Capital Market Assumptions

Expected real returns for major asset classes as of March 31, 2020

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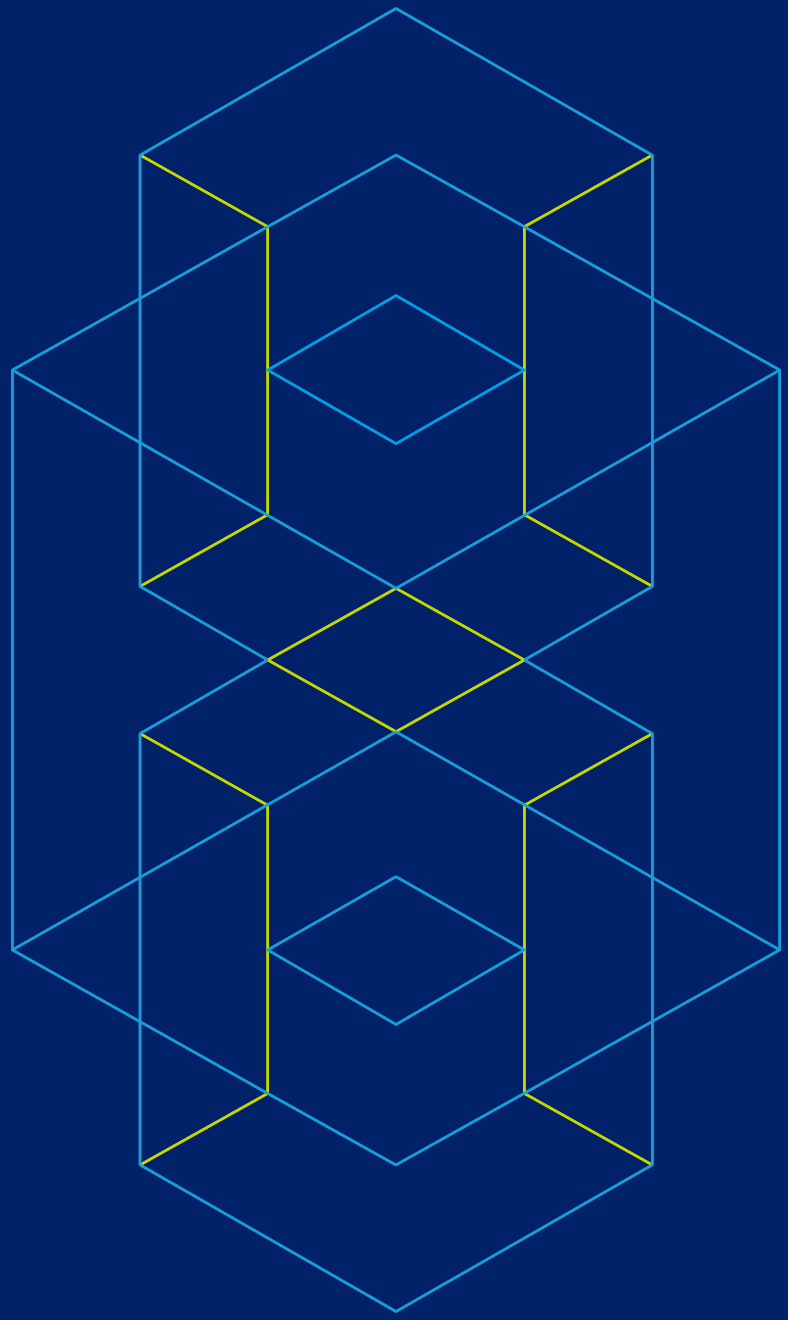
Q2 2020



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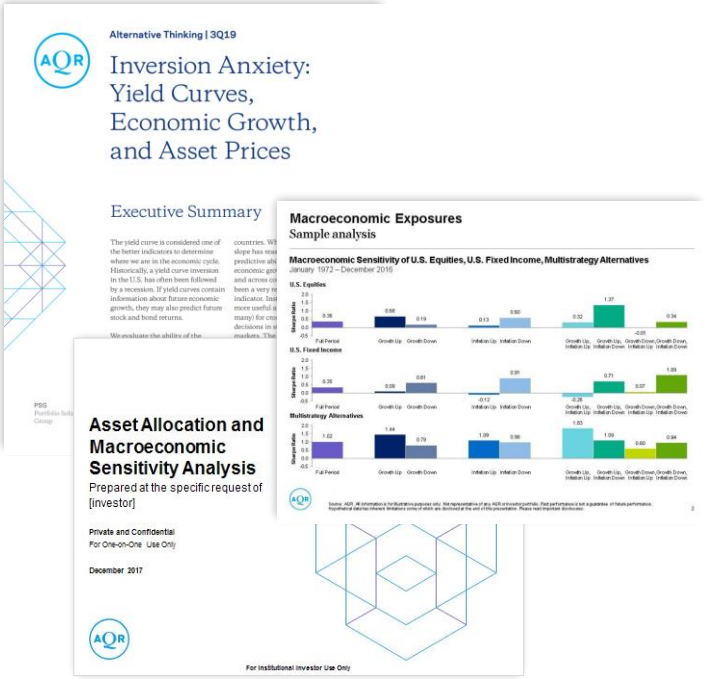
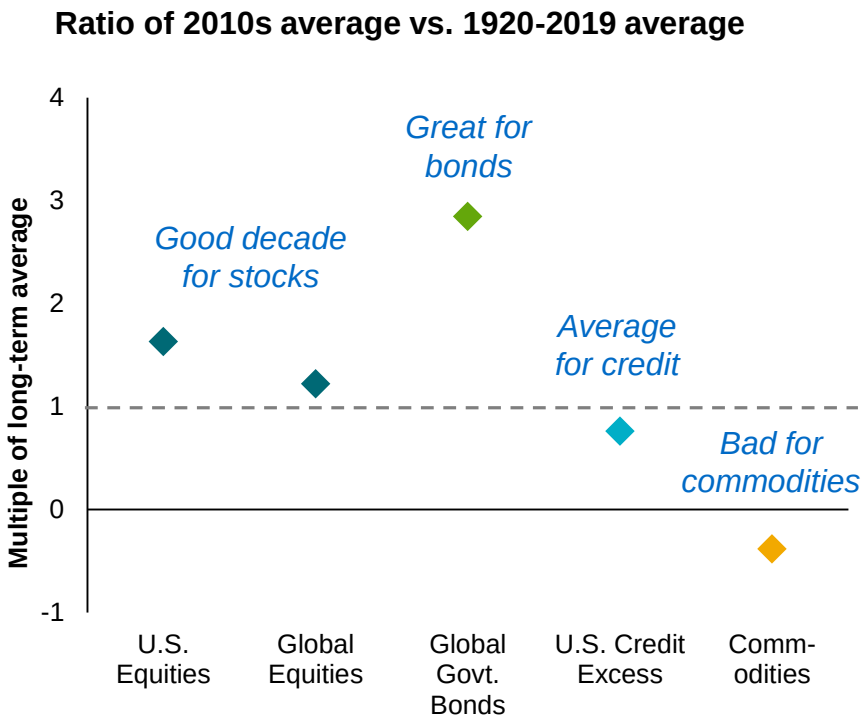


