Alternative Thinking

Capital Market Assumptions for Major Asset Classes

This issue updates our multi-year expected returns for major asset classes. Compared to historical averages, we are still very much in a world of low expected returns. We have revised our method for estimating equity expected returns, incorporating estimates of net buyback yield and broadening our estimates of earnings growth to include additional inputs.

First Quarter 2017

AQR Capital Management, LLC
Two Greenwich Plaza
Greenwich, CT 06830

p: +1.203.742.3600
f: +1.203.742.3100
w: aqr.com

Executive Summary

- In this article we update our estimates of long-term expected returns for stocks, bonds and some other asset classes and factors.
- Our current estimate for the long-run real return of U.S. equities is 4.2%, somewhat lower than most other developed markets (average 4.6%) and emerging markets (5.4%). Our current estimate for U.S. 10-year government bonds' long-run real return is 0.7%. For U.S. investment-grade and high-yield credit we estimate real returns of 1.4% and 2.1%, respectively. For a risk-weighted portfolio of commodities we estimate a long-run real return of around 3%.
- From a historical perspective almost all long-only investments have low expected returns today. In fact, the traditional US 60/40 portfolio has, in recent years, offered an expected real return of less than half its long-term average (since 1900) of roughly 5%.
- In this low return environment, one increasingly popular way to potentially enhance returns is diversification via uncorrelated, alternative risk premia like styles. We expect higher returns for smart beta than cap-weighted portfolios, and clearly higher expected risk-adjusted returns for long-short style premia compared to long-only portfolios.
- This year we revise our methodology for estimating expected equity market returns, to account for the growing use of buybacks. In principle, expected returns should not be affected by changes in payout policy. However, as described later, the classic dividend discount model (DDM) may underestimate equity returns. We make changes to both the earnings-based and payout-based estimates that we combine for our expected real returns.

Introduction and Framework

For the past three years, the first quarter's *Alternative Thinking* has presented our capital market assumptions for major asset classes, with a focus on long-term expected returns[1] (see 2014, 2015 and 2016). We update these estimates annually, both because market conditions evolve and because our methodologies may evolve based on ongoing research. We also add additional asset classes where our research permits.

We remind readers that any point estimates for expected returns come with significant uncertainty and that the frameworks for making such estimates may be more useful than the numbers themselves — and more useful for planning than market timing, except perhaps at exceedingly rare extremes. Further, while the low yields of bonds are the most evident, we stress that almost all long-only investments have low expected returns today. All long-only assets are priced as the sum of their expected cash flows discounted by the riskless yield plus myriad risk premia. Thus, the riskless yield is the common component of all assets' discount rate and when it is near historical lows, it tends to make all assets expensive versus their own histories. For example, a U.S. 60/40 portfolio[2] averaged a 5.4% expected real return in the 1900s but has offered only 2-2.5% in recent years. For other countries and assets, we may not have as long histories, but the decline in expected returns is still evident.

As usual, we present expectations in terms of *real* (inflation-adjusted) annual compound rates of return for a horizon of 5- to 10-years. Over such intermediate horizons, initial market yields and valuations tend to be the most important inputs.[3]

For even longer (multi-decade) forecast horizons, the impact of starting yields is diluted, so theory and historical average returns matter more in judging

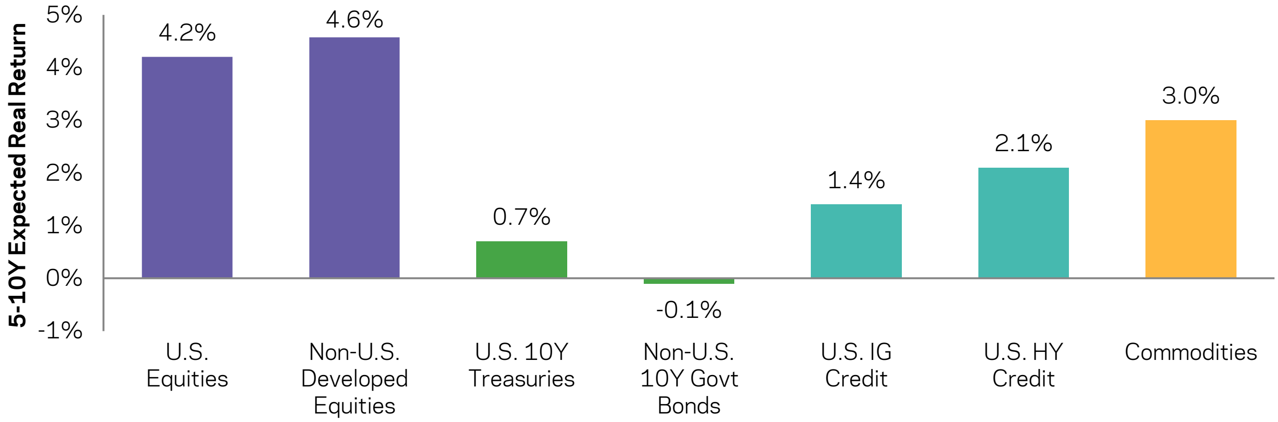
Diversification does not eliminate the risk of experiencing investment losses.

[1] Volatilities and correlations are relatively easier to forecast — both over short and long horizons — than returns because they are more persistent.

[2] The U.S. 60/40 is 60% U.S. stocks represented by the Standard&Poor's 500 Index and 40% U.S.10-year Treasuries.

