metal prices roughly quadrupled and food prices doubled, attributed largely to demand from emerging markets.

DEBT SERVICE RATIO The ratio of interest payments plus amortizations to income.

DE-EQUITIZATION The substitution of debt for equity, especially at the level of global capital markets. At the company level, it is the process whereby companies shift from equity financing to debt financing.

DE-RATING A fall in the valuation multiple that investors are prepared to pay for a security or investment.

DUPONT ANALYSIS Breaking return on equity (RoE) into three component parts. Specifically, RoE = profit margins (earning-to-sales) × asset turnover (sales-to-assets) × financial leverage (assets-to-equity).

EQUILIBRIUM LEVEL The average or cycle-neutral value for a market or macroeconomic variable (for example, yield or credit spread) expected to prevail over the long term.

FINANCIAL REPRESSION A set of conditions which result in artificially depressed returns on savings, usually to the benefit of borrowers. Measures typically implemented aim to reduce the cost of debt for governments (or government-linked actors). These may include capping interest rates; high reserve requirements for banks; regulatory measures requiring the purchase of certain types of assets (e.g., requiring pension funds to hold a proportion of assets in government bonds); ceilings on the allowable return on deposits.

HEDGE RATIO Measures the sensitivity of pension plan assets to a change in interest rates, relative to the sensitivity of plan liabilities to the same rate change. A 50% hedge ratio implies, for example, that for a given interest rate increase (decrease), assets would decline (increase) half as much as liabilities.

ILLIQUIDITY PREMIUM/LIQUIDITY PREMIUM The extra return investors demand for holding an asset, such as private equity or real estate, that is less readily convertible to cash than another.

INTERNET OF THINGS (IOT) Everyday, standalone objects ("smart devices" such as body monitors, automated appliances, connected vehicles, medical implants and professional field tools) embedded with computing capability and connected to the internet, allowing them to collect and exchange data. Users may remotely control them with, for example, a mobile application. A combination of software, hardware, data and services.

LABOR FORCE GROWTH The prospective growth rate of a country's supply of labor, generated through projected working-age population growth and forecast changes in the labor force participation rate (the share of the working-age population involved in the labor market).

MOORE'S LAW The empirical observation that the number of transistors in an integrated circuit, closely related to computational performance, has for several decades doubled approximately every two years.

MULTIFACTOR PRODUCTIVITY The increase in the efficiency of workers over and above that which can be explained by better workers or an increase in the capital/labor ratio.

OUTPUT GAP The difference between an economy's actual and potential output.

PLACEMAKING A multi-faceted approach to the planning, design and management of public spaces, capitalizing on a local community's assets, inspiration and potential to create public spaces that promote health, happiness and well-being.

SAVINGS GLUT The idea that rapid accumulation of global savings in the late 1990s and early 2000s contributed to a meaningful decline in global interest rates.

SHARPE RATIO A measure used to examine the performance of an investment by adjusting for its risk. The Sharpe ratio is the return in excess of the risk-free rate per unit of risk.

SPREAD DURATION The sensitivity of a bond price to spread changes.

SUSTAINABLE GROWTH RATE (SGR) A concept developed by Robert C. Higgins (1977). The assumed maximum rate of growth in earnings a company can sustain without issuing new equity; equal to return on equity (RoE) × portion of earnings not paid out to shareholders. It assumes that future earnings can only grow by re-investing the retained proportion of earnings at a stable RoE, thereby expanding book value at the same rate as earnings. For a given RoE, slower earnings growth thus implies a higher payout ratio.

TAIL RISK The risk of the value of an asset, or portfolio of assets, moving more than 3 standard deviations from its current value.

TOTAL FACTOR PRODUCTIVITY (TFP) Productivity growth that is not explained by capital stock accumulation or the labor force (increased hours worked) but rather captures the efficiency or intensity with which inputs are utilized. A residual that likely reflects technological change.

UNFUNDED DURATION HEDGING Achieving an asset-liability duration hedge using derivatives rather than cash instruments.

VALUE-ADDED Flows to value-added strategies are strong at this stage of the cycle. As this dry powder gets invested, expect a compression in returns and convergence between core and value-added returns.

WINSORIZATION Applies a cap and a floor to extreme data values to remove the impact of potentially spurious outlier data on statistical results.

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EDITORIAL TEAM

John Bilton, CFA
Head of Global Multi-Asset Strategy, Multi-Asset Solutions

Michael Feser, CFA
Portfolio Manager, Multi-Asset Solutions

Jonathon Griggs
Head of Applied Research, Global Fixed Income, Currency & Commodities

Michael Hood
Global Strategist, Multi-Asset Solutions

Dr. David Kelly, CFA
Chief Global Strategist, Head of Global Market Insights Strategy

Grace Koo, Ph.D.
Quantitative Analyst and Portfolio Manager, Multi-Asset Solutions

Stephen Macklow-Smith
Portfolio Manager, European Equity Group

Patrik Schöwitz, CFA
Global Strategist, Multi-Asset Solutions

Anthony Werley
Chief Portfolio Strategist, Endowment and Foundations Group

LTCMA COMMITTEE

Michael Albrecht, CFA
Global Strategist, Multi-Asset Solutions

Hannah Anderson
Global Market Strategist, Global Market Insights Strategy

Brian Bovino
Associate, Multi-Asset Solutions

Leon Goldfeld, CFA
Portfolio Manager, Multi-Asset Solutions

Sorca Kelly-Scholte, FIA
Global Strategist, Global Pension Solutions

Akira Kunikyo
Client Portfolio Manager, Multi-Asset Solutions

Pete Klingelhofer, CFA
Portfolio Manager, Multi-Asset Solutions

Timothy Lintern
Analyst, Global Strategist, Multi-Asset Solutions

Thushka Maharaj, DPhil, CFA
Global Strategist, Multi-Asset Solutions

Benjamin Mandel, Ph.D.
Global Strategist, Multi-Asset Solutions

John C. Manley
Global Market Strategist, Global Market Insights Strategy

Nika Mosenthal
Analyst, Multi-Asset Solutions

Emily Overton
Associate, Global Insights

Catherine Peterson
Global Head of Insights Programs

Nandini Srivastava
Quantitative Analyst, Multi-Asset Solutions

Livia Wu
Quantitative Analyst, Multi-Asset Solutions

Vladimir Zdorovenin
Global Strategist, Global Insurance Solutions

EXECUTIVE SPONSORS

Chris Willcox
Chief Executive Officer, Asset Management

Mike O'Brien
Chief Executive Officer, Asset Management Solutions

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