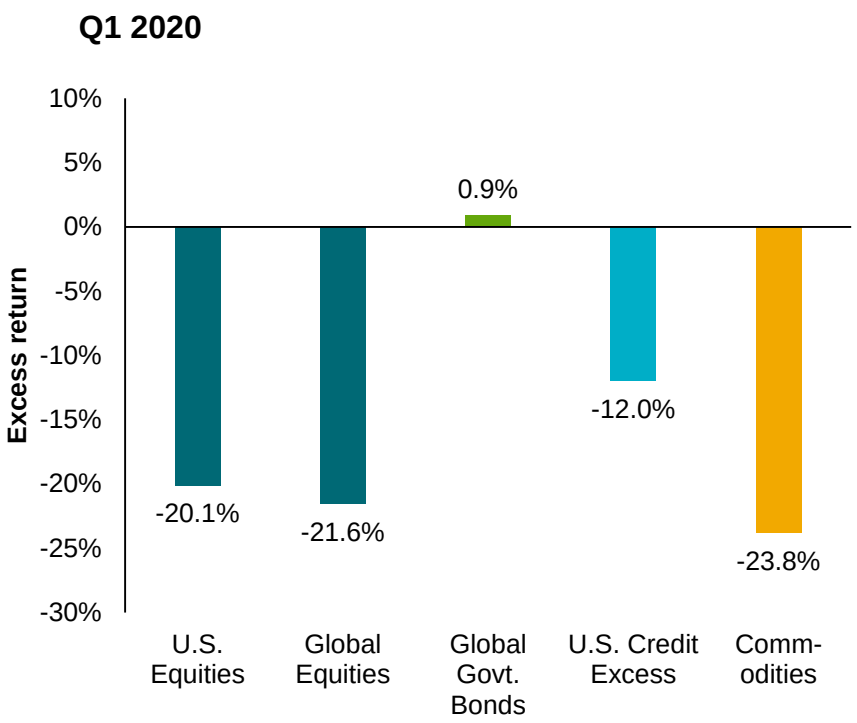
Source: AQR. For illustrative purposes only.

Volatile Q1 2020 Followed an Exceptionally Benign Decade

The 2010s were exceptional for stock/bond portfolios

Hypothetical gross excess-of-cash returns of major asset classes





Source: AQR data library, Bloomberg. Long-term data sets are described in "Do Factor Premia Vary Over Time? A Century of Evidence" (2019) and "Commodities for the Long Run" (2018). Ratios are calculated vs. long-term series starting in January 1920, except for credit excess (January 1926). 2020 returns are based on S&P 500, MSCI World USD, Barclays Global Treasury USD Hedged, Barclays US IG Credit Excess and Bloomberg Commodities indices. Please see appendix for important disclosures regarding the construction of each return series. Performance is expressed gross of trading costs and fees. Hypothetical performance results have certain inherent limitations, some of which are disclosed in the Appendix. Please read important disclosures in the Appendix. Gross performance results do not reflect the deduction of investment advisory fees, which would reduce an investor's actual return.

Volatility Poses Challenges for Estimating Expected Returns

Do our estimates fully reflect impact of COVID-19 on fundamentals?

We present expected returns for a horizon of 5 to 10 years

Over such intermediate horizons, initial **market yields and valuations** tend to be the most important inputs

Our latest updates reflect Q1's large changes in prices

But we also use various **fundamental inputs**, some of which do not yet capture the impact of COVID-19 – and this may give an upward bias to our estimates for equities

Most are *intended* to be slow-moving, so impact of COVID-19 may be modest; examples:

- **Earnings**: we use past 10 years' earnings (intended to reflect long-term earnings potential of the market) – no COVID-19 impact reflected yet, will only have gradual impact even in worst case
- **Dividends**: we use past 1 year dividends – no COVID-19 impact reflected yet, likely to see substantial impact (e.g., due to government guidance to some sectors not to pay dividends)
- **EPS growth**: we combine several constant or slow-moving components that are intended to smooth cyclical variations – no COVID-19 impact reflected yet; impact will be small
- **Net buyback yield**: we use 10-year average (to reflect secular trends but not cyclical variations); gradual impact
- **Inflation**: we use consensus 10-year expectations – does not reflect COVID-19 impact, but this may be modest over long horizon, especially given uncertainty surrounding possible effects

We think our estimates are reasonable midpoints for setting medium-term expectations

BUT uncertainty is even higher than normal; large allocation shifts are unlikely to be warranted

Source: AQR; see later slides for details. Estimates and commentary as of March 31, 2020. 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.