[3] Thus, we prefer to estimate expected returns based on current market yields, and we use them for stocks and bonds with some tweaks (adjusting for growth, rolldown, default estimates). In other cases — commodities and style premia — yield measures are not available or as relevant, so our estimates are based more on historical returns. In no cases do we assume mean-reverting valuations (we discussed the evidence in the *Alternative Thinking*, 2015 Q1).

Exhibit 1 | *Summary of Expected Long-Run Real Return Estimates for Major Asset Classes*



Source: AQR; see Exhibits 2-6 for details. "Non-U.S. developed equities" is a cap-weighted average of Euro-5, Japan, U.K., Australia and Canada. "Non-U.S. 10Y government bonds" is a GDP-weighted average of Germany, Japan, U.K., Australia and Canada.

expected returns. For short horizons, returns are largely unpredictable but any predictability mainly reflects momentum and the macro environment.

Exhibit 1 summarizes our expected return estimates for long-only asset classes. They have not changed much from last year; the clearly biggest move is a 1% fall in the expected return of high-yield credits. Next up, we briefly describe the methodology used for each.

Equity Markets

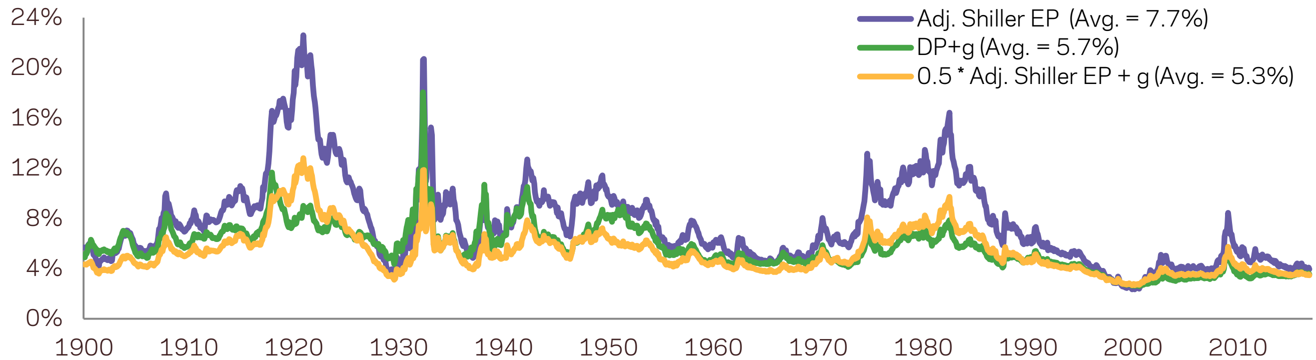
In the classic DDM, the expected real return on equities is approximately the sum of dividend yield (DY), expected trend growth (g) in real dividends or earnings per share EPS, and expected change in valuations (Δv), that is: $E(r) \approx DY+g+\Delta v$. As in past years, we average estimates from two methods which include the first two terms — yield and growth proxies — but assume no mean reversion in valuations, i.e., $E(r) \approx DY+g$.
This year, we revise our methodology to account for the structural change of firms replacing dividend payouts with share buybacks since the 1980s, which can influence both the yield and growth estimates. We provide a summary here with more color in the appendix.

1. Earnings yield (E/P)

The inverse of a P/E ratio measures the ex-ante real return on equities, albeit under quite strict assumptions. To smooth the excessive cyclicality in annual earnings, we use the inverse of the CAPE ratio (cyclically-adjusted P/E ratio, also called the Shiller P/E), which is the 10-year average of earnings, inflation-adjusted to today's price levels, divided by today's price.

Earnings yield is independent of payout ratio and changes in payout policy. However, as shown in **Exhibit 2**, it results in equity return estimates too volatile for long-run estimates that assume no mean-reversion. One simple way to remedy this is to proxy dividend yield with 50% of the Shiller E/P (roughly the long-run average dividend payout ratio in the U.S.), and plug this into the DDM with a real growth rate of 1.5% (the long-run run average real growth in EPS) to form a less volatile earnings-based estimate of expected real return that is still unaffected by changes in payout policy. Exhibit 2 plots expected returns from this modified earnings yield approach for the U.S. since 1900 (yellow line), alongside the simple earnings yield approach and the classic DDM method. We see that the revised method closely mirrors the classic DDM but has the advantage of being notably less volatile than the regular Shiller E/P. Exhibit 2 also shows that across all three methods, equity expected returns are far lower today than in the 1900s, as mentioned earlier.

Exhibit 2 | *U.S. Long-Run Expected Equity Returns 1900-2016*



Source: AQR, Shiller data, XPressFeed and Bloomberg. g refers to earnings growth rate, assumed to be a constant 1.5%.All estimates use the S&P 500 index. Adjusted Shiller EP is 1.075 / Shiller PE, embedding an annual real EPS growth of 1.5%.

To summarize, our revised earnings yield-based equity expected return is:

$$E(r) \approx 0.5 * \text{Adjusted Shiller } E/P + g$$

where g = long-run real earnings-per-share growth

We apply the U.S. long-run average payout ratio of 50% and real growth rate in EPS of 1.5% to all countries, except for emerging markets where we use a somewhat higher growth rate of 2%.

