Alternative Thinking I 1Q19

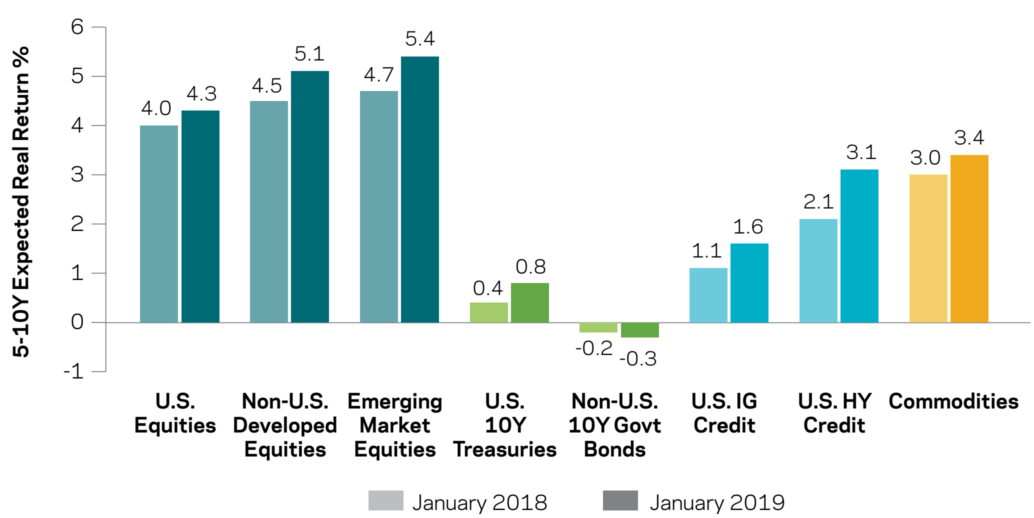
Capital Market Assumptions for Major Asset Classes

Executive Summary

This article updates our estimates of medium-term (5- to 10-year) expected returns for major asset classes. It also includes a section on estimating expected returns for private equity and real estate. Selected estimates are summarized in **Exhibit 1**. The year 2018 saw cheapening across many asset classes, and compared to last year expected returns are somewhat higher for equities, U.S. Treasuries and credit. However, from a historical perspective, nearly all long-only investments still have low expected real returns. The expected real return of the traditional U.S. 60/40 portfolio is 2.9%, compared to a long-term average of 5% (since 1900[1]).

Exhibit 1

Medium-Term Expected Real Returns for Liquid Asset Classes



Source: AQR; see Exhibits 3-6 for details. "Non-U.S. Developed Equities" is cap-weighted average of Euro-5, Japan, U.K., Australia, Canada. "Non-U.S. 10Y Govt. Bonds" is GDP-weighted average of Germany, Japan, U.K., Australia, Canada. Estimates are for illustrative purposes only, are not a guarantee of performance, and are subject to change. Not representative of any portfolio that AQR currently manages.

1 Based on historical real yields for U.S. large-cap equities and 10-year Treasuries; methodology and sources described in Appendix.

Contents

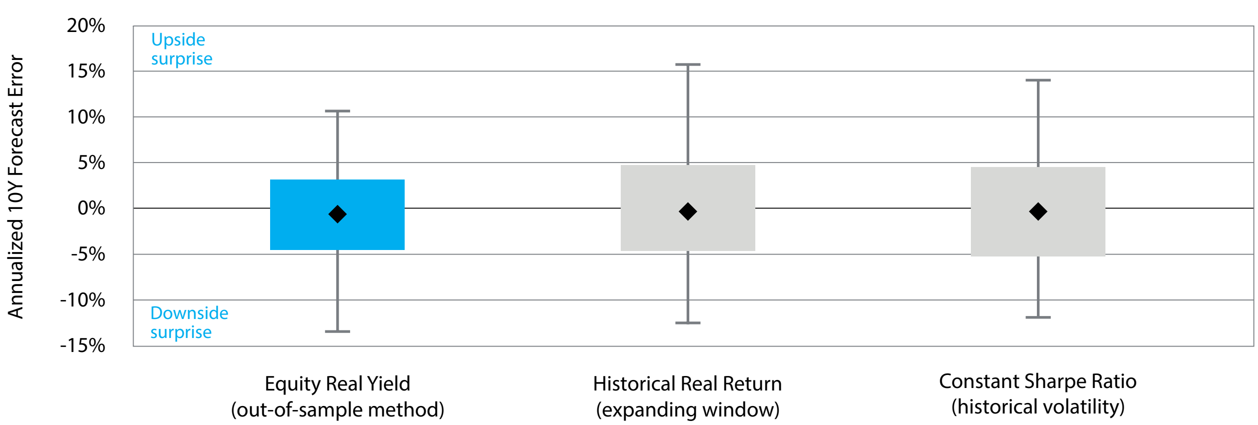
Introduction and Framework

For the past five years, the first quarter's *Alternative Thinking* has presented our capital market assumptions for major asset classes, with a focus on medium-term expected returns (see 2014, 2015, 2016, 2017 and 2018). We update these estimates annually, and each year we provide additional analysis in the form of new asset classes or other new material. This year, we update our estimates using the same methodology as last year and then discuss similar yield-based frameworks for estimating returns for illiquid asset classes.

As usual, we present local real (inflation-adjusted) annual compound rates of return[2] for a horizon of 5 to 10 years. Over such intermediate horizons, initial market yields and valuations tend to be the most important inputs. For multi-decade forecast horizons, the impact of starting yields is diluted, so theory and long-term historical average returns (or yields) may matter more in judging expected returns. For shorter horizons, returns are largely unpredictable, and any predictability has tended to mainly reflect momentum and the macro environment.