Overview of Our Latest Estimates

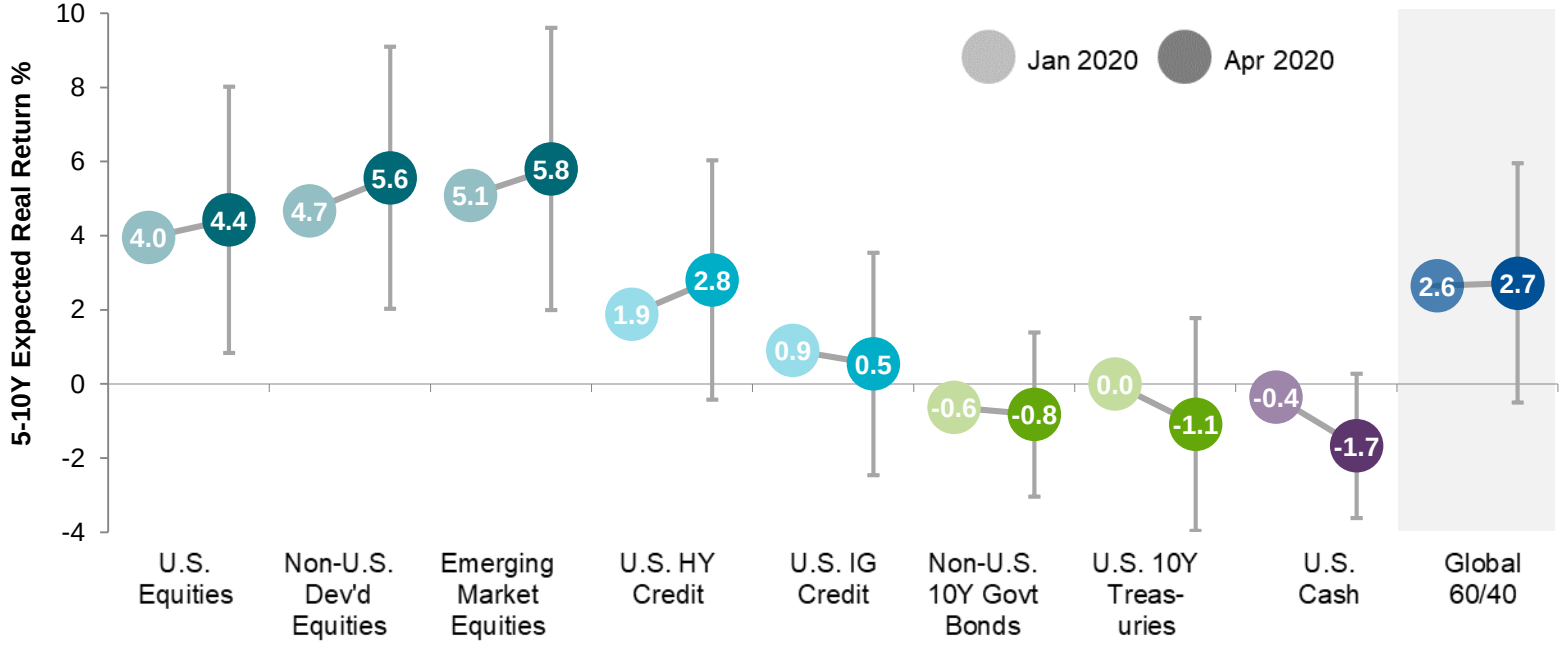
As of March 31, 2020

We present local real (inflation-adjusted) annual compound rates of return for a horizon of 5 to 10 years

In Q1, expected returns for equities and HY credit went **up** (though with very uncertain inputs)