2. DDM yield

As per the classic DDM $E(r) \approx$ DY+g, our past approach was to estimate returns by summing country-specific current dividend yield DY and country-specific long-run real growth rates in EPS, proxied by forecast growth in GDP per capita.

To adjust the DDM for buybacks, we add smoothed net buyback yield (net buybacks equals buybacks minus issuance) to dividend yield, and correspondingly convert the per-share growth term to an aggregate growth term that includes net issuance. As shown in the technical appendix, assuming no repricing of valuation multiples, the Net Total Payout model defines expected real equity return approximately as

$$E(r) \approx NTY + g_{TPagg}$$

where

NTY = Net Total Payout Yield = DY + Net Buyback Yield

g_{TPagg} = growth in real aggregate total payouts

Putting It All Together

Exhibit 3 summarizes our expected equity returns using both methods described above, as well as their average as our final estimate.

Exhibit 3 | *Expected Equity Return Estimates*

	Earnings-Yield Based	DDM Based	Average
	0.5 * Adj. Shiller E/P + g(EPS)	DY + NBY + g_{TPagg}	Expected Real Equity Return
U.S	3.7%	4.8%	**4.2%**
Euro-5	4.4%	5.2%	**4.8%**
Japan	3.7%	4.2%	**3.9%**
U.K.	4.6%	6.0%	**5.3%**
Australia	4.5%	5.8%	**5.1%**
Canada	4.0%	3.6%	**3.8%**
Global Devlpd.	3.8%	4.9%	**4.4%**
Global Dev. ex US	4.2%	5.0%	**4.6%**
Emerging Mkts	6.4%	4.5%	**5.4%**

Source: AQR, Consensus Economics and Bloomberg. Return assumptions and methodology are subject to change and based on data as of December 30, 2016. 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 g(EPS) 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 (DY) plus estimates of net buyback yield (NBY) and long-term real growth of aggregate payouts g_{TPagg}. 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. The period for NBY is 1988 through 2016. For DDM estimates, all countries are based on corresponding MSCI indices. "Global Developed" is a cap-weighted average of the developed market estimates. Hypothetical performance results have certain inherent limitations, some of which are disclosed in the back.

Exhibit 4 | *Building Expected Real Returns for Government Bonds*

	Y	RR	I	Y+RR-I
	10-Year Nominal Bond Yield	Rolldown Return	10-Year Forecast Inflation	Expected Real 10Y Bond Return
U.S.	2.4%	0.5%	2.3%	**0.7%**
Japan	0.0%	0.3%	1.1%	**-0.7%**
Germany	0.2%	1.2%	1.7%	**-0.3%**
U.K.	1.2%	1.0%	2.2%	**0.1%**
Australia	2.8%	0.6%	2.5%	**0.9%**
Canada	1.7%	0.9%	2.0%	**0.6%**
Global Developed	1.8%	0.6%	2.0%	**0.3%**

Source: Bloomberg, Consensus Economics and AQR. Estimates as of December 30, 2016. Return assumptions are subject to change. "Global Developed" is a GDP-weighted average of the country estimates.

Our final estimate of long-run expected real return for U.S. equities is 4.2% using our new method (just 0.2% higher than it would have been under the former method). As before, prospective real return estimates are clearly higher for European, Australian, and Emerging equity markets than for North America and Japan.

For emerging markets, we continue to use the classic DDM in place of the NTY model, due to data limitations described in the technical appendix. Exhibit A1 in the appendix provides a more detailed break-down of Exhibit 3.

Government Bonds

Government bonds' prospective nominal total returns, especially over long horizons, are strongly anchored by their yields. For bond portfolios with stable duration, so-called *rolling yield* is a better measure of expected long-run return, if an unchanged yield curve is a good base case. If the yield curve is upward-sloping, this implies rolldown gains when bonds age and their yields roll down the unchanged curve (say, from 2.43% 10-year yield to 2.37% 9-year yield). Expected returns then exceed the yield. For example, a strategy of holding constant-maturity 10-year Treasuries has an expected annual (nominal) return of near 3% given the starting yield of 2.43%, augmented by the capital gains from a 6bp annual rolldown yield decline.

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.[4] Real return estimates are in the range 0% to 1% for most markets, but are negative for Japan and Germany. Among major economies, expected U.S. equity returns remain relatively low while expected U.S. Treasury returns remain relatively high.

Any adjustment to these expected bond returns boils down to expectations on future changes in the yield curve level or shape. Capital gains/losses due to falling/rising yields dominate bond returns over short horizons but matter less over long horizons. Over the past few years, many investors have held strong views that (1) bond yields will rise soon, and (2) this outcome will be very bad news for bond investors. We have argued that both views should be considered highly uncertain, and 2016 vindicated this skepticism again as yields fell in all countries, at least until the U.S. presidential election. Even after some sharp yield rises in the fourth quarter, a currency-hedged global government bond index outperformed cash over the year.

[4] 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).

Expectations of looser fiscal policy and tighter monetary policy have raised U.S. Treasury yields in recent months. Our expected return estimates in Exhibit 4 do not embed future shifts in the yield curve, but the steepness does give some cushion against further yield rises, and provide rolldown gains if the yield curve remains unchanged.