Our estimates are intended to assist investors with their strategic allocation and planning decisions and, in particular, with setting appropriate medium-term expectations. They are highly uncertain and not intended for market timing. The frameworks for making such estimates may be more useful and informative than the numbers themselves. As one cautionary example, the blue interquartile error range shown in **Exhibit 2**, taken from last year's article, suggests that there is a 50% chance that realized equity market returns *over the next 10 years* will under- or overshoot our estimates by more than 3% per annum.

Exhibit 2
Yield-Based Estimates Are the Best We Have but Still Highly Uncertain
10-Year Forecast Errors for Simple Expected Real Return Candidates for U.S. Equities 1900-2017



Source: AQR. Based on quarterly overlapping 10-year periods. "Error" is realized return minus forecast return. The black diamond indicates the mean error—if it lies on the x-axis at zero, the predictor has been unbiased on average. The shaded box shows the interquartile range of errors (containing half the observations), and the whiskers indicate the largest upside (top) and downside (bottom) errors. See Appendix for construction of each predictor. For illustrative purposes only. Hypothetical data has inherent limitations, some of which are disclosed herein.

2 For a discussion of expected arithmetic (or simple) vs. geometric (or logarithmic, or compound) rates of return, see the 2018 edition.

Equity Markets

For equities our starting point is the classic dividend discount model (DDM), under which expected real return is approximately the sum of dividend yield (DY), expected trend growth (g) in real dividends or earnings per share (EPS), and expected change in valuation (Δv), that is: $E(r) \approx DY+g+\Delta v$. We take the average of two approaches,[3] described below. We assume no change in valuations, i.e., no mean reversion from today's (mostly high) valuations toward historical averages.[4]

1. **Earnings-based:** We start from the inverse of the CAPE ratio (cyclically adjusted P/E), which is the 10-year average of earnings, inflation-adjusted to today's price levels, divided by today's price. We multiply by 0.5 (roughly the US long-run dividend payout ratio) and add a real earnings growth rate of 1.5% (roughly the U.S. long-run geometric average). Our earnings-based expected return[5] is therefore: $E(r) \approx 0.5^{*}\ \textit{Adjusted Shiller}\ E/P + g_{EPS}$

2. **Payout-based:** Our estimate of net total payout yield (NTY) is the sum of current dividend yield and smoothed net buyback yield for each country. To this we add an estimate of long-term real growth of aggregate payouts that includes net issuance. This country-specific growth estimate, g_{TPagg}, is an average of smoothed historical geometric aggregate earnings growth and forecast GDP growth. So our payout-based expected return is: $E(r) \approx NTY + g_{TPagg}$, where $NTY = DY + \textit{net buyback yield}\ (NBY)$.

All estimates are higher than last year, due to cheapening from falling equity prices in 2018 (see **Exhibit 3**). In a reverse of last year's changes, lower valuations are partly offset by slightly lower growth estimates. Estimates remain low by historical standards.

3 See *Alternative Thinking Q1 2017* and its online appendix for details and discussion of the methodology.
4 See *Alternative Thinking Q1 2015* for a discussion of mean reversion in stock and bond valuations and our decision to exclude it.
5 For our earnings-based estimate, we apply a 50% payout ratio to all countries, and use g = 1.5% for all countries except for emerging markets, where we use a higher growth rate of 2%. *Adjusted Shiller* EP is Shiller EP * 1.075 where the scalar accounts for average earnings growth during the 10-year earnings window of the Shiller EP.

Exhibit 3
Expected Local Real Returns for Equities, January 2019

	1. Earnings-Based			2. Payout-Based				Combined	
	Adjusted ShillerEP	g_{EPS}	0.5 * EP + g_{EPS}	Dividend Yield	NBY	g_{TPagg}	DY+NBY + g_{TPagg}	2019 Est.	*1yr Change*
U.S.	4.2%	1.5%	**3.6%**	2.2%	0.2%	2.6%	**5.0%**	**4.3%**	*(+0.3%)*
Euro-5	6.0%	1.5%	**4.5%**	3.7%	-0.5%	2.4%	**5.7%**	**5.1%**	*(+0.5%)*
Japan	4.8%	1.5%	**3.9%**	2.6%	0.1%	2.1%	**4.8%**	**4.3%**	*(+0.6%)*
U.K.	6.3%	1.5%	**4.6%**	5.0%	-0.3%	2.4%	**7.1%**	**5.9%**	*(+0.7%)*
Australia	5.6%	1.5%	**4.3%**	4.9%	-0.9%	2.7%	**6.7%**	**5.5%**	*(+0.3%)*
Canada	5.5%	1.5%	**4.2%**	3.5%	-1.4%	2.6%	**4.7%**	**4.5%**	*(+0.5%)*
Global Developed	4.7%	1.5%	**3.8%**	2.7%	0.0%	2.5%	**5.2%**	**4.5%**	*(+0.3%)*
Global Dev. ex US	5.6%	1.5%	**4.3%**	3.7%	-0.3%	2.4%	**5.9%**	**5.1%**	*(+0.6%)*
Emerging Markets	7.9%	2.0%	**5.9%**	*2.9%*	--	--	**4.9%**	**5.4%**	*(+0.6%)*

Source:AQR, Consensus Economics and Bloomberg. Return assumptions and methodology subject to change and based on data as of December 31, 2018. See main text for methodology. For earnings yield, US is based on the S&P 500; UK on the FTSE 100 Index; "Euro-5" is a cap-weighted average of large-cap indices in Germany, France, Italy, Netherlands and Spain; Japan on the Topix Index; and Emerging Markets on the MSCI Emerging Markets Index. The period for net buyback yield (NBY) is 1988 to 2018. For payout-based estimates, all countries are based on corresponding MSCI indices. "Global Developed" is a cap-weighted average. For emerging markets, the payout-based estimate is dividend yield + forecast GDP per capita growth. Hypothetical performance results have certain inherent limitations, some of which are disclosed in the back. Estimates are for illustrative purposes only, are not a guarantee of performance and are subject to change. Not representative of any portfolio that AQR currently manages.

