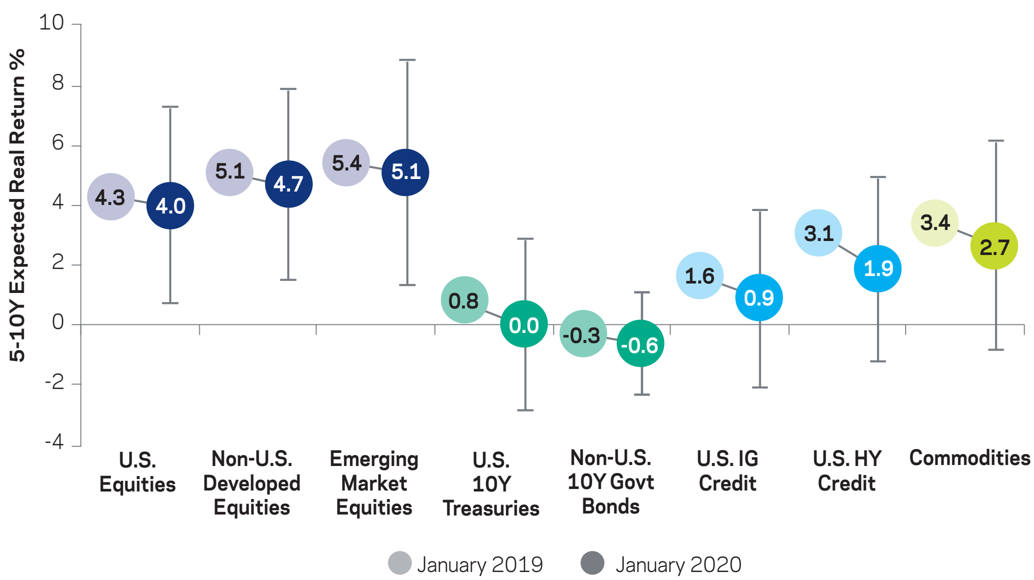
Capital Market Assumptions for Major Asset Classes

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 cash. Selected estimates are summarized in **Exhibit 1**. The year 2019 saw a reverse of 2018's cheapening, with expected returns falling for both equities and (especially) bonds. The expected real return of the traditional U.S. 60/40 portfolio is just 2.4%, around half its long-term average of nearly 5% (since 1900[1]).

Exhibit 1

Medium-Term Expected Real Returns for Liquid Asset Classes



Source: AQR; see Exhibits 3-5 for details. Estimates as of December 31, 2019. "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. Error bars cover 50% confidence range, based on analysis from *Alternative Thinking Q1 2018* and adjusted for current expected volatilities. These are intended to emphasize the uncertainty around any point estimates. Not only are the return forecasts uncertain, but also any measures of forecast uncertainty are debatable. Forecasting requires humility at many levels. 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.

PSG
Portfolio Solutions Group

1 Based on historical real yields for U.S. large-cap equities and 10-year Treasuries, using a simplified methodology that allows long-term historical comparisons; methodology and sources described in Appendix.

Contents

About the Portfolio Solutions Group

PSG provides thought leadership to the broader investment community and custom analyses to help AQR clients achieve better portfolio outcomes.

Introduction and Framework

For the past six 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, 2018 and 2019). 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 a simple yield-based framework for estimating returns for cash.

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.

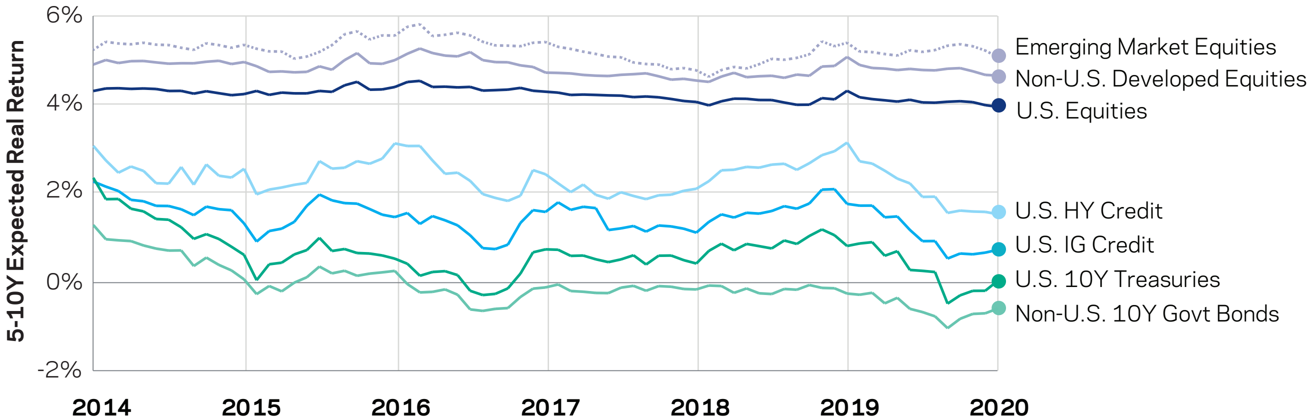
Our estimates are intended to assist investors with their strategic allocation and planning decisions, and, in particular, with setting appropriate medium-term expectations. They are highly uncertain, and not intended for market timing. The frameworks for making such estimates may be more useful and informative than the numbers themselves. As one cautionary example, the error ranges shown in Exhibit 1, based on historical analysis in the 2018 edition, suggest 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.