What about Europe and Japan: can investments in negative-yielding bonds ever be justified? We believe the answer is yes, for several reasons. Firstly, the purpose of investing (rather than holding cash) is to earn returns in excess of the risk-free rate. Long-horizon expected cash returns are difficult to estimate (see later section) but low bond yields should be considered in the context of exceptionally low cash rates. Secondly, as we discovered in 2016, yields can turn negative — in other words, there are conceivable outcomes where yields fall even further. This may not be the central case but it warrants humility in tactical allocation. Thirdly, bonds remain useful diversifiers for equity-dominated portfolios. Even in rising rates environments they have exhibited low correlations to other asset classes. Reducing to zero a major allocation such as German or Japanese bonds represents a very aggressive tilt ill-matched to the low conviction in return forecasts.

Currency and Cash Considerations

We present real returns in local-currency terms, which are not directly comparable across countries for an investor in one country. To convert these to expected real returns seen by a foreign investor (E_{int}), we must first correct for any difference in expected inflation (I) in the two countries, and then correct for the expected cash rate differential (R, if hedged) or the expected exchange rate return from spot rate changes ($E_{currency}$, if unhedged). The adjustment for currency-hedged positions reflects the expected real cash rate differential.

$$E_{int\ hedged} = E_{local} + (I_{local} - I_{home}) + (R_{home} - R_{local})$$

$$E_{int\ unhedged} = E_{local} + (I_{local} - I_{home}) + E_{currency}$$

The significance of these corrections has increased somewhat over the past year. For example, expected U.S. inflation is approximately 0.5% higher than in Germany and 1% higher than in Japan, while U.S. cash rate differentials are now near 1% for both. If those differentials were to persist, a hedged U.S. investor would expect real returns about 0.5% higher than local estimates for Germany, and similar to local estimates for Japan.[5]

To present results in terms of excess returns over cash, we would need to subtract the expected real return of cash from the expected real market returns we report. Thus, if for simplicity we assume real cash rates to average zero over the coming decade, expected excess returns for all markets would equal their expected real returns.

Credit Indices

In last year's article we discussed possible methodologies for estimating expected returns for credit indices, and settled on the following simple approach. We apply a haircut of 50%[6] to both IG and HY spreads to represent the combined effects of expected default losses, downgrading bias and bad selling practices. We assume no change in the spread curve, say, through mean-reversion.

Exhibit 5 applies our preferred approach to U.S. IG and HY credit indices. Halving the 2016 year-end OAS gives an expected excess return over duration-matched Treasuries of 0.6% (2.0%) for IG (HY).[7] To this we add the expected real yield of a duration-matched Treasury (currently negative for the lower duration high yield index). Finally, we add rolldown

[5] This hedging adjustment assumes that covered interest rate parity (CIP) holds. In recent years, the failure of CIP has tended to make hedging more attractive than implied by local cash rates for U.S. investors holding euro- and yen-denominated assets, and vice versa (*BIS Annual Report* 2016).

[6] Consistent with Giesecke et al (2011), who find that over the very long term, the average credit risk premium is roughly half the average spread. We find similar results using a shorter data set. We may try to improve on this estimate in future editions, but note that improved forecasts of default losses are typically made for shorter horizons, not for 5-10 years.

[7] Exhibit 5 shows spreads for cash bonds in the popular Barclays indices. Actively traded synthetic indices (Markit North America CDX) tend to have 50-100bps narrower spreads for HY bonds. The so-called basis between cash and synthetic bonds narrowed during 2016, with the CDX trading near 3.6% at year-end compared to cash bonds' 4.1%.

Exhibit 5 | *Expected Real Return on U.S. Credit Indices*

	A. Spread Return			B. Treasury Real Yield			C. Rolldown Return			
	S	h	A = S * h	Y	I	B = Y - I	R_T	R_C	$C=R_T+R_C$	A+B+C
	Option-Adjusted Spread	OAS Haircut	Expected Excess Return	Duration Matched Tsy Yield	Forecast Inflation	Dur-M'd Real Tsy Yield	Treasury Rolldown Return	OAS Rolldown Return	Total Rolldown Return	Expected Real Return
U.S. IG	1.2%	50%	0.6%	2.3%	2.3%	0.0%	0.5%	0.3%	0.8%	**1.4%**
U.S. HY	4.1%	50%	2.0%	1.6%	2.3%	-0.6%	0.6%	0.0%	0.7%	**2.1%**

Source: Barclays, Bloomberg and AQR. OAS and duration data is for Barclays U.S. Corporate Investment Grade Index and Barclays U.S. Corporate High Yield Index. Duration for the Barclays Investment Grade index is 7.3 years whiile that for the Barclays High Yield index is 4.1 years.

return — both Treasury rolldown and the additional spread curve rolldown as bonds age and roll down the OAS curve. Thanks to the credit spreads (and additional rolldown for IG bonds), the expected real return for credits is clearly higher than for Treasuries.

Commodities

In last year's article, we tested for predictable time variation in the commodity risk premium using a uniquely long data set of commodity futures returns, dating back to 1877.[8] While we did find statistically significant predictability in short-term returns, this did not extend to predicting multi-year returns. Lack of useful yield measures and lack of long-horizon predictability suggest that our best estimate of 5-10 -year expected return for commodity futures is simply the long-run average return.

A diversified portfolio of commodity futures has earned about 3% geometric average excess return over cash. **Exhibit 6** shows evidence on the performance of an equal-volatility-weighted portfolio of commodity futures, in early decades holding only 3-6 grains but the universe growing to 15 by 1970 and 24 by 1990. The geometric average return over cash was 3.2% since 1877 and 3.4% since 1951. If we assume near-zero real return for cash, the expected real return would be 3%.