Government Bonds

Government bonds' prospective medium-term nominal total returns are strongly anchored by their yields. For bond portfolios with stable duration, so-called rolling yield is a better measure (assuming an unchanged yield curve).[6] For example, a strategy of holding constant-maturity 10-year Treasuries has an expected annual (nominal) return of 2.9%, given the starting yield of 2.7% and expected capital gains of 0.2% from rolldown as the bonds age. **Exhibit 4** shows current local rolling yields for six countries, converted to local real return estimates by subtracting a survey-based forecast of long-term inflation.

Since last year, our estimate for U.S. Treasuries has increased due to higher yields, whereas German Bunds see a decrease due to lower yields and a flatter curve. The estimate for Japan remains negative. Low bond yields should be considered in the context of exceptionally low cash rates. Any

6 If we assumed a more realistic random-walk (rather than unchanged) yield curve, our estimate would theoretically need to include convexity and variance drag components. However, since these terms are small and mostly offsetting for single bonds, we ignore them here.

adjustment to these expected returns boils down to expected future changes in the yield curve level or shape. Capital gains/losses due to falling/rising yields dominate returns over short horizons but are highly uncertain and matter less over longer horizons.

Exhibit 4

Expected Local Real Returns for Government Bonds, January 2019

	Y	RR	I	Y + RR - I	
	10-Year Nominal Bond Yield	Rolldown Return	10-Year Forecast Inflation	Expected Real Return	*1yr Change*
U.S.	2.7%	0.2%	2.2%	**0.8%**	*(+0.4%)*
Japan	0.0%	0.6%	1.2%	**-0.6%**	*(+0.1%)*
Germany	0.2%	1.1%	1.8%	**-0.5%**	*(-0.5%)*
U.K.	1.3%	0.8%	2.1%	**-0.1%**	*(+0.2%)*
Australia	2.3%	0.2%	2.4%	**0.1%**	*(-0.4%)*
Canada	2.0%	0.3%	2.0%	**0.3%**	*(-0.1%)*
Global Developed	1.9%	0.4%	2.0%	**0.3%**	*(+0.2%)*
Global Developed ex US	0.7%	0.7%	1.7%	**-0.3%**	*(-0.1%)*

Source: Bloomberg, Consensus Economics and AQR. Estimates as of December 31, 2018. “Global Developed” and “Global Developed ex US” are GDP-weighted averages of the country estimates. Rolldown return is estimated from fitted yield curves and based on annual rebalance. Estimates are for illustrative purposes only, are not a guarantee of performance, and are subject to change. Not representative of any portfolio that AQR currently manages.

Inflation, Currency and Cash Considerations in the Current Environment

The local real returns that we report don’t tell the whole story. To convert local real to nominal total returns, we must add expected inflation. To convert local real to excess-of-cash returns, we must subtract an estimate of expected real cash return. To convert local returns to those seen by a foreign investor, we must correct for the expected risk-free rate differential plus possible cross-currency basis (if hedged) or the expected exchange rate return from spot rate changes (if unhedged).

The significance of some of these conversions has increased in recent years. We therefore include in the Appendix our estimates of hedged excess-of-cash returns for equities and government bonds.

For European investors, the widening differential between U.S. dollar and euro short rates makes hedging appear increasingly expensive, although this differential is not exactly a cost. Rather, it ensures you can only earn your own risk-free rate unless you accept currency risk (and hedged investors will only “pay” the differential, compared to unhedged investors, if the exchange rate remains constant—a big “if”). Expected inflation differentials are one possible basis for medium-term expected exchange rate return estimates, and after adjusting for higher expected inflation in the U.S., the dollar versus euro differential is somewhat narrower.

Credit Indices

To estimate expected real returns for credit indices, we first apply a haircut of 50% to both IG and HY spreads to represent the combined effects of expected default losses, downgrading bias and bad selling practices.[7] We assume no change in the spread curve, say, through mean-reversion. We add the expected real yield of a duration-matched Treasury. Finally, we add rolldown return — both Treasury rolldown and the additional spread curve rolldown as bonds age and roll down the OAS curve. **Exhibit 5** shows our updated estimates for US credit indices,[8] as well as hard-currency emerging market sovereign debt, which we include for the first time. Over the past year, return estimates have risen due to both wider credit spreads and higher Treasury yields.

Exhibit 5

Expected Real Returns for US Credit Indices, January 2019

	A. Spread Return		B. Treasury Real Yield			C. Rolldown Return				
	S	S * 0.5	Y	I	Y - I	R_T	R_C	R_T+R_C	A + B + C	
	Option-Adj. Spread	Exptd Excess Return	Dur-M'tched Tsy Yld	Forecast Inflation	Dur-M'd Real Tsy Yld	Tsy Rolldown	OAS Rolldown	Total Rolldown	Expected Real Return	*1yr Change*
US IG	1.5%	**0.8%**	2.6%	2.2%	**0.5%**	0.2%	0.3%	**0.5%**	**1.6%**	*(+0.5%)*
US HY	5.3%	**2.6%**	2.6%	2.2%	**0.4%**	0.1%	0.0%	**0.1%**	**3.1%**	*(+1.0%)*
EM Debt	3.9%	**1.9%**	2.7%	2.2%	**0.5%**	0.1%	--	**0.1%**	**2.6%**	*(+1.0%)*

Source: Barclays, Bloomberg, AQR. Estimates as of December 31, 2018. OAS and duration data is for Barclays US. Corporate Investment Grade (IG) Index, Barclays US Corporate High Yield (HY) Index and Barclays Emerging USD Sovereign (EM Debt) Index. Index durations are 7.1 years, 4.0 years and 7.0 years respectively. Estimates are for illustrative purposes only, are not a guarantee of performance and are subject to change. Not representative of any portfolio that AQR currently manages.