Since we started publishing our CMAs in January 2014, equity estimates have flatlined while fixed income estimates have ground lower (in other words, equities have become somewhat more attractive relative to bonds; see **Exhibit 2**). We should not be surprised that many long-only investments have low expected returns today. In theory, all assets are priced according to the present value of their expected cash flows. The riskless yield is the common component of all assets' discount rates, and when it is lower than historical averages it tends to make all assets expensive.

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

Exhibit 2

Expected Real Returns for Liquid Asset Classes, Jan-2014 to Dec-2019



Source: AQR; see Exhibits 3-5 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 based on current methodologies, 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.

Equity Markets

Our starting point for equities is the dividend discount model, 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) ≈ DY+g+Δv. 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 towards historical averages.[4]

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

2. Payout-based: We estimate net total payout yield (NTY) as the sum of current dividend yield and smoothed net buyback yield. To this we add an estimate of long-term real growth of aggregate payouts that includes net issuance. This 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: $E(r) \approx NTY + g_{\text{TPagg}}$, where $NTY = DY + \text{net buyback yield (NBY)}$

All estimates are lower than last year, due to richening from rising equity prices in 2019 (see **Exhibit 3**). Estimates are 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. In short, our analysis suggests mean reversion is unreliable and difficult to forecast, and there are plausible arguments for yields remaining lower than historical levels.

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 2020

	1. Earnings-Based			2. Payout-Based				Combined	
	Adjusted Shiller EP	g_{EPS}	0.5 * EP + g_{EPS}	Dividend Yield	NBY	g_{TPagg}	DY+NBY + g_{TPagg}	2020 Est.	*1yr Change*
U.S.	3.6%	1.5%	**3.3%**	1.8%	0.2%	2.6%	**4.6%**	**4.0%**	*(-0.3%)*
Euro-5	4.9%	1.5%	**4.0%**	3.2%	-0.5%	2.4%	**5.0%**	**4.5%**	*(-0.6%)*
Japan	4.7%	1.5%	**3.9%**	2.3%	0.2%	2.1%	**4.5%**	**4.2%**	*(-0.2%)*
U.K.	5.8%	1.5%	**4.4%**	4.4%	-0.4%	2.3%	**6.4%**	**5.4%**	*(-0.5%)*
Australia	5.0%	1.5%	**4.0%**	4.2%	-0.7%	2.6%	**6.1%**	**5.0%**	*(-0.5%)*
Canada	4.8%	1.5%	**3.9%**	3.1%	-1.3%	2.5%	**4.3%**	**4.1%**	*(-0.3%)*
Global Developed	4.0%	1.5%	**3.5%**	2.3%	0.0%	2.5%	**4.8%**	**4.1%**	*(-0.4%)*
Global Dev. ex U.S.	5.0%	1.5%	**4.0%**	3.2%	-0.2%	2.3%	**5.3%**	**4.7%**	*(-0.4%)*
Emerging Markets	7.2%	2.0%	**5.6%**	2.6%	--	--	**4.6%**	**5.1%**	*(-0.3%)*

Source: AQR, Consensus Economics and Bloomberg. Estimates and methodology subject to change and based on data as of December 31, 2019. See main text for methodology. For earnings yield, U.S. is based on S&P 500; U.K. on FTSE 100 Index; "Euro-5" is a cap-weighted average of large-cap indices in Germany, France, Italy, Netherlands and Spain; Japan on Topix Index; and "Emerging Markets" on MSCI Emerging Markets Index. Period for net buyback yield (NBY) is 1988 to 2019. For payout-based estimates, all countries are based on corresponding MSCI indices. "Global Developed" is a cap-weighted average. For emerging markets, 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.

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 spot exchange rate return (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 and Japanese investors in U.S assets, the differential between U.S. dollar and local short rates makes hedging appear expensive, although this differential — which narrowed slightly in 2019 — 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 differentials are somewhat narrower.