Expected returns for U.S. Treasuries and cash went **down**

Medium-Term Expected Real Returns for Liquid Asset Classes

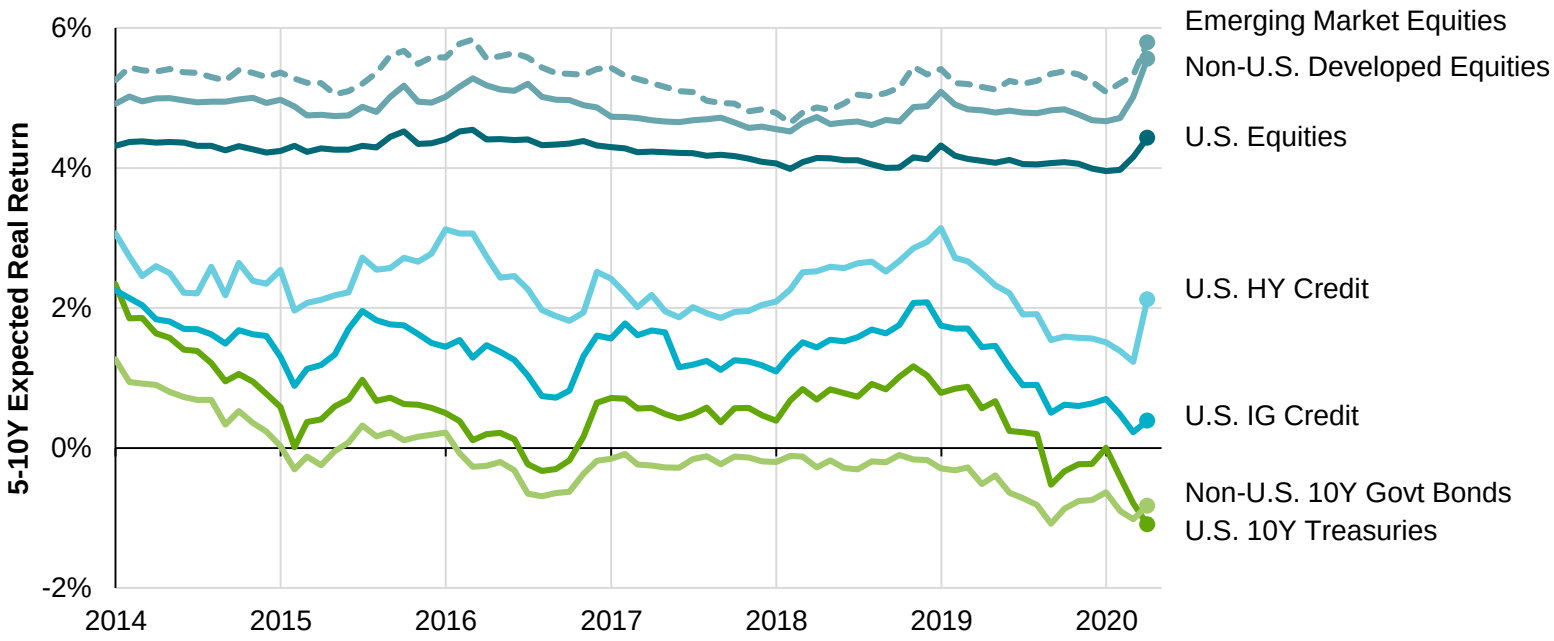


Source: AQR; see later slides for details. Estimates as of March 31, 2020 are local real annual compound rates of return for a horizon of 5 to 10 years. "Non-U.S. developed equities" is cap-weighted average of Euro-5, Japan, U.K., Australia, Canada. "Non-U.S. 10Y govt. bonds" is GDP-weighted average 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.

Expected Returns Through Time: A Sharp Divergence

As of March 31, 2020

Medium-Term Expected Real Returns for Liquid Asset Classes Jan 2014 – Mar 2020



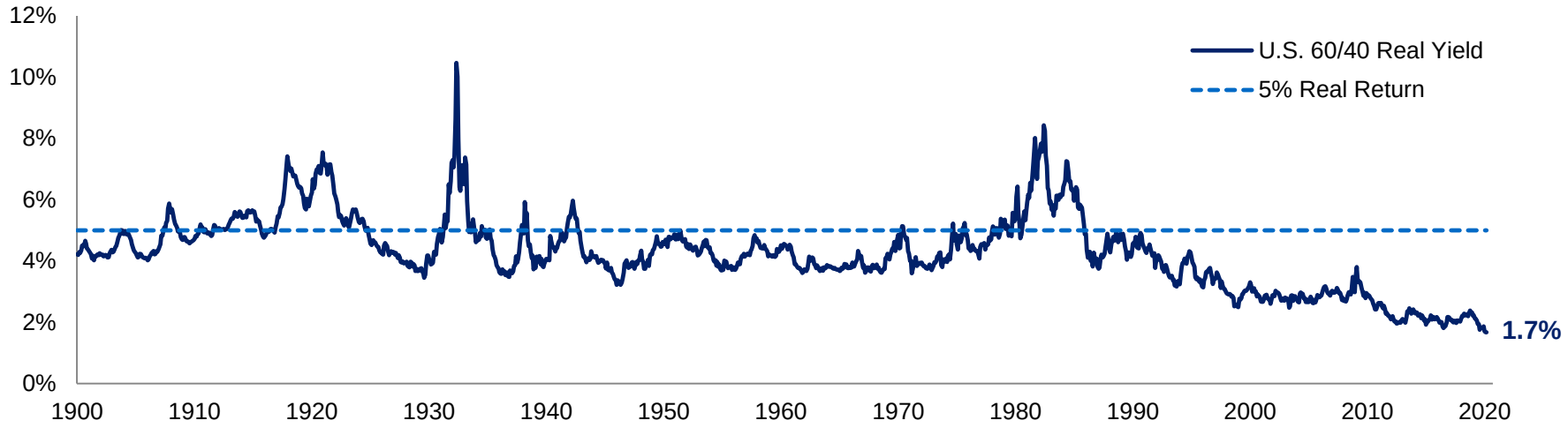
Source: AQR; see later slides for details. Estimates as of March 31, 2020. "Non-U.S. developed equities" is cap-weighted average of Euro-5, Japan, U.K., Australia, Canada. "Non-U.S. 10Y govt. bonds" is GDP-weighted average of Germany, Japan, U.K., Australia, Canada. Error bars cover 50% confidence range, 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.

The Long View: Still a World of Low Expected Returns

Low expected returns for stock/bond portfolios

Expected Real Return of the U.S. 60/40 Stock/Bond Portfolio

January 1, 1900 – March 31, 2020



Expected return for 60/40 averaged 5% real in the 1900s, fell to around 2% in recent years (and still no increase in Q1 2020, as falling Treasury yields offset rising equity yields)

These metrics are of little use for market timing:

- U.S. 60/40 delivered 6.5% real return over the 5 years 2015-2019 (5.0% for Global 60/40)*
- We do not know whether low expected returns will materialize through “slow pain” or “fast pain” (Q1 2020 delivered a dose of the latter)