7 Consistent with Giesecke et al. (2011), who find that over the long term, the average credit risk premium is roughly half the average spread. "Bad selling" refers to the practice of selling bonds that no longer meet the rating or maturity criteria of the index.

8 Exhibit 5 shows spreads for cash bonds in the popular Barclays indices. Actively traded synthetic indices (Markit North America CDX) have tended to have slightly tighter spreads. The difference was small for most of 2017 and 2018 but increased in Q4 2018. For EM debt we have insufficient data to calculate an OAS rolldown term. This year for US corporate indices, our final estimates include corrections for Treasury convexity and variance drag — these terms are small and partly offsetting but not as closely offsetting for indices as they are for single bonds.

Commodities

Commodities do not have obvious yield measures, and we find no statistically significant predictability in medium-term returns (*Alternative Thinking Q1 2016*). Our estimate of 5- to 10-year expected return is therefore simply the long-run average return. **Exhibit 6** shows the performance of an equal-dollar-weighted portfolio of commodity futures, in early decades holding only five or six assets but the universe growing to 13 by 1970 and 22 by 1990. This portfolio has earned about 3% geometric average excess return over cash. To this we add a small U.S. real cash return to give our expected real return of 3.4%.

Exhibit 6

Historical Performance of Equal-Dollar-Weighted Portfolio of Commodity Futures

	1877-2018	1951-2018
Excess-of-Cash Return (AM)	4.5%	4.0%
Excess-of-Cash Return (GM)	3.0%	3.1%
Annualized Volatility	17.6%	13.4%
Sharpe Ratio (AM)	0.26	0.30

Source: AQR, Bloomberg, Chicago Board of Trade, Commodity Systems Inc. Portfolio consists of 5 to 25 of the most actively traded commodity futures, weighted equally and rebalanced monthly, with the universe generally increasing over time as new data becomes available. AM = arithmetic mean. GM = geometric mean. Risk-free rate used to calculate Sharpe ratio is 3M T-bill. Hypothetical data has inherent limitations, some of which are disclosed herein. Data presented are based on hypothetical portfolios and are not representative of any AQR product or investment.

Alternative Risk Premia

Style-Tilted Long-Only Portfolios

We believe a hypothetical value-tilted, diversified long-only equity portfolio that is carefully implemented and reasonably priced may be assumed to have an expected real return 0.5% higher than the cap-weighted index, after fees. A multi-style strategy — which we assume to include balanced allocations to three highly complementary, "tried and true" strategy styles, notably value, momentum and defensive — may achieve a higher expected net active return of around 1.0% at a similar tracking error. Finally, we think a defensive or low-risk equity portfolio may be assumed to have an expected return similar to that of the relevant cap-weighted index but may achieve this with lower volatility.[9]

Long/Short Style Premia

Alternative risk premia strategies apply similar tilts as long-only smart beta strategies, but in

9 Style-tilted strategies exhibit many design variations. Our estimates are purely illustrative and do not represent any AQR product or strategy.

a market-neutral fashion and often in multiple asset classes. Because long/short strategies can be invested at any volatility level, it makes sense to focus on expected Sharpe ratios. The degree of diversification is essential. A single long/short style applied in a single asset class might have an expected Sharpe ratio of only 0.2 to 0.3. For a diversified composite, we believe an expected Sharpe ratio of 0.7 to 0.8, net of trading costs and fees, can be feasible when multiple styles are applied in multiple asset classes. At a target volatility of 10%, such a hypothetical portfolio would have an expected return of 7 to 8% over cash.[10] We stress that this requires careful craftsmanship in portfolio construction as well as great efficiency in controlling trading, financing and shorting costs.[11] Strategies that are less well-designed or poorly implemented may have much lower expected returns.

What about current style valuations? Aggregate valuations across multiple styles remain somewhat higher than long-term averages. Some styles are rich (notably, the defensive style in equities) but not off-the-chart. Others are on the cheap side — equity value, for example, suffered losses in 2018 and is cheap by some measures. Our research suggests there is only a weak link between the value spreads of style factors and their future returns, making it difficult to use tactical timing based on valuations to outperform a strategic multi-style portfolio.[12]

Cash

The prospects for nominal cash returns depend on the expected path of inflation and of real cash rates. Long-term U.S. inflation expectations have remained well-anchored just above 2%. The Federal Reserve remains in policy-tightening mode, and the U.S. real cash rate is now in positive territory. The European Central Bank has finally ended QE, and the Bank of Japan may soon follow suit, but with low inflation expected to continue, their real policy rates may remain negative or near zero over our forecast horizon. Some tentative estimates for expected real cash returns are shown in the Appendix, Exhibit A1.

10 Consistent with historical data, we assume low correlations between the styles to produce our Sharpe ratio range for a diversified composite of long/short styles. As transaction costs depend on implementation and both transaction costs and fees vary with target volatility, our estimates are based on a transaction-cost-optimized strategy targeting 10% volatility with fees of 1 to 1.5%. Refer to *Alternative Thinking Q1 2015* for details of our style premia assumptions, which we believe are plausible and conservative. All assumptions are purely illustrative and do not represent any AQR product or strategy.
11 See Israel, Jiang and Ross (2017), "Craftsmanship Alpha: An Application to Style Investing."
12 See Asness, Chandra, Ilmanen and Israel (2017), "Contrarian Factor Timing Is Deceptively Difficult."

Extending Our Framework to Include Illiquids

Investors allocating to illiquid private asset classes alongside public markets may find themselves asking whether the former's substantially higher fees are justified by higher expected returns. This comparison of public and private assets is not straightforward. Illiquid assets are inherently harder to model, and this is exacerbated by a lack of good quality and transparent data. Nevertheless, here we extend our discounted-cashflow-based approach for equity and fixed income to the realms of private equity and private real estate. A common framework helps highlight how the expected returns (ER) of private assets have similar drivers — say, yield and growth — as public assets.