Government Bonds

Government bonds' prospective medium-term nominal total returns are strongly anchored by their yields. The so-called *rolling yield* measures the expected return of a constant-maturity bond allocation assuming an unchanged yield curve.[6] For example, a strategy of holding constant-maturity 10-year Treasuries has an expected annual (nominal) return of 2.1%, given the starting yield of 1.9% 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 returns by subtracting a survey-based forecast of long-term inflation.

Since last year, our estimates have fallen for all markets except Japan, mostly due to lower yields. Low bond yields should be considered in the context of exceptionally low cash rates (indeed, all excess-of-cash returns are positive — see Appendix Exhibit A1). Any 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 2020

	Y	RR	I	Y + RR - I	
	10-Year Nominal Bond Yield	Rolldown Return	10-Year Forecast Inflation	Expected Real Return	*1yr Change*
U.S.	1.9%	0.2%	2.1%	**0.0%**	*(-0.8%)*
Japan	0.0%	0.3%	0.8%	**-0.5%**	*(+0.1%)*
Germany	-0.2%	0.9%	1.7%	**-0.9%**	*(-0.4%)*
U.K.	0.8%	0.6%	2.1%	**-0.7%**	*(-0.6%)*
Australia	1.4%	0.3%	2.3%	**-0.6%**	*(-0.8%)*
Canada	1.7%	0.0%	2.0%	**-0.2%**	*(-0.6%)*
Global Developed	1.3%	0.3%	1.9%	**-0.3%**	*(-0.6%)*
Global Developed ex U.S.	0.4%	0.5%	1.6%	**-0.6%**	*(-0.3%)*

Source: Bloomberg, Consensus Economics and AQR. Estimates as of December 31, 2019. "Global Developed" and "Global Developed ex U.S." are GDP-weighted averages. 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.

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.

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 from both Treasury and spread curves. **Exhibit 5** shows our updated estimates for U.S. credit indices[8] and hard-currency emerging market sovereign debt. Return estimates have fallen substantially during 2019, due to both narrower credit spreads and lower Treasury yields. The HY-IG spread has also narrowed.

Exhibit 5

Expected Real Returns for Credit Indices, January 2020

	A. Spread Return		B. Treasury Real Yield		C. Rolldown Return				
	S	S * 0.5	Y	Y - I	R_T	R_C	R_T+R_C	A + B + C	
	Option-Adjusted Spread	Expected Excess Return	Duration-Matched Tsy Yield	Real Tsy Yield (I=2.1%)	Tsy Rolldown	OAS Rolldown	Total Rolldown	Expected Real Return	*1yr Change*
U.S. IG	0.9%	**0.5%**	1.9%	**-0.2%**	0.2%	0.3%	**0.5%**	**0.9%**	*(-0.7%)*
U.S. HY	3.4%	**1.7%**	1.8%	**-0.3%**	0.2%	0.2%	**0.3%**	**1.9%**	*(-1.2%)*
EM Debt	3.8%	**1.9%**	1.9%	**-0.2%**	0.2%	0.2%	**0.4%**	**2.2%**	*(-0.4%)*

Source: Barclays, Bloomberg, AQR. Estimates as of December 31, 2019. OAS and duration data is for Barclays U.S. Corporate Investment Grade (IG) Index, Barclays U.S. Corporate High Yield (HY) Index and Barclays Emerging USD Sovereign (EM Debt) Index. Index durations are 7.9 years, 3.1 years and 7.7 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.

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 of an equal-dollar-weighted portfolio of commodity futures. This portfolio has earned 3.0% geometric average excess return over cash since 1877, and a similar return if measured since 1951.[9] To this we add a (now negative) U.S. real cash return to give our expected real return of 2.7%.

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 (e.g., this basis averaged around 0.4% for HY in 2019). For EM debt we use U.S. HY OAS rolldown due to data limitations. Real return 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.

9 For more details see *Alternative Thinking* Q1 2016, Levine, Ooi, Richardson and Sasseville (2018), and the AQR data library.

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, with 2-3% tracking error. An integrated multi-style strategy — which we assume to include balanced allocations to value, momentum and defensive styles — may achieve a higher expected net active return of around 1% 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.[10] These are long-term estimates — we discuss tactical considerations below.

Long/Short Style Premia

Alternative risk premia strategies apply similar tilts as long-only smart beta strategies, but in 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 0.2-0.3. For a diversified composite, we believe an expected Sharpe ratio of 0.7-0.8, 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 7-8% over cash.[11] We stress that this requires careful craftsmanship in portfolio construction as well as great efficiency in controlling trading, financing and shorting costs.[12] 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 are near long-term averages. Among equity styles, defensive and momentum styles are mildly rich by some measures, while value has been looking increasingly cheap. 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.[13] However, we believe during 2019 some value factors have become sufficiently cheap to warrant an overweight in multi-factor strategies.[14]

10 Style-tilted strategies exhibit many design variations. Our estimates are purely illustrative and do not represent any AQR product or strategy.
11 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, 2015 Q1 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.
12 See Israel, Jiang and Ross (2017), "Craftsmanship Alpha: An Application to Style Investing".
13 See Asness, Chandra, Ilmanen and Israel (2017), "Contrarian Factor Timing Is Deceptively Difficult".
14 See *Cliff's Perspective* blog, 'It's Time for a Venial Value-Timing Sin,' November 2019.