But yield-based estimates give a useful anchor for next 5-10-year returns

* U.S. 60/40 is based on 60% S&P 500 TR Index and 40% Barclays U.S. Aggregate Index from January 1, 2015 to December 31, 2019. Global 60/40 is based on 60% MSCI World Net TR USD Index and 40% Global Aggregate Hedged Index over the same period. Real returns are obtained by deducting U.S. inflation based on the change in CPI.
Source: AQR, Bloomberg, Robert Shiller’s Data Library, Ibbotson Associates (Morningstar), Kozicki-Tinsley (2006), Federal Reserve Bank of Philadelphia, Blue Chip Economic Indicators, Consensus Economics. Earnings data through 9/30/2019. The U.S. 60/40 portfolio is 60% U.S. equities and 40% 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. The universe of stocks represented is the S&P 500. The real bond yield is the yield on long-term U.S. Treasury bonds minus long-term expected inflation based on Blue Chip Economic Indicators, Consensus Economics and the Federal Reserve Bank of Philadelphia. Before survey data became available in 1978, expected long-term inflation is based on statistical estimates and on 1-year ahead Livingston inflation forecasts. This is one set of estimates of ex-ante real yields for equities and bonds, but other reasonable specifications should tell broadly the same story. Chart is for illustrative purposes only. Past performance is not a guarantee of future performance. Please read important disclosures in the Appendix.

Equities
Building 5- to 10-year local real return estimates

We average two yield-based approaches:

1. Earnings-based: Shiller E/P * 0.5 (long-run dividend payout ratio) + 1.5% long-run real EPS growth
2. Payout-based: Dividend Yield + Net Buyback Yield + estimated real aggregate payout growth

We assume no mean reversion in equity valuations, and we quote local real returns

Most equity return estimates increased during Q1 2020 due to falling prices

The suddenness of the repricing in Q1 and heightened earnings and growth uncertainty make these estimates even more uncertain than usual

	1. Earnings-Based $0.5 * E/P + G_{EPS}$	2. Payout-Based $D/P + NBY + G_{agg}$	Combined Avg (1, 2)		
	Earnings-Based Expected Return	Payout-Based Expected Return	Expected Local Real Equity Return	*Change in Q1*	Expected Local Excess-of-Cash Return**
U.S.	3.7%	5.1%	**4.4%**	*+0.5%*	**6.1%**
Euro-5	4.8%	6.1%	**5.5%**	*+1.0%*	**7.2%**
Japan	4.5%	5.0%	**4.8%**	*+0.6%*	**5.6%**
U.K.	5.4%	8.1%	**6.7%**	*+1.4%*	**8.5%**
Australia	4.8%	7.6%	**6.2%**	*+1.2%*	**7.8%**
Global Developed	4.1%	5.4%	**4.7%**	*+0.6%*	**6.3%**
Emerging Markets	6.5%	5.1%*	**5.8%**	*+0.7%*	**5.3%**

* For emerging markets, our payout-based estimate is dividend yield plus forecast GDP growth per capita (due to data availability).
** This is effectively the return accessed by a hedged foreign investor (add your own expected cash return to get an expected hedged total return).
Source: AQR, Consensus Economics and Bloomberg. Return assumptions and methodology are subject to change and based on data as of March 31, 2020. The local real equity expected return is an average of two approaches: 1. The Shiller earnings yield (using 10-year earnings) scaled by 1.075 (embedding an annual real EPS growth of 1.5%), multiplied by 0.5 and added to a real growth rate in EPS of 1.5% for developed countries and 2% for emerging markets. 2. The sum of dividend yield plus estimates of net buyback yield (NBY) and long-term real growth of aggregate payouts, G. G is the average of two measures: (i) long-term historical real earnings growth (since 1970) adjusted for dilution (GP), and (ii) long-term forecast real GDP growth based on Consensus Economics data (GG). GP and GG are both shrunk halfway towards a cross-country average. For earnings yield, U.S. is based on the S&P 500; U.K. on the FTSE 100 Index; "Euro-5" is a cap-weighted average of large-cap indices in Germany, France, Italy, the Netherlands and Spain; Japan on the Topix Index; and "Emerging Markets" is based on the MSCI Emerging Markets Index. For payout-based estimates, all countries are based on corresponding MSCI indices. "Global Developed" is a cap-weighted average of the developed market estimates.

Government Bonds

Building local real return estimates for 10-year government bonds

We assume no mean reversion in real bond yields, and we quote local real returns

In Q1 2020 return estimates fell in most markets and especially the U.S., where yields fell sharply

Available data on inflation may not fully reflect the latest expectations, which are likely to be highly uncertain

Can investments in very low- or negative-yielding bonds be justified? We believe the answer is yes:

- Low bond yields should be considered in the context of exceptionally low cash rates in most markets
- Tactical humility is warranted and bonds remain useful diversifiers for equity-dominated portfolios

	Y	RR	I	Y+RR-I		
	10-Year Nominal Bond Yield	Rolldown Return	10-Year Forecast Inflation	Expected Local Real 10-Year Bond Return	*Change in Q1*	Expected Local Excess-of-Cash Return*
U.S.	0.7%	0.4%	2.1%	**-1.1%**	*-1.1%*	**0.6%**
Japan	0.0%	0.5%	0.8%	**-0.2%**	*+0.3%*	**0.6%**
Germany	-0.5%	0.7%	1.7%	**-1.4%**	*-0.3%*	**0.8%**
U.K.	0.4%	0.6%	2.1%	**-1.2%**	*-0.4%*	**0.6%**
Australia	0.8%	0.5%	2.3%	**-1.0%**	*-0.4%*	**0.6%**

* This is effectively the return accessed by a hedged foreign investor (add your own expected cash return to get an expected hedged total return).
Source: AQR, Bloomberg and Consensus Economics. The estimate starts with the yield of a constant-maturity bond portfolio (Y), adds on the one-year rolldown gains in an unchanged yield curve scenario (RR), and then subtracts expected long-term inflation (I) to get expected real return. One could add to this the annual capital loss of any expected yield rise (roughly, duration times yield rise, pro-rated to the number of years). For an explanation of how to translate these estimates to USD hedged or unhedged returns, please see AQR Alternative Thinking Q1 2020. Hypothetical performance results have certain inherent limitations, some of which are disclosed in the Appendix. Rolldown return is estimated from fitted yield curves. Long-term expected inflation is based on data from Consensus Economics. Return assumptions are subject to change and based on data as of March 31, 2020.