Private Equity

Our estimate is for U.S. buyout funds. We present net-of-fee expected returns, as fees are a substantial component of returns for illiquid assets. Admittedly, each of our inputs is debatable as PE data limitations necessitate many simplifying assumptions. Still, the broad framework explains the mechanism of how PE firms have the potential to generate higher returns than public equity. PE firms can employ multiple levers to boost returns: namely, higher starting yields through deal selection; higher earnings growth rates through operational improvements; multiple expansion through opportunistic timing of entries/exits; and financial leverage. However, we should expect yields and growth rates for PE to be at least loosely anchored to those for public equities.

Exhibit 7 illustrates our framework.[13] First, we estimate unlevered ER using the DDM: $E(r) \approx y_U + g_U$, where y_U = unlevered payout yield and g_U = real earnings-per-share growth rate. Then we estimate the levered return to equity by applying leverage and the cost of debt, and finally we add expected multiple expansion and subtract fees to arrive at a net ER. The building blocks are as follows:

- **Yield**: We proxy PE's *unlevered* payout yield by a quarter of its EBITDA/EV at deal inception.
- **Growth rate**: We assume an unlevered real growth rate of 3%.
- **Leverage**: We use estimates of debt-to-equity at deal inception.
- **Cost of debt**: We estimate PE's cost of debt as real cash rate plus a third of the HY index OAS.
- **Multiple expansion**: We assume partial richening of PE multiple toward public market multiple.

13 See Ilmanen, Chandra and McQuinn (2019a) for a detailed discussion of this framework, our input choices, and the sources. Strictly speaking, the framework applies to the current vintage rather than the entire PE market. This paper also discusses the theoretical rationales and historical average returns to assess expected PE returns.

- **Fees**: We assume all-in PE fees of 5.7%, as per average experience of large institutions.[14]

Putting it all together, our yield-based estimate is about 4% net-of-fee real return, half the long-run average. This compares to 3.5% for our earnings-based estimate for U.S. public equity, net of a 0.1% fee for passive investing. We thus find PE to have a roughly 0.5% higher net-of-fee ER. We interpret this expected outperformance as a warranted risk premium given PE's higher equity risk, assuming that any warranted illiquidity premium is offset by investors paying for the smoothness in private asset returns.

Our current estimate of PE expected return and expected outperformance over public equity are clearly low compared to historical averages. A downtrend in expected returns from the 1990s to the 2010s was driven by richening PE multiples (resulting in both lower yields and lower multiple expansion) and a gradual decline in PE leverage.

On the next page we outline an alternative approach for generating an expected return for PE, which gives a higher estimate of 5.6%. Taking a simple average of the two approaches gives a **final estimate of 4.7%**, compared to our combined U.S. large cap equity estimate of 4.3%.

Exhibit 7
Building Blocks for U.S. Private Equity Expected Real Returns

	Unlevered					Financial Leverage		Levered								
	y_u		g_u		$r_u = y_u + g_u$	D/E	k_d	$r_l = r_u + (D/E) * (r_u - k_d)$		m		$r_g = r_l + m$				
	Earnings Yield		Real Growth Rate		Real Return	Debt to Equity	Real Cost of Debt	Real Return		Multiple Expansion (Ann.)		Gross Real ER		Fees		Net Exp. Real Return
Current	2.1%	+	3.0%	=	5.1%	109%	1.2%	9.3%	+	0.3%	=	9.6%	-	5.7%	=	3.9%
Historical Average (1993-2018)	3.1%	+	3.0%	=	6.1%	181%	2.3%	12.9%	+	1.0%	=	13.8%	-	5.7%	=	8.1%

Source: AQR, Pitchbook, Bain & Company, Bloomberg, CEM Benchmarking, Consensus Economics. Current estimate as of September 30, 2018, and subject to change. Historical averages cover period January 1, 1993 to September 30, 2018. Strictly speaking, our inputs are log returns and should be converted to simple returns before leverage is applied, then converted back to log returns. This "round-trip" has only a small impact, so we omit it here. Please see the Appendix for further detail. For illustrative purposes only and not representative of any portfolio or strategy that AQR currently manages. There is no guarantee, express or implied, that long-term return targets will be achieved. Realized returns may come in higher or lower than expected.

14 Assumptions as of September 30, 2018, and subject to change. EBITDA/EV (earnings before interest, tax, depreciation and amortization/enterprise value) data from Pitchbook. Our yield proxy reflects limited available PE data and historical experience for public equities, where dividend payout has averaged roughly half of earnings, and unlevered earnings (EBIT) has averaged roughly half of EBITDA. The 3% growth rate is more than double what we assume for public equities (due to potential operational improvements and sector composition), and it is further amplified through financial leverage. Leverage estimates are from Pitchbook. The cost of debt includes a large haircut to the HY spread, as PE debt is mainly secured bank loans financed at a lower cost of debt, and further, the entire credit spread may overstate the cost of debt actually borne by firms on average. The fee estimate is from a CEM Benchmarking analysis quoted in Doskeland-Stromberg (2018) and McKinsey (2017) and includes 167 funds. For more details on assumptions, see Ilmanen, Chandra and McQuinn (2019a). All assumptions are purely illustrative and do not represent any AQR product or strategy.