Private Equity and Real Estate

Illiquid assets are inherently harder to model than public markets, and this is exacerbated by a lack of good quality and transparent data. Nevertheless, last year we extended our discounted-cashflow-based approach into the illiquid realm and we update these estimates below. For private equity (PE) 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. Each of our inputs is debatable as PE data limitations necessitate lots of simplifying assumptions. **Exhibit 6** illustrates our yield-based framework and current inputs.[15] 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.

Our yield-based real return estimate is 3.1% net of fees, down nearly 1% since last year. An alternative approach, based on applying simple size and leverage adjustments to a public proxy and assuming zero net alpha, gives a higher estimate of 5.5%.[16] Taking a simple average of the two approaches gives a final estimate of 4.3%, compared to our combined U.S. large cap equity estimate of 4.0%.

Exhibit 6
Expected Real Returns for U.S. Private Equity

	Unlevered			Leverage		Unlevered					
	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	$r_g = r_l + m$			
	Income Yield	Real Growth Rate	Real Return	Debt to Equity	Real Cost of Debt	Levered Real Return	Multiple Expansion (Ann.)	Gross Real ER	Fees	Net Exp. Real Return	*1yr Change*
U.S. PE	2.0%	+ 3.0%	= 5.0%	86%	1.4%	8.0%	+ 0.1%	= 8.1%	5.0%	= **3.1%**	*(-0.8%)*

Source: AQR, Pitchbook, Bloomberg, CEM Benchmarking. Estimates as of September 30, 2019 and subject to change. Historical averages cover period January 1993 to September 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. Hypothetical data has inherent limitations, some of which are disclosed herein. For illustrative purposes only and not representative of any AQR product or strategy.

15 See Ilmanen, Chandra and McQuinn (2020) for a detailed discussion of the framework, our input choices, and the sources, as well as a literature review. 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.

16 See *Alternative Thinking Q1 2019* for details of this alternative method.

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 (this is also true of PE). As with our DDM-based approach for equities, we sum payout yield and expected long-term growth rate.[17] **Exhibit 7** shows our expected real return of roughly 3% for unlevered RE (to make it comparable to the unlevered returns reported by NCREIF).

Exhibit 7

Expected Real Returns for U.S. 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	*1yr Change*
U.S. Real Estate	4.7%	1.6%	3.1%	0.0%	**3.1%**	*(+0.2%)*

Source: AQR, NCREIF Webinar Q3 2019. Estimates as of September 30, 2019 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.

Estimating the Return on Cash

Our yield-based return assumptions for equities and bonds are total real returns, often the relevant measure for comparing expected returns to investment objectives. But allocation decisions should be informed by *excess-of-cash* returns, since the risk-free interest rate is a common component and baseline that the investor cannot influence. The expected short-term interest rate (real or nominal) is therefore a crucial input in allocation decisions, as well as a fundamental economic variable.

In previous years we have offered qualitative opinions on the likely direction of real cash rates and their implications for portfolio decisions. For example, we have emphasized that low bond yields should be considered in the context of even lower expected cash rates, and we have discussed the implications of expected rate differentials on hedged international investments. This year we formally include cash in our yield-based framework, and provide some empirical analysis to support our methodology.

One option for cash estimates would be to use survey-based expectations, but decade-out estimates are published only for the U.S. Thus we prefer to use market yields, ensuring consistency across markets and consistency with our broader CMA framework. A long-term government bond yield is the sum of (1) the market's expectations for future short-term yields, and (2) a required term premium which is not directly observable and may be time-varying. So long-term yields may be a useful input if we can say something about the expected term premium. And given the poor track record of both economists and the market in forecasting future cash rates, the current short-term rate may also be a