Credit Indices

Building real return estimates using spreads

We apply a haircut of 50% to Investment Grade, High Yield and EM spreads to represent the combined effects of expected default losses, downgrading bias and bad selling practices

We assume no change in spreads through mean reversion

In Q1 2020 spreads widened sharply but Treasury yields also fell significantly

For investment grade credit the fall in yields more than offset the wider spreads, so our estimate fell

For high yield and emerging debt, wider spreads outweigh both the fall in yields and negative carry from the now negative rolldown return, leading to an increase in expected real return

	S = OAS * 0.5	T	R	S + T + R *		
	Spread Return	**Real Yield of Duration-Matched Treasury**	**Rolldown Return (Treasury & Spread Curves)**	**Expected Local Real Return**	***Change in Q1***	**Expected Local Excess-of-Cash Return****
U.S. Investment Grade	1.4%	-1.4%	0.4%	**0.5%**	*-0.4%*	**2.2%**
U.S. High Yield	4.4%	-1.5%	-0.3%	**2.8%**	*+0.9%*	**4.5%**
EM Debt USD	4.0%	-1.4%	-0.3%	**2.5%**	*+0.3%*	**4.2%**

* 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. For EM debt we use US HY OAS rolldown due to data limitations.

** This is effectively the return accessed by a hedged foreign investor (add your own expected cash return to get an expected hedged total return).

Source: AQR, Bloomberg and Consensus Economics. Long-term expected inflation is based on data from Consensus Economics. U.S. High Yield and U.S. Investment Grade refer to the Barclays Corporate U.S. High Yield and Barclays Corporate U.S. Investment Grade indices respectively. EM Debt USD refers to Barclays Emerging USD Sovereign index. Methodology and return assumptions are subject to change and based on data as of March 31, 2020. We assume a 50% expected loss/haircut for all credit spreads based on Giesecke, Longstaff, Schaefer and Strebulaev (2011), who show that over the long term credit spreads are roughly twice as large as default losses. This is consistent with AQR analysis over shorter historical periods. See AQR *Alternative Thinking* Q1 2016 for discussion of methodology.

Cash

Simple estimates combine pure expectations and random-walk assumptions

Our simple methodology is based on a weighted average of short- and long-term yields (see AQR *Alternative Thinking* Q1 2020 for discussion and analysis)

During Q1, cash estimates fell sharply in the US and Canada, with smaller reductions in other markets

If expected returns for bonds are low, they are even lower for cash – and this important fact will be true for almost any methodology

	S	L	I	(L*2/3 + S*1/3) - I	
	3-Month Yield	10-Year Yield	10Y Forecast Inflation	Expected Local Real Cash Return	*Change in Q1*
U.S.	0.1%	0.7%	2.1%	-1.7%	*-1.3%*
Japan	-0.2%	0.0%	0.8%	-0.8%	*n.c.*
Germany	-0.7%	-0.5%	1.7%	-2.2%	*-0.2%*
U.K.	0.2%	0.4%	2.1%	-1.8%	*-0.5%*
Australia	0.4%	0.8%	2.3%	-1.6%	*-0.6%*
Canada	0.3%	0.7%	2.0%	-1.4%	*-1.1%*

Source: Bloomberg, Consensus Economics and AQR. Estimates as of March 31, 2020. 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.

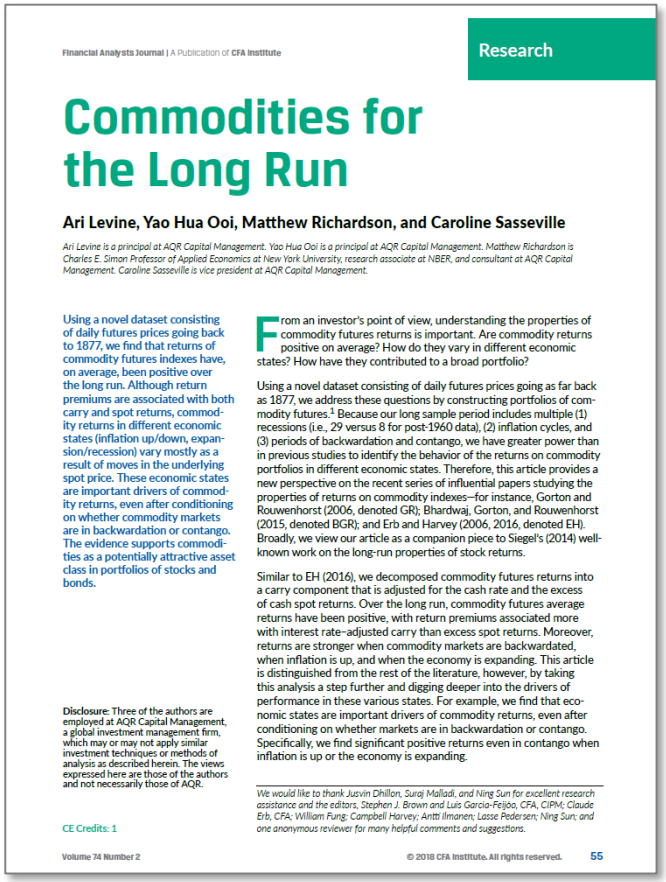
Commodities

Where yield-based measures are lacking, we make reasonable assumptions

We find no variables that significantly predict multi-year returns

Over the very long term, a portfolio of commodity futures has delivered approximately 3% over cash, and we use this as our expected return estimate

As of March 2020, this translates to 1.3% real return, a decrease since December 2019 because our U.S. real cash return estimate has fallen substantially



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Research

Commodities for the Long Run

Ari Levine, Yao Hua Ooi, Matthew Richardson, and Caroline Sasseville

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Using a novel dataset consisting of daily futures prices going back to 1877, we find that returns of commodity futures indexes have, on average, been positive over the long run. Although return premiums are associated with both carry and spot returns, commodity returns in different economic states (inflation up/down, expansion/recession) vary mostly as a result of moves in the underlying spot price. These economic states are important drivers of commodity returns, even after conditioning on whether commodity markets are in backwardation or contango. The evidence supports commodities as a potentially attractive asset class in portfolios of stocks and bonds.