A Simpler Approach: Start from a Public Equity Estimate and Adjust for Size and Leverage

Rather than separately modeling all the different components listed above, we could simply assert that on average, at the industry level, any PE alpha is retained by managers in the form of fees. Under this assumption, PE end-investors receive, on average, levered small-cap exposure with some useful return-smoothing but zero net alpha (i.e., the same net Sharpe ratio as public equity). Here is an example of how this method could be employed (see Appendix for details):[15]

Step 1:

Start from expected real return of large cap public equity; subtract real cash return and add variance drag to give excess-of-cash return; use volatility estimate from historical data to calculate expected Sharpe ratio:

	Expected Real Return (GM)	→	Excess-of-Cash Exp. Return (AM)	Expected Volatility	→	Expected Sharpe Ratio
U.S. LC Public Equity	4.3%		5.0%	14.6%		0.34

Step 2:

Assume same Sharpe ratio for small caps; estimate small cap return based on higher volatility:

	Expected Sharpe Ratio	→	Expected Volatility	→	Excess-of-Cash Exp. Return (AM)
U.S. SC Public Equity	0.34		19.2%		6.5%

Step 3:

Estimate private equity expected net-of-fee excess-of-cash return by applying a leverage adjustment, then add real cash return and subtract variance drag to get estimated PE real return:

	SC Public Equity	Leverage	Private Equity	→	PE Expected Real Return (GM)	Premium Over LC Public Equity
Excess-of-Cash Return	6.5%	x 1.2 =	7.8%		5.6%	1.3%
Volatility	19.2%	x 1.2 =	23.0%			
Sharpe Ratio	0.34		0.34			

The **advantages** of this top-down public proxy approach are its simplicity (fewer design choices to get right but still economically intuitive and consistent with the empirical evidence) and higher quality input data.

The **disadvantages** are that it may be *too* simple: it tells us nothing about any time-varying premium of private over public equities, for example, due to changing relative valuations, and it gives fewer insights into the fundamental drivers of PE's expected return.

15 Source: AQR, Bloomberg. Assumptions of December 31, 2018, and subject to change. Hypothetical data has inherent limitations, some of which are disclosed herein. For illustrative purposes only and not representative of any AQR product or strategy. Please see Appendix for further detail on proxies and methodology.

Private Real Estate

We estimate expected returns for unlevered U.S. direct real estate (RE) as represented by the NCREIF indices. We caveat that returns for individual RE funds can vary vastly from the industry average, due to a wide dispersion of returns by geographic region, sector, and manager (this is also true of PE).

Real estate returns can be characterized as the sum of a relatively steady income component and more volatile price appreciation. Our yield-based approach for RE is similar to our DDM-based approach for equities, where we sum payout yield and expected long-term growth rates.[16] Our assumptions for RE's building blocks are as follows: [17]

- **Yield**: We follow Pagliari (2017) in approximating RE cashflow yield by two-thirds of net operating income yield (NOI/market cap), since one-third tends to be offset by capital expenditure. As of Q3 2018, the NCREIF NOI yield was roughly 4.4%, leading to an estimated cashflow yield of 2.9%.
- **Growth rate**: We expect that on average, the long-term growth rate in real estate cashflows should equal inflation, i.e., the real growth rate in earnings is zero.
- **Multiple expansion**: As with public equities and bonds, we assume no change in multiples.

Putting this together in **Exhibit 8** gives us a gross expected real return of roughly 3% for unlevered RE (to make it comparable to the unlevered returns reported by NCREIF). This is similar to our real return estimate of 2.9% for a 60/40 portfolio.

Exhibit 8

Real Expected Returns for Private Real Estate

	NOI	C ≈ NOI / 3	CF ≈ NOI - C	g	ER = CF + g
	NOI Yield	Capital Expenditure	Cashflow Yield	Real Growth	Unlevered Real Return
U.S. Real Estate	4.4%	1.5%	2.9%	0.0%	**2.9%**

Source: AQR, NCREIF Webinar Q3 2018. Estimates as of September 30, 2018, and subject to change. Hypothetical data has inherent limitations, some of which are disclosed herein. For illustrative purposes only and not representative of any AQR product or strategy.

16 As with private equity, an alternative approach would be to use a public proxy (i.e., REITs) and adjust for leverage as required. We omit the details here for the sake of brevity.

17 See Ilmanen, Chandra and McQuinn (2019b) and Pagliari (2017) for details. Our growth assumption is a compromise given mixed evidence of mildly positive or mildly negative long-run real growth.

Concluding Thoughts

Yield-based expected returns for equities and bonds may be our best estimates of medium-term prospects for these asset classes. As of January 2019, these estimates are mostly higher than they were a year ago, but compared to historical norms, they remain soberingly low. They continue to suggest that over the next decade, many investors may struggle to meet return objectives anchored to a rosier past.

Growing investor interest in illiquid assets encouraged us to add them to our report this year. We believe some investors may have inflated return expectations for such assets. This may be due to inherent modeling difficulties, as well as lack of transparency on fees and performance. While some of our assumptions are debatable, we hope our framework helps to illustrate the “moving parts” underlying expected returns for private equity and real estate. This framework is a work in progress, but we believe it is a step toward a more intuitive and transparent comparison between public and private assets.

We again emphasize that our return estimates for all asset classes are highly uncertain. The estimates in this report do not in themselves warrant aggressive tactical allocation responses — but they may warrant other kinds of responses. For example, investment objectives may still need to be reassessed, even if this necessitates higher contribution rates and lower expected payouts. And the case for diversifying away from traditional equity and term premia remains strong despite recent modest rises in expected returns.