17 See Ilmanen, Chandra and McQuinn (2019) for full details of our methodology and assumptions.

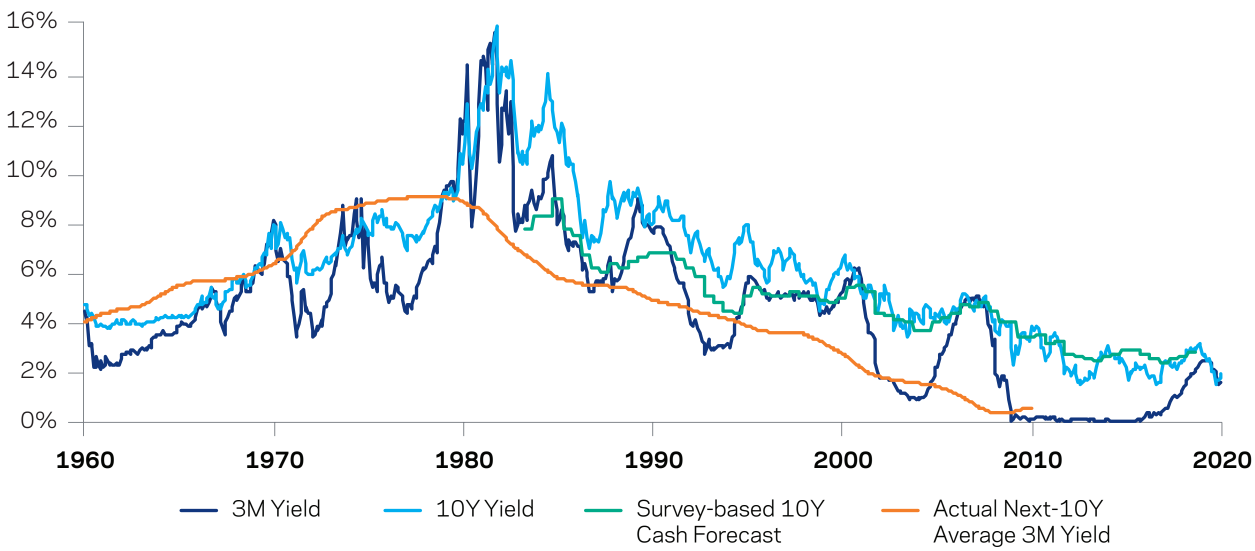
worthwhile candidate (effectively assuming future cash rate changes are a random walk).[18]

Exhibit 8 shows historical long-term and short-term U.S. yields since 1960, survey-based cash forecasts since 1983, and subsequent next-decade returns on T-Bills. Persistent upward and then downward trends are immediately apparent, and these secular trends will tend to make the results of any empirical analysis sample-specific.

For example, the current T-Bill yield was a persistent under-estimator of future cash rates during the 1960s and 1970s, but a persistent over-estimator in the past four decades of falling rates. Similarly, since the survey forecasts begin in 1983, they have *always* overestimated next-decade cash rates (and by as much as 4 percentage points). It would be unwise to assume similar overestimates would have occurred in the 1960s and 1970s, or that they will persist in the future.

Exhibit 8

U.S. Bond and Bill Yields, Cash Forecast and Subsequent Cash Rate 1960-2019



Source: Global Financial Data, Blue Chip Economic Indicators and AQR.

We propose as our cash forecast candidate a **weighted average of current short-term and long-term yields**, giving a larger (two-thirds) weight to the 10-year yield. Our reasoning is as follows:

- We average two extremes: the 10-year yield is consistent with the pure expectations hypothesis that the yield curve expresses expected short rates, while the current short rate is consistent with the pure risk premium hypothesis that the yield curve contains no information about future short rates. [19]
- A blend implies a downward adjustment to the long-term yield when the yield curve is upward sloping, consistent with assuming a positive term premium in that environment.

18 Another option would be to use some combination of forward rates (such as the average of the current 3M rate, 3M 5 years forward, and 3M 10 years forward). But forward rates can be noisy, and when averaged across the full 10-year window we obtain a 10-year spot yield, for which the par or on-the-run yield is a reasonable approximation.

19 Empirical evidence in Fama and Bliss (1987) and some other early studies supported the risk premium hypothesis. Campbell and Shiller (1991) gave a more nuanced verdict, suggesting the yield curve predicts near-term changes in long bond yields poorly, but may predict gradual changes in short rates — more consistent with the pure expectations hypothesis.