[8] For more details, see Levine, Ooi and Richardson (2016).

Exhibit 6 | *Historical Performance of an Equal-Volatility-Weighted Portfolio of Commodity Futures (Estimating a Constant Commodity Risk Premium)*

	1877-2016	1951-2016
Excess Return (AM)	4.5%	4.1%
Excess Return (GM)	3.2%	3.4%
Annualized Volatility	16.8%	12.3%
Sharpe Ratio	0.27	0.33

Sources: AQR, Bloomberg, Chicago Board of Trade, Commodity Systems Inc. The portfolio consists of 2 to 25 of the most actively traded commodity futures, with the universe generally increasing over time as new data becomes available. Equal-volatility-weighting is based on rolling 12-month volatilities. AM = arithmetic mean. GM = geometric mean. Data presented is based on hypothetical portfolios and are not representative of any AQR product or investment. Hypothetical performance results have certain inherent limitations, some of which are disclosed in the back.

Smart Beta and Style Premia

"Smart Beta" (Style-Tilted Long-Only) Portfolios

In this low return environment for traditional long-only asset classes, investors have been increasingly trying to boost returns by adding diversifying alternative risk premia like styles to their portfolios.[9] We therefore provide our long-run expectations for long-only smart beta and diversified long/short style premia portfolios, as described more fully in the 2015 edition of this article.

In our 2015 article we assumed that a hypothetical value-tilted (but still diversified long-only equity) portfolio has an expected real return of around 1% higher than the cap-weighted index, after fees.[10] A

[9] Refer to AQR *Alternative Thinking*, Q2 2015,"Strategic Portfolio Construction: How to Put It All Together"

[10] 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

multi-style strategy — which we assume to include three highly complementary, "tried and true" strategy styles, notably value, momentum and quality — can be designed to convert its superior expected diversification into a higher expected active return of around 2% net.[11] Finally, 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.

Style Premia (Long/Short Alternative Risk Premia)

Style 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 Sharpe ratios and then scale them by the chosen volatility target to get ex-ante estimates of excess return over cash.

The degree of diversification is essential. Individual alternative risk premia (a single long/short style in a single asset class) might have similar forward-looking Sharpe ratios as market risk premia in asset classes (0.2-0.3). Very few long-only portfolios may realistically reach ex-ante Sharpe ratios of 0.5-0.6. Yet, for a diversified composite of alternative risk premia we believe an ex-ante Sharpe ratio of 0.7-0.8, net of trading costs and fees[12], 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.[13] We stress that this requires careful craftsmanship in portfolio construction as well as great efficiency in controlling trading, financing and shorting costs.

What About Current Style Valuations?

The above estimates are mainly based on historical average returns, adjusted for trading costs and fees and some discounting. There has been active debate on whether smart beta or style premia valuations are currently exceptionally expensive and on whether such valuations can be used for contrarian factor timing or rotation. We have studied these topics closely and expect to publish more on them in 2017[14], but our short answers are:

- First, viewed as a group, the main factors are hardly expensive. Indeed, today's valuations are, on average, surprisingly close to 25-year norms. Some factors are rich (notably, defensive stock strategies) but not off-the-chart, while others are on the cheap side.
- Second, contrarian factor timing or rotation using such valuation signals has been surprisingly ineffective in the past. At least three reasons contribute: (i) factor portfolios have evolving constituents, and timing a "moving target" is harder; (ii) contrarian factor timing strategy is itself correlated with static value; and (iii) it is especially hard to improve on the performance of a strategically diversified multi-factor portfolio that already includes value (diversification trumps timing).

Cash

The prospects for 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%, though rising slightly and becoming more uncertain following the result of the presidential election. Even though the Federal Reserve is the only major central bank in a policy tightening mode, it expects

they may have different levels of tracking error. Beyond the strategy design, implementation efficiency and fees affect net expected returns.

[11] The assumed 2% excess return over the market assumes a tracking error of 4% and net information ratio of 0.5.

[12] 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 assumptions, which we believe are plausible and conservative. All assumptions are purely illustrative and do not represent any AQR product or strategy.

[13] Diversification from combining low correlated premia boosts Sharpe ratios by reducing portfolio volatility. To achieve a target volatility near 10%, leverage of around 4x in each the long and short side may be required. Diversification does not eliminate the risk of experiencing investment losses. Hypothetical performance results have certain inherent limitations, some of which are disclosed in the back.

[14] For now, we refer to Arnott et al (2016a and 2016b) and Asness (2016a and 2016b).

to act slowly and keep real policy rates negative still at the end of 2017. The European Central Bank and the Bank of Japan intend to continue quantitative easing amid very low inflation and negative nominal and real short-term rates. In Europe and Japan it is conceivable that real policy rates stay negative over our forecast horizon.

Conclusion

This report details improvements to our return estimates for equities, and updates estimates for several other asset classes and sources of return.

By adopting a net total payout model for equity returns, we use a model that is independent of payout policy, and thus more comparable across countries. The net payout model is better suited to the growing use of share repurchases in place of dividends, unlike the traditional DDM which underestimates returns if dividend yields are used with historical per-share growth rates.