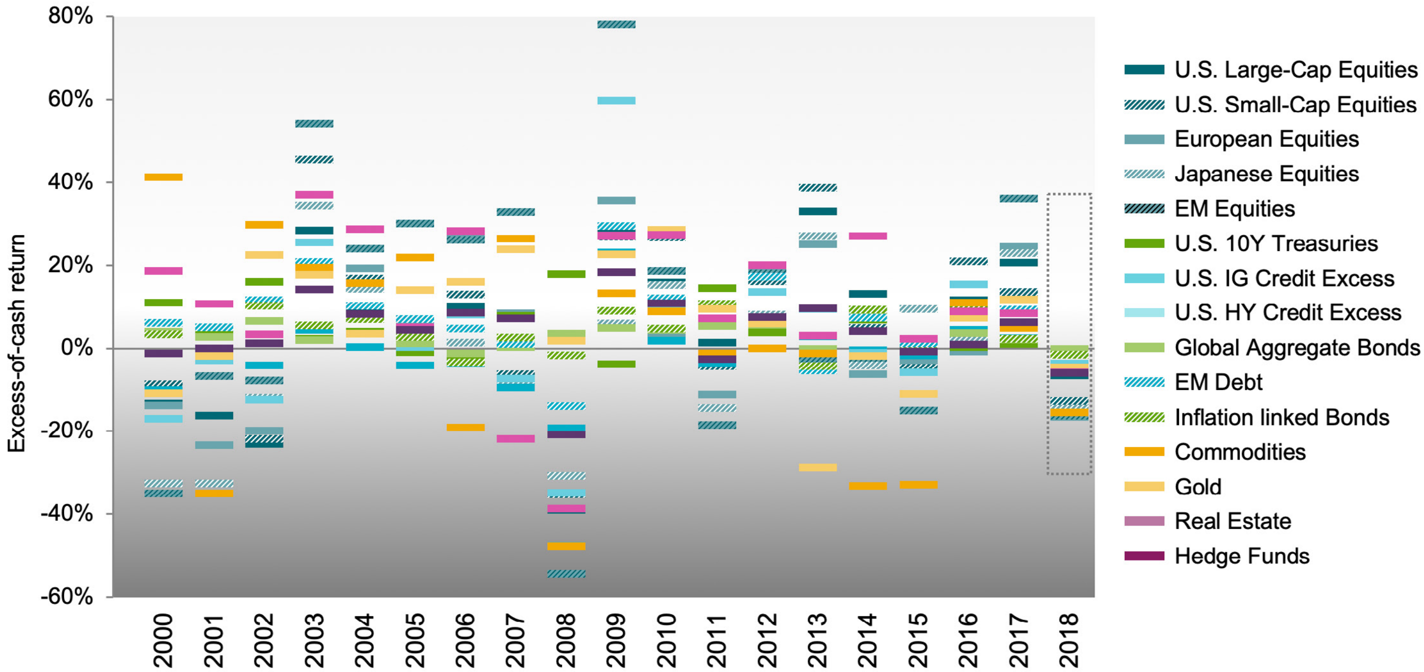
And Finally... Historical Context for 2018, the Year with Nowhere to Hide

The year 2018 was exceptional not in the *depth* of market losses, which were nothing like the losses of a decade earlier, but in the *breadth* of pain for investors. We illustrate this in **Exhibit 9** below, which shows the annual performance of 15 major investments compared to cash. Not since 1981 (not shown), when cash rates were in the double digits, have we seen 2018’s breadth of underperformance. Equity losses were much worse in 2008, but that year at least Treasuries were up (though this was a double-whammy for pension funds with unhedged liabilities). The year 2018 also stands out because of what preceded it—in 2017 all 15 investments outperformed cash, and in 2016 it was all but one.

One simple take-way from this observation: investors whose portfolios suffered broad pain in the past year—and who may be questioning their strategic asset allocation—should not overreact. Any one-year period can exhibit extreme outcomes, and 2018, the year when diversification failed for almost everyone, was a prime example of this.

Exhibit 9

Annual Performance of Selected Investments 2000-2018



Source: AQR, Bloomberg. See Appendix for proxies. Past performance is not a guarantee of future performance. Please read important disclosures in the Appendix.

References

Asness, C., S. Chandra, A. Ilmanen and R. Israel, 2017, "Contrarian Factor Timing Is Deceptively Difficult," *Journal of Portfolio Management Special Issue.*

Døskeland, T. M. and Strömberg, P., 2018, "Evaluating Investments in Unlisted Equity for the Norwegian Government Pension Fund Global," Norwegian Ministry of Finance report.

Giesecke, K., F. Longstaff, S. Schaefer and I. Strebulaev, 2011, "Corporate Bond Default Risk: A 150-Year Perspective," *Journal of Financial Economics*, 102, 233-250.

Ilmanen, A., S. Chandra and N. McQuinn, 2019a, "Demystifying Illiquid Assets: Expected Returns for Private Equity," AQR white paper.

Ilmanen, A., S. Chandra and N. McQuinn, 2019b, "Demystifying Illiquid Assets: Expected Returns for Real Estate," AQR white paper.

Israel, R., S. Jiang and A. Ross, 2017, "Craftsmanship Alpha: An Application to Style Investing," *Journal of Portfolio Management Multi-Asset Strategies Special Issue.*

McKinsey, 2017, "Equity investments in unlisted companies," Norwegian Ministry of Finance report.

Pagliari, J. L., 2017, "Some Thoughts on Real Estate Pricing," *Journal of Portfolio Management* 34 (6), 44-61.

Appendix

Translating Local Real Returns to Hedged Excess-of Cash Returns

In Exhibit A1 we translate our local real return estimates to nominal excess-of-cash returns by subtracting intermediate-horizon estimates of real cash return for each market. These tentative real cash return estimates are a weighted combination of current nominal cash rates and 10-year bond yields, minus expected inflation.

These excess-of-cash returns are the expected excess returns accessed by hedged investors irrespective of their base currency. While real returns are often relevant for assessing expectations versus investment objectives, excess-of-cash returns are the appropriate unit for making international allocation decisions. When viewed in excess of local cash, non-U.S. assets look relatively more attractive, and U.S. assets relatively less attractive.