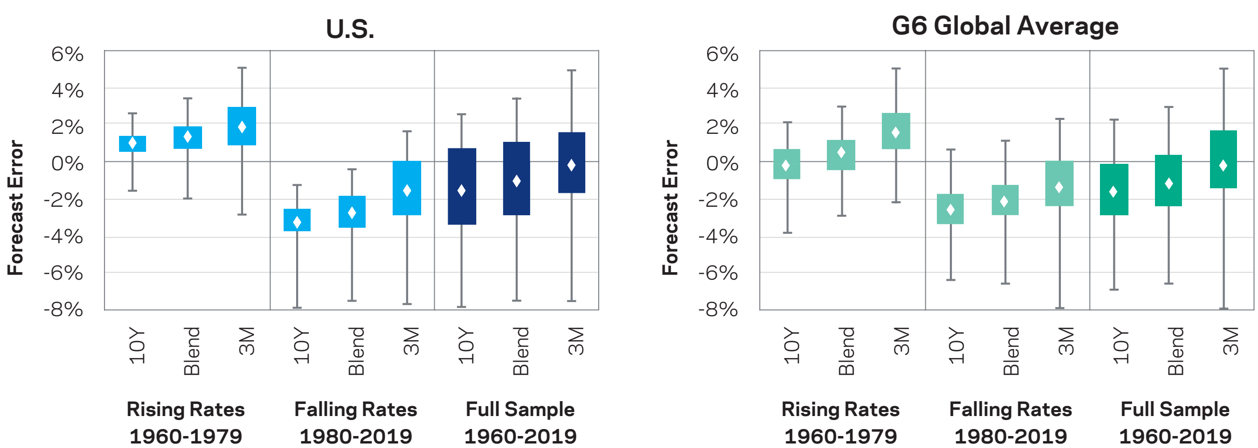
- Giving a larger weight to the 10-year yield implies market rate expectations explain a larger portion of the yield curve slope than the required term premium, a conjecture arguably justified by relatively low inflation uncertainty and the role of forward guidance from central banks.

We now conduct a simple 'horserace' to test our cash forecast candidates (we conducted a similar analysis for equity and bond return estimates in the 2018 edition). Our data set is monthly yield and return data for six major developed countries since 1960. Each month we calculate forecast errors by comparing market yields to subsequent 10-year returns on cash. **Exhibit 9** shows the distribution of these forecast errors for each candidate. In these 'box plots', the 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 inter-quartile range of errors (containing half the observations), and the whiskers indicate the largest upside (top) and downside (bottom) errors.

For both U.S. and the global average, errors tended to be positive during the first 20 years of our sample when rates were generally rising (i.e., outcomes tended to be higher than forecasts), and negative during the past 40 years of falling rates (outcomes tended to be lower). The 10-year yield tended to be the better forecast of cash returns during the early sample (smaller bias and narrower spread of errors), whereas in the later sample and over the full 60-year sample, the 3-month yield had the smallest bias. Our preferred blended estimate does not 'win' any of the horseraces, but importantly it has a better worst case than either yield used alone.[20]

Exhibit 9

Distribution of Errors for Different Cash Forecast Candidates 1960-2019



Source: Global Financial Data and AQR. Based on monthly overlapping 10-year periods. 'Forecast error' is realized return minus forecast return. Diamond indicates mean error; shaded box shows inter-quartile range of errors; whiskers indicate largest upside and downside errors. 'G6 Global Average' takes average distribution characteristics from U.S., Japan, Germany, U.K., Australia and Canada. 'Blend' is 2/3 10-year yield, 1/3 3-month yield. For illustrative purposes only. Hypothetical data has inherent limitations, some of which are disclosed herein.

20 Over the shorter period for which we have U.S. survey-based estimates, our blended yield-based estimate has performed comparably, with a similar bias but a slightly wider error distribution.

Exhibit 10 presents expected real cash returns as of year-end 2019, based on the above blended yield method. Over the past year, the U.S. estimate fell from positive to slightly negative, while estimates for Japan and Europe remained negative. If expected returns for equities and bonds are low, they are even lower for cash — and this important fact will be true for almost any methodology. In the Appendix we perform the subtraction to give excess-of-cash return estimates.

Exhibit 10

Expected Local Real Returns for Cash, January 2020

	S	L	I	(L*2/3 + S*1/3) - I	
	3-Month Yield	10-Year Yield	10Y Forecast Inflation	Expected Real Cash Return	*1yr Change*
U.S.	1.5%	1.9%	2.1%	-0.4%	*(-0.8%)*
Japan	-0.1%	0.0%	0.8%	-0.9%	*(+0.3%)*
Germany	-0.8%	-0.2%	1.7%	-2.0%	*(-0.5%)*
U.K.	0.7%	0.8%	2.1%	-1.3%	*(-0.3%)*
Australia	0.9%	1.4%	2.3%	-1.1%	*(-0.9%)*
Canada	1.7%	1.7%	2.0%	-0.3%	*(-0.2%)*

Source: Bloomberg, Consensus Economics and AQR. Estimates as of December 31, 2019. 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.

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 2020, these estimates are soberingly low. They suggest that over the next decade, many investors may struggle to meet return objectives anchored to a rosier past. Low expected cash returns are one clear culprit, dragging down expected total returns on all risky investments. In this article we introduce one very simple but justifiable method for quantifying the expected return on cash, which is an essential input for investors seeking to make sense of — and make choices from — this unappetizing menu of low-yielding 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 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 is arguably stronger than ever.