The investment environment remains challenging. Most asset classes do have positive expected real returns, which is more than can be said for cash. However, for the two asset classes where we have century-long histories, current expected real returns are well below the median level since 1900 (which was 6.2% for U.S. equities and 2.7% for U.S. Treasuries)[15].

Long/short style premia offer the advantage of being relatively insensitive to the riskless real yields which serve as (part of) discount rates for all long-only assets. The richness of long-only assets need not carry over to long/short strategies and the latter may be less vulnerable to any increases in real yields.

It bears stressing that the message we take away from all the above is not to time the market aggressively[16] but to make sure to use reasonable (i.e., lower) expectations for asset class returns, and diversify as much as constraints permit across many sources of expected returns.

---

[15] Estimated using adjusted Shiller EP for the S&P 500 and real bond yield (nominal yield – expected inflation) for U.S. Treasuries.
[16] See Asness, Ilmanen, and Maloney (2016).

Appendix: Revisions to Our Methodology for Equity Expected Returns

In this section, we provide more specific details on our methodology. For the subset of readers who would like to peruse the topic in even greater depth, we also provide an expanded technical appendix available online that presents the underlying theory and practical guidance on building such estimates.

First we explain our motivation for revising our equity expected returns methodology. There is clear evidence that many U.S. firms have replaced dividend payouts with share buybacks, following the SEC rule 10b-18 in 1982 that paved the way for companies to conduct share buybacks without suspicions of price manipulation. Other reasons for the growing use of buybacks include tax advantages and corporate signaling benefits. We have seen a clear decline in dividend yield and an increase in buyback yield since the 1980s. Thus, unless a model is inherently independent of payout policy, failure to account for these structural changes may make it less comparable across regimes and countries. Next, we describe the modifications to each of our methods.

1. Earnings yield (E/P)

To recap our former methodology, we use the Shiller E/P ratio which compares a 10-year average of earnings (each year's earnings scaled to today's prices using the CPI), with today's equity prices. While this variant is smoother, it leaves us with the problem that the "Shiller earnings" are, on average, 5 years stale compared to current earnings. the long-run real growth rate of earnings in the U.S. has been 1.5%. Hence, we scale up the Shiller earnings yield for each country by 1.075 to account for the fact that for a series that grows at 1.5% annually, the 10-year average will be understated by 7.5% (5 years with a 1.5% growth rate).

The E/P ratio embeds some implicit mix of dividend payouts and the growth rate of retained earnings (as explained in the technical appendix). Our revised method makes this mix explicit by assuming a constant dividend payout ratio and a constant earnings growth rate. In our new method, dividend yield is approximated by 50% of the Shiller E/P, and plugged into the DDM with a real growth rate of 1.5%. The new method applies the U.S. long-run average payout ratio of 50% to all developed countries as well as the U.S. long-run EPS growth arte of 1.5% (except for emerging markets where we assume 2%).

2. DDM yield

Our former approach was the classic DDM, $E(r) \approx$ DY+g, where we use country-specific estimates of DY and g. The DDM may underestimate equity returns if current low dividend yields (that do not capture the total payout to shareholders) are used together with historical realized per-share growth rates (that underestimate forward-looking per-share growth by missing the impact of lower share count due to buybacks). We adopt the Net Total Payout model of stock returns as presented in Ibbotson-Straehl (2016) and used by Grinold, Kroner and Siegel (2011) to forecast equity market returns.

Net Total Payout Model Methodology

As explained in the technical appendix, assuming no repricing of valuation multiples, the Net Total Payout model defines expected real equity return approximately as

$$E(r) \approx NTY + g_{TPagg}$$

where NTY = net total payout yield and g_{TPagg} = growth in real aggregate total payouts

Net Total Payout Yield

We construct NTY on the lines of Boudukh et al (2007) and Ibbotson-Straehl (2016), as a sum of the dividend yield and the net buyback yield. We define net buyback yield for a stock as the (negated) monthly change in shares outstanding times the share price, divided by the monthly market capitalization, and aggregate this to the equity index level using index constituent weights. Just as with the Shiller CAPE, we smooth cyclical variations in buybacks and issuance, by normalizing 10-year averages of net buybacks (scaled by the CPI to current price levels) by current prices. We add this to current dividend yield to get NTY.

Growth in Aggregate Total Payouts (g_{TPagg})

The NTY approach involves the use of aggregate earnings growth, while the classic DDM approach involves the use of per-share earnings growth. We estimate growth in aggregate total payouts for each developed country using the average of two approaches. The first is a top-down, forward-looking approach: we use consensus forecast long-term growth in real aggregate GDP as a proxy for the long-term growth in real total payouts. The second is a bottom-up, historical-based approach that starts with the realized long-term growth in real EPS of the equity indices since 1970. Assuming a constant payout ratio, per-share growth in EPS equals per-share growth in payouts. To convert this per-share growth in payouts to aggregate growth in payouts, we add an estimate of *dilution,* proxied by U.S. long-term realized equity dilution (1.6%). We shrink both the aggregate GDP growth and the EPS growth estimates towards cross-country averages.

Putting It All Together

Exhibit A1 provides more detail on the building blocks behind the expected return estimates in Exhibit 3.