From an investor's point of view, understanding the properties of commodity futures returns is important. Are commodity returns positive on average? How do they vary in different economic states? How have they contributed to a broad portfolio?

Using a novel dataset consisting of daily futures prices going as far back as 1877, we address these questions by constructing portfolios of commodity futures.[1] Because our long sample period includes multiple (1) recessions (i.e., 29 versus 8 for post-1960 data), (2) inflation cycles, and (3) periods of backwardation and contango, we have greater power than in previous studies to identify the behavior of the returns on commodity portfolios in different economic states. Therefore, this article provides a new perspective on the recent series of influential papers studying the properties of returns on commodity indexes—for instance, Gorton and Rouwenhorst (2006, denoted GR); Bhardwaj, Gorton, and Rouwenhorst (2015, denoted BGR); and Erb and Harvey (2006, 2016, denoted EH). Broadly, we view our article as a companion piece to Siegel's (2014) well-known work on the long-run properties of stock returns.

Similar to EH (2016), we decomposed commodity futures returns into a carry component that is adjusted for the cash rate and the excess of cash spot returns. Over the long run, commodity futures average returns have been positive, with return premiums associated more with interest rate–adjusted carry than excess spot returns. Moreover, returns are stronger when commodity markets are backwardated, when inflation is up, and when the economy is expanding. This article is distinguished from the rest of the literature, however, by taking this analysis a step further and digging deeper into the drivers of performance in these various states. For example, we find that economic states are important drivers of commodity returns, even after conditioning on whether markets are in backwardation or contango. Specifically, we find significant positive returns even in contango when inflation is up or the economy is expanding.

We would like to thank Jusvin Dhillon, Suraj Malladi, and Ning Sun for excellent research assistance and the editors, Stephen J. Brown and Luis Garcia-Feijóo, CFA, CIPM; Claude Erb, CFA; William Fung; Campbell Harvey; Antti Ilmanen; Lasse Pedersen; Ning Sun; and one anonymous reviewer for many helpful comments and suggestions.

Disclosure: Three of the authors are employed at AQR Capital Management, a global investment management firm, which may or may not apply similar investment techniques or methods of analysis as described herein. The views expressed here are those of the authors and not necessarily those of AQR.

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Financial Analysts Journal 2018

Source: AQR. To get a long-run return estimate for commodities, we constructed an equally weighted index of commodity futures going back to 1947. This simulated index is rebalanced each month to equal nominal weights to ensure diversification. The commodity universe grows from 3 in 1947 to over 20 by early 1990s. See Alternative Thinking Q1 2016 for further details on how to think about the expected returns of commodity futures. All assumptions are purely illustrative and do not represent any AQR product or strategy. Methodology and return assumptions are subject to change and are as of March 31, 2020. Hypothetical performance results have certain inherent limitations, some of which are disclosed in the Appendix.

Alternative Risk Premia

Where yield-based measures are lacking, we make reasonable assumptions

Style-tilted long-only equities:

- Assume net active return of ~0.5% for a single style such as value
- Assume ~1% net for an integrated multi-style portfolio

Long/short alternative risk premia:

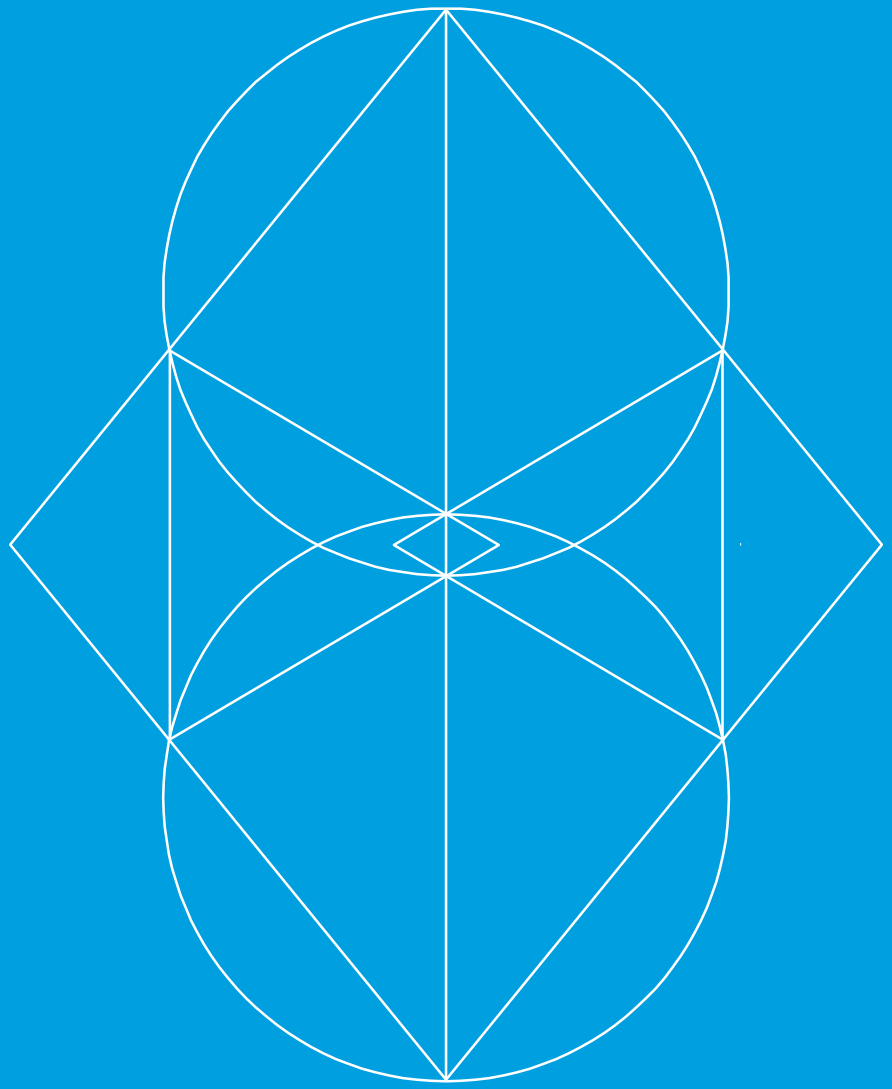
- For a diversified multi-style, multi-asset composite, we assume an expected Sharpe ratio of ~0.7-0.8, net of trading costs and fees
- Requires craftsmanship in portfolio construction and efficiency in controlling implementation costs