Exhibit A1

Translating Local Real Returns to Hedged Excess-of Cash Returns

Equities	Local Real Return	Local Real Cash Return	Hedged Excess-of-Cash Return
U.S.	**4.3%**	0.4%	**3.9%**
Euro-5	**5.1%**	-1.5%	**6.6%**
Japan	**4.3%**	-1.2%	**5.6%**
U.K.	**5.9%**	-1.0%	**6.9%**
Australia	**5.5%**	-0.2%	**5.7%**
Canada	**4.5%**	-0.1%	**4.5%**
Global Developed	**4.5%**	-0.2%	**4.7%**
Developed ex US	**5.1%**	-1.1%	**6.2%**
Emerging Mkts	**5.4%**	1.4%	**4.0%**

10-Year Government Bonds	Local Real Return	Local Real Cash Return	Hedged Excess-of-Cash Return
U.S.	**0.8%**	0.4%	**0.4%**
Japan	**-0.6%**	-1.2%	**0.6%**
Germany	**-0.5%**	-1.5%	**1.0%**
U.K.	**-0.1%**	-1.0%	**0.9%**
Australia	**0.1%**	-0.2%	**0.4%**
Canada	**0.3%**	-0.1%	**0.4%**
Global Developed	**0.3%**	-0.2%	**0.5%**
Developed ex US	**-0.3%**	-1.0%	**0.7%**

Source: AQR, Consensus Economics and Bloomberg. Return assumptions and methodology subject to change and based on data as of December 31, 2018. See main text and Exhibits 3 and 4 for methodology. Global Developed and Developed ex US are cap-weighted for equities but GDP-weighted for bonds. Hypothetical performance results have certain inherent limitations, some of which are disclosed in the back. Estimates are for illustrative purposes only, are not a guarantee of performance and are subject to change. Not representative of any portfolio that AQR currently manages.

Sources for Long-Term Historical Expected Returns

Sources for historical equity and bond expected returns are AQR, Robert Shiller's data library, Kozicki-Tinsley (2006), Federal Reserve Bank of Philadelphia, Blue Chip Economic Indicators, Consensus Economics and Morningstar. Prior to 1926, stocks are represented by a reconstruction of the S&P 500 available on Robert Shiller's website, which uses dividends and earnings data from Cowles and associates, interpolated from annual data. After that, stocks are the S&P 500. Bonds are represented by long-dated Treasuries. The equity yield is a 50/50 mix of two measures: 50% Shiller E/P * 1.075 and 50% Dividend/Price + 1.5%. Scalars are used to account for long-term real Earnings Per Share (EPS) Growth. Bond yield is 10-year real Treasury yield minus 10-year inflation forecast as in Expected Returns (Ilmanen, 2011), with no rolldown added.

Methodology for Forecast Error Analysis (Exhibit 2)

We first produce a long historical time series for our yield-based estimate for U.S. equities (the analysis starts in 1900, but we use data from the 1870s onward). We then calculate two intuitive non-yield-based candidates: one is simply the historical average real return up to the date of the forecast while the other assumes a constant Sharpe ratio of 0.2 and converts this into a real return estimate using historical volatility and real cash return. These candidates are described below. We test their predictive power using quarterly overlapping 10-year periods since 1900. See *Alternative Thinking Q1 2018* for more details.

Candidate	Construction	Hindsighted?
Equity Real Yield (out-of-sample)	Avg(adj. Shiller EP * o-o-s payout, DP) + o-o-s G	Only in use of DDM model (~1956) & CAPE (1988)
Historical Real Return (1881-)	Annualized geom. real return (1881 - forecast date)	No
Constant SR=0.2, Historical Vol	(0.2 * annualized vol) + real cash ret. (1881 - forecast date)	Yes: SR = 0.2

Source: AQR, Shiller data library, Blue Chip Economic Indicators, Consensus Economics and the Federal Reserve Bank of Philadelphia. All inputs based on historical data use expanding windows starting in 1871. Out of sample ("o-o-s") estimates are calculated from available data, using an expanding window. EP and DP are earnings-to-price and dividend-to-price ratios respectively. SR is Sharpe ratio. For illustrative purposes only.

Assumptions for Simple Proxy-Based PE Estimate

We start from our 4.3% expected real return for US large-cap public equity as stated in Exhibit 3. We add 1.1% variance drag, then subtract 0.4% real cash return (see Exhibit A1) to give an arithmetic excess-of-cash return of 5.0%. Our volatility estimate of 14.6% is based on the S&P 500 since 1990 (monthly data), and implies an expected Sharpe ratio of 0.34. Our small-cap volatility estimate of 19.2% is based on the Russell 2000 since 1990; with the same Sharpe ratio, this implies an excess return of 6.5%. We multiply this by 1.2 to account for PE's higher leverage, then add the real cash return and subtract variance drain of 2.7%, based on estimated volatility of 23% (small-cap volatility x 1.2). This gives our final proxy-based PE estimate of 5.6% real return, as of December 31, 2018.

Proxy Indices for Annual Returns Chart (Exhibit 9)

Asset Class	Proxy Index
U.S. Large-Cap Equities	Russell 1000
U.S. Small-Cap Equities	Russell 2000
European Equities	MSCI Europe USD Unhedged
Japanese Equities	MSCI Japan USD Unhedged
Emerging Markets Equities	MSCI Emerging Markets USD Unhedged
U.S. 10Y Treasuries	U.S. 10-Year Treasuries
U.S. IG Credit Excess	Barclays U.S. Corporate IG (excess of Treasuries)
U.S. HY Credit Excess	Barclays U.S. HY (excess of Treasuries)
Global Aggregate Bonds	Barclays Global Aggregate USD Hedged
EM Debt	JP Morgan EMBI
Inflation-linked Bonds	Barclays Global Inflation-Linked USD Hedged
Commodities	S&P GSCI
Gold	S&P GSCI Gold Index
Real Estate	FTSE NAREIT All REITs
Hedge Funds	Credit Suisse Hedge Fund Index

Source: AQR, Bloomberg.

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