Exhibit A1 | *Building Expected Real Returns for Equity Markets*

	Earnings-Yield Based			Dividend Discount Model Based					Combined
	E/P	g (EPS)	0.5 * E/P + g(EPS)	DY	NBY	GP	GG	DDM = DY+NBY +avg(GP,GG)	Avg (E/P Based , DDM Based)
	Adj. Shiller Earnings Yield	g(EPS)	EP Based E[r]	Div. Yield	10y Cycl. Adj. Net Buyback Yield	Long-Term Historical Real Payout Growth	Long-Term Forecast GDP Growth	DDM Based E[r]	Expected Real Equity Return
U.S.	4.3%	1.5%	**3.7%**	2.1%	0.1%	3.3%	2.0%	**4.8%**	**4.2%**
Euro-5	5.8%	1.5%	**4.4%**	3.2%	-0.4%	3.2%	1.7%	**5.2%**	**4.8%**
Japan	4.3%	1.5%	**3.7%**	2.0%	0.0%	3.1%	1.3%	**4.2%**	**3.9%**
U.K.	6.2%	1.5%	**4.6%**	4.0%	-0.3%	2.7%	1.9%	**6.0%**	**5.3%**
Australia	5.9%	1.5%	**4.5%**	4.1%	-1.1%	3.1%	2.3%	**5.8%**	**5.1%**
Canada	5.0%	1.5%	**4.0%**	2.7%	-1.6%	3.0%	1.9%	**3.6%**	**3.8%**
Global Devlpd.	4.7%	1.5%	**3.8%**	2.4%	-0.1%	3.2%	1.9%	**4.9%**	**4.4%**
Global Dev. ex US	5.4%	1.5%	**4.2%**	3.0%	-0.5%	3.0%	1.7%	**5.0%**	**4.6%**
Emerging Mkts	8.7%	2.0%	**6.4%**	2.5%			*2%**	**4.5%***	**5.4%**

*For emerging markets, our DDM estimate is dividend yield plus forecast GDP growth *per capita*. The growth estimate 2% is thus not comparable to other markets.

Source: AQR, Consensus Economics and Bloomberg. Return assumptions and methodology are subject to change and based on data as of December 31, 2016. 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_{TPagg}. 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 DDM estimates, all countries are based on corresponding MSCI indices. "Global Developed" is a cap-weighted average of the developed market estimates. Hypothetical performance results have certain inherent limitations, some of which are disclosed in the back.

References

AQR Alternative Thinking, First Quarter 2014, "Capital Market Assumptions for Major Asset Classes."

AQR Alternative Thinking, First Quarter 2015, "Capital Market Assumptions for Major Asset Classes."

AQR Alternative Thinking, First Quarter 2016, "Capital Market Assumptions for Major Asset Classes."

Arnott, R., N. Beck, V.Kalesnik, and J. West, 2016a, "How Can "Smart Beta" Go Horribly Wrong?", Research Affiliates whitepaper.

Arnott, R., N. Beck, and V.Kalesnik, 2016b, "To Win with "Smart Beta" Ask If the Price Is Right", Research Affiliates whitepaper.

Asness, C., 2016a, "The Siren Song of Factor Timing", *The Journal of Portfolio Management*, 42(5), 1-6.

Asness, C., 2016b, "My Factor Philippic", working paper.

Asness, C., A. Ilmanen, and T. Maloney, 2016, "Market Timing: Sin A Little," AQR whitepaper.

Bank for International Settlements, Annual Report 2016.

Boudukh, J., R. Michaely, M. Richardson, and M.R. Roberts, 2007, "On the Importance of Measuring Payout Yield: Implications for Empirical Asset Pricing", *The Journal of Finance,* 62, 877-915.

Giesecke, K., F.A. Longstaff, S. Schaefer, I. Strebulaev, 2011, "Corporate bond default risk: a 150 year perspective," *The Journal of Financial Economics*, 102, 233-250.

Grinold, R.C., K.F. Kroner, and L.B. Siegel, 2011, "A Supply Model of the Equity Premium", in *Rethinking the Equity Risk Premium,* edited by B. Hammond, M. Leibowitz, and L. Siegel, Research Foundation of CFA Institute.

Ibbotson, R.G., and P.U. Straehl, 2016, "The Supply of Stock Returns: Adding Back Buybacks", working paper.

Ilmanen, A., 2011, *Expected Returns,* Wiley.

Levine, A., Y.H. Ooi, and M. Richardson, 2016, "Commodities for the Long Run", working paper.

Disclosures

Performance of all cited indices is calculated on a total return basis with dividends reinvested. 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 FTSE 100 Index is an index composed of the 100 largest companies by market capitalization listed on the London Stock Exchange.

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.

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 Bloomberg Barclays US Corporate Bond Index measures the USD-denominated, investment-grade, fixed-rate, taxable corporate bond market.

The Bloomberg Barclays US Corporate High Yield Index measures the USD-denominated, high yield, fixed-rate corporate bond market. Securities are classified as high yield if the middle rating of Moody's, Fitch and S&P is Ba1/BB+/BB+ or below.

The Bloomberg Barclays Emerging Markets Hard Currency (USD) Sovereign Index is an Emerging Markets debt benchmark that includes USD denominated debt from sovereign EM issuers.

The NCREIF Property Index measures the performance of real estate investments on a quarterly basis and evaluates the rate of returns in the market. The NPI covers properties that are acquired in place of institutional investors that are exempted from taxes in the fiduciary environment.

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.