What about current style valuations?

- Research finds only a weak link between the value spreads of style factors and their future returns
- Aggregate valuations across multiple styles are near long-term averages
- Among equity styles, **value** looks very cheap by most measures, while the **defensive** style looks somewhat rich
- We believe value's cheapness has become sufficiently extreme to warrant an overweight in multi-factor strategies

Sounce: AQR. Smart beta strategies exhibit so many design variations that it is difficult to generalize. To list just a few, style tilts may be industry-neutral or may permit industry bets, they may or may not be beta-neutral, and they may have different levels of tracking error. Beyond the strategy design, implementation efficiency and fees affect net expected returns. The style-tilted equities and diversified long/short alternative risk premia assumptions above are plausible, conservative assumptions based on a combination of historical evidence, theory and starting valuations. See Alternative Thinking Q1 2015 for further discussion. All assumptions are purely illustrative and do not represent any AQR product or strategy. Methodology and return assumptions are subject to change and are as of March 31, 2020. Hypothetical performance results have certain inherent limitations, some of which are disclosed in the Appendix.

Appendix



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Index descriptions

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 **S&P 500 Index** is the Standard & Poor's composite index of 500 stocks, a widely recognized, unmanaged index of common stock prices.

The **MSCI World Index** is a free float-adjusted market capitalization weighted index that is designed to measure the equity market performance of developed markets.

The **Bloomberg Barclays Global Treasury Index** tracks fixed-rate local currency government debt of investment grade countries.

The **Bloomberg Barclays Global Aggregate Index** is an unmanaged index that is comprised of several other Bloomberg Barclays indexes that measure fixed income performance of regions around the world.

The **Bloomberg Barclays US Aggregate Bond Index** is a broad-based flagship benchmark that measures the investment grade, US dollar-denominated, fixed-rate taxable bond market. The index includes Treasuries, government-related and corporate securities, MBS (agency fixed-rate and hybrid ARM pass-throughs), ABS and CMBS (agency and non-agency).

The **FTSE 100 Index** is an index composed of the 100 largest companies by market capitalization listed on the London Stock Exchange.

The **MSCI Emerging Markets Index** is a free float-adjusted market capitalization index that is designed to measure equity market performance of emerging markets.

The **TOPIX Index** is a free-float adjusted market capitalization-weighted index that is calculated based on all the domestic common stocks listed on the TSE First Section.

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Historical Returns for Major Asset Classes

U.S. Equity Market Data: Prior to 1926, the U.S. Equity series is constructed by adding price-weighted capital appreciation returns of NYSE stocks collected by Goetzmann, Ibbotson, and Peng to U.S. equity dividend returns recorded by the Cowles commission. The series consists of returns of the S&P 90 from 1926 to 1957 and returns of the S&P 500 from 1957 onwards.

Global Equity Indices: We obtain returns on equity indices from 43 equity markets internationally from Global Financial Data, which include all countries covered in the MSCI World Index as of April 2018. Since most countries have multiple equity indices, we use the index that is investable, has the most coverage of the total stock market of that country, and has the longest history. We source monthly total returns (including dividends) from Global Financial Data and futures returns from Bloomberg and Datastream.

Fixed Income: Nominal yield and total returns data of 10-year local currency government bonds as well as 3-month interest rates from Global Financial Data and supplement it with Bloomberg and Datastream. The cross-section of government bond indices includes 26 countries, covering North America, Western and Northern Europe, Japan, and the Antipdeans.

Credit Excess: Ibbotson's U.S. Long-Term Corporate Bond Total Return minus empirical-duration-matched long-term government bonds from Ibbotson's U.S. Long-Term Government Bond Total Return. From 1926-1935, durations are estimated using in-sample regressions. From 1936-2014, they are estimated using rolling 10-year regressions. Please see section 3.1.1 in the paper (Asvanunt and Richardson, 2015, “The Credit Risk Premium”) for additional information on the regressions used. From January 1, 2015 this series is Barclays U.S. Aggregate Corporate Bond Index in excess of Duration Match Treasuries.

Commodities: This series is from the “Commodities for the Long Run" (Levine, Ooi, Richardson, and Sasseville, FAJ, 2018) data set from January 1920 through June 2018 and is the Bloomberg Commodity Index thereafter.

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