References

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

Campbell, J. and R. Shiller, 1991, "Yield Spreads and Interest Rate Movements: A Bird's Eye View," *Review of Economic Studies*, 58(3).

Fama, E. and R. Bliss, 1987, "The Information in Long-Maturity Forward Rates," *American Econ. Review*, 77(4).

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, 2020, "Demystifying Illiquid Assets: Expected Returns for Private Equity," *Journal of Alternative Investments*, 22(3).

Ilmanen, A., S. Chandra and N. McQuinn, 2019, "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*.

Levine, A., Y. Ooi, M. Richardson and C. Sasseville, 2018, "Commodities for the Long Run," *Financial Analysts Journal*, 74(2).

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 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.	**4.0%**	-0.4%	**4.3%**
Euro-5	**4.5%**	-1.7%	**6.2%**
Japan	**4.2%**	-0.9%	**5.0%**
U.K.	**5.4%**	-1.3%	**6.7%**
Australia	**5.0%**	-1.1%	**6.1%**
Canada	**4.1%**	-0.3%	**4.4%**
Global Developed	**4.1%**	-0.7%	**4.8%**
Developed ex U.S.	**4.7%**	-1.2%	**5.9%**
Emerging Mkts	**5.1%**	0.9%	**4.2%**

10-Year Government Bonds	Local Real Return	Local Real Cash Return	Hedged Excess-of-Cash Return
U.S.	**0.0%**	-0.4%	**0.4%**
Japan	**-0.5%**	-0.9%	**0.4%**
Germany	**-0.9%**	-2.0%	**1.1%**
U.K.	**-0.7%**	-1.3%	**0.6%**
Australia	**-0.6%**	-1.1%	**0.4%**
Canada	**-0.2%**	-0.3%	**0.0%**
Global Developed	**-0.3%**	-0.7%	**0.4%**
Developed ex U.S.	**-0.6%**	-1.2%	**0.6%**

Source: AQR, Consensus Economics and Bloomberg. Return assumptions and methodology subject to change and based on data as of December 31, 2019. See main text and Exhibits 3 and 4 for methodology. Global Developed and Developed ex U.S. 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 real equity yield is a simple average of two measures: (0.5 * Shiller E/P * 1.075) + 1.5% and Dividend/Price + 1.5%. The 1.5% term is assumed long term real earnings per share (EPS) growth. The 0.5 multiplier reflects the long-term payout ratio; the 1.075 multiplier accounts for EPS growth during the 10-year earnings window. 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 1)

We first produce historical time series of yield-based estimates for U.S. equities and U.S. Treasuries (analysis starts in 1900, but we use data from 1870s onwards). We test their predictive power using quarterly overlapping 10-year periods since 1900 and measure the distribution of errors. See *Alternative Thinking* Q1 2018 for more details. Error ranges in Exhibit 1 are based on interquartile ranges of these distributions, adjusted for current volatility estimates.

Disclosures

market behavior or future performance of any particular investment which may differ materially, and should not be relied upon as such. Target allocations contained herein are subject to change. There is no assurance that the target allocations will be achieved, and actual allocations may be significantly different than that shown here. This presentation should not be viewed as a current or past recommendation or a solicitation of an offer to buy or sell any securities or to adopt any investment strategy.

The information in this presentation may contain projections or other forward-looking statements regarding future events, targets, forecasts or expectations regarding the strategies described herein, and is only current as of the date indicated. There is no assurance that such events or targets will be achieved, and may be significantly different from that shown here. The information in this presentation, including statements concerning financial market trends, is based on current market conditions, which will fluctuate and may be superseded by subsequent market events or for other reasons. Performance of all cited indices is calculated on a total return basis with dividends reinvested.

Diversification does not eliminate the risk of experiencing investment losses. Broad-based securities indices are unmanaged and are not subject to fees and expenses typically associated with managed accounts or investment funds. Investments cannot be made directly in an index.

The investment strategy and themes discussed herein may be unsuitable for investors depending on their specific investment objectives and financial situation. Please note that changes in the rate of exchange of a currency may affect the value, price or income of an investment adversely.

Neither AQR nor the author assumes any duty to, nor undertakes to update forward looking statements. No representation or warranty, express or implied, is made or given by or on behalf of AQR, the author or any other person as to the accuracy and completeness or fairness of the information contained in this presentation, and no responsibility or liability is accepted for any such information. By accepting this presentation in its entirety, the recipient acknowledges its understanding and acceptance of the foregoing statement.

The data and analysis contained herein are based on theoretical and model portfolios and are not representative of the performance of funds or portfolios that AQR currently manages. Volatility targeted investing described herein will not always be successful at controlling a portfolio's risk or limiting portfolio losses. This process may be subject to revision over time.