Note to readers in Australia: AQR Capital Management, LLC, is exempt from the requirement to hold an Australian Financial Services License under the Corporations Act 2001, pursuant to ASIC Class Order 03/1100 as continued by ASIC Legislative Instrument 2016/396, ASIC Corporations (Amendment) Instrument 2021/510 and ASIC Corporations (Amendment) Instrument 2022/623. AQR is regulated by the Securities and Exchange Commission ("SEC") under United States of America laws and those laws may differ from Australian laws. **Note to readers in Canada:** This material is being provided to you by AQR Capital Management, LLC, which provides investment advisory and management services in reliance on exemptions from adviser registration requirements to Canadian residents who qualify as "permitted clients" under applicable Canadian securities laws. No securities commission or similar authority in Canada has reviewed this presentation or has in any way passed upon the merits of any securities referenced in this presentation and any representation to the contrary is an offence. **Note to readers in Europe:** AQR in the European Economic Area is AQR Capital Management (Germany) GmbH, a German limited liability company (Gesellschaft mit beschränkter Haftung; "GmbH"), with registered offices at Maximilianstrasse 13, 80539 Munich, authorized and regulated by the German Federal Financial Supervisory Authority (Bundesanstalt für Finanzdienstleistungsaufsicht, „BaFin"), with offices at Marie-Curie-Str. 24-28, 60439, Frankfurt am Main und Graurheindorfer Str. 108, 53117 Bonn, to provide the services of investment advice (Anlageberatung) and investment broking (Anlagevermittlung) pursuant to the German Securities Institutions Act (Wertpapierinstitutsgesetz; "WpIG"). The Complaint Handling Procedure for clients and prospective clients of AQR in the European Economic Area can be found here: https://ucits.aqr.com/Legal-and-Regulatory. **Note to readers in Asia:** This presentation may not be copied, reproduced, republished, posted, transmitted, disclosed, distributed or disseminated, in whole or in part, in any way without the prior written consent of AQR Capital Management (Asia) Limited (together with its affiliates, "AQR") or as required by applicable law. This presentation and the information contained herein are for educational and informational purposes only and do not constitute and should not be construed as an offering of advisory services or as an invitation, inducement or offer to sell or solicitation of an offer to buy any securities, related financial instruments or financial products in any jurisdiction. Investments described herein will involve significant risk factors which will be set out in the offering documents for such investments and are not described in this presentation. The information in this presentation is general only and you should refer to the final private information memorandum for complete information. To the extent of any conflict between this presentation and the private information memorandum, the private information memorandum shall prevail. The contents of this presentation have not been reviewed by any regulatory authority in Hong Kong. You are advised to exercise caution and if you are in any doubt about any of the contents of this presentation, you should obtain independent professional advice. AQR Capital Management (Asia) Limited is licensed by the Securities and Futures Commission ("SFC") in the Hong Kong Special Administrative Region of the People's Republic of China ("Hong Kong") pursuant to the Securities and Futures Ordinance (Cap 571) (CE no: BHD676). AQR Capital Management (Asia) Limited Unit 2023, 20/F, One IFC, 1 Harbour View Street, Central Hong Kong, Hong Kong Licensed and regulated by the Securities and Futures Commission of Hong Kong (CE no: BHD676). **Note to readers in Singapore:** This document does not constitute an offer of any fund which AQR Capital Management, LLC ("AQR") manages. Any fund that this document may relate to and any fund related prospectus that this document may relate to has not been registered as a prospectus with the Monetary Authority of Singapore. Accordingly, this document and any other document or material in connection with the offer or sale, or invitation for subscription or purchase, of shares may not be circulated or distributed, nor may the shares be offered or sold, or be made the subject of an invitation for subscription or purchase, whether directly or indirectly, to persons in Singapore other than (i) to an institutional investor pursuant to Section 304 of the Securities and Futures Act, Chapter 289 of Singapore (the "SFA")) or (ii) otherwise pursuant to, and in accordance with the conditions of, any other applicable provision of the SFA. **Note to readers in Korea:** Neither AQR Capital Management (Asia) Limited or AQR Capital Management, LLC (collectively "AQR") is making any representation with respect to the eligibility of any recipients of this document to acquire any interest in a related AQR fund under the laws of Korea, including but without limitation the Foreign Exchange Transaction Act and Regulations thereunder. Any related AQR fund has not been registered under the Financial Investment Services and Capital Markets Act of Korea, and any related fund may not be offered, sold or delivered, or offered or sold to any person for re-offering or resale, directly or indirectly, in Korea or to any resident of Korea except pursuant to applicable laws and regulations of Korea. **Note to readers in Japan:** This document does not constitute an offer of any fund which AQR Capital Management, LLC ("AQR") manages. Any fund that this document may relate to has not been and will not be registered pursuant to Article 4, Paragraph 1 of the Financial Instruments and Exchange Law of Japan (Law no. 25 of 1948, as amended) and, accordingly, none of the fund shares nor any interest therein may be offered or sold, directly or indirectly, in Japan or to, or for the benefit, of any Japanese person or to others for re-offering or resale, directly or indirectly, in Japan or to any Japanese person except under circumstances which will result in compliance with all applicable laws, regulations and guidelines promulgated by the relevant Japanese governmental and regulatory authorities and in effect at the relevant time. For this purpose, a "Japanese person" means any person resident in Japan, including any corporation or other entity organised under the laws of Japan. **