HYPOTHETICAL PERFORMANCE RESULTS HAVE MANY INHERENT LIMITATIONS, SOME OF WHICH, BUT NOT ALL, ARE DESCRIBED HEREIN. NO REPRESENTATION IS BEING MADE THAT ANY FUND OR ACCOUNT WILL OR IS LIKELY TO ACHIEVE PROFITS OR LOSSES SIMILAR TO THOSE SHOWN HEREIN. IN FACT, THERE ARE FREQUENTLY SHARP DIFFERENCES BETWEEN HYPOTHETICAL PERFORMANCE RESULTS AND THE ACTUAL RESULTS SUBSEQUENTLY REALIZED BY ANY PARTICULAR TRADING PROGRAM. ONE OF THE LIMITATIONS OF HYPOTHETICAL PERFORMANCE RESULTS IS THAT THEY ARE GENERALLY PREPARED WITH THE BENEFIT OF HINDSIGHT. IN ADDITION, HYPOTHETICAL TRADING DOES NOT INVOLVE FINANCIAL RISK, AND NO HYPOTHETICAL TRADING RECORD CAN COMPLETELY ACCOUNT FOR THE IMPACT OF FINANCIAL RISK IN ACTUAL TRADING. FOR EXAMPLE, THE ABILITY TO WITHSTAND LOSSES OR TO ADHERE TO A PARTICULAR TRADING PROGRAM IN SPITE OF TRADING LOSSES ARE MATERIAL POINTS THAT CAN ADVERSELY AFFECT ACTUAL TRADING RESULTS. THERE ARE NUMEROUS OTHER FACTORS RELATED TO THE MARKETS IN GENERAL OR TO THE IMPLEMENTATION OF ANY SPECIFIC TRADING PROGRAM, WHICH CANNOT BE FULLY ACCOUNTED FOR IN THE PREPARATION OF HYPOTHETICAL PERFORMANCE RESULTS, ALL OF WHICH CAN ADVERSELY AFFECT ACTUAL TRADING RESULTS.

The hypothetical performance results contained herein represent the application of the quantitative models as currently in effect on the date first written above, and there can be no assurance that the models will remain the same in the future or that an application of the current models in the future will produce similar results because the relevant market and economic conditions that prevailed during the hypothetical performance period will not necessarily recur. Discounting factors may be applied to reduce suspected anomalies. This backtest's return, for this period, may vary depending on the date it is run. Hypothetical performance results are presented for illustrative purposes only. In addition, our transaction cost assumptions utilized in backtests, where noted, are based on AQR Capital Management LLC's, ("AQR's") historical realized transaction costs and market data. Certain of the assumptions have been made for modeling purposes and are unlikely to be realized. No representation or warranty is made as to the reasonableness of the assumptions made or that all assumptions used in achieving the returns have been stated or fully considered. Changes in the assumptions may have a material impact on the hypothetical returns presented. Actual advisory fees for products offering this strategy may vary.

Gross performance results do not reflect the deduction of investment advisory fees, which would reduce an investor's actual return. For example, assume that $1 million is invested in an account with the Firm, and this account achieves a 10 percent compounded annualized return, gross of fees, for five years. At the end of five years that account would grow to $1,610,510 before the deduction of management fees. Assuming management fees of 1 percent per year are deducted monthly from the account, the value of the account at the end of five years would be $1,532,886 and the annualized rate of return would be 8.92 percent. For a ten-year period, the ending dollar values before and after fees would be $2,593,742 and $2,349,739, respectively. AQR's asset-based fees may range up to 2.85 percent of assets under management and are generally billed monthly or quarterly at the commencement of the calendar month or quarter during which AQR will perform the services to which the fees relate. Where applicable, performance fees are generally equal to 20 percent of net realized and unrealized profits each year, after restoration of any losses carried forward from prior years. In addition, AQR funds incur expenses (including start-up, legal, accounting, audit, administrative and regulatory expenses) and may have redemption or withdrawal charges up to 2 percent based on gross redemption or withdrawal proceeds. Please refer to AQR's ADV Part 2A for more information on fees. Consultants supplied with gross results are to use this data in accordance with SEC, CFTC, NFA or the applicable jurisdiction's guidelines.

There is a risk of substantial loss associated with trading commodities, futures, options, derivatives and other financial instruments. Before trading, investors should carefully consider their financial position and risk tolerance to determine if the proposed trading style is appropriate. Investors should realize that when trading futures, commodities, options, derivatives and other financial instruments one could lose the full balance of their account. It is also possible to lose more than the initial deposit when trading derivatives or using leverage. All funds committed to such a trading strategy should be purely risk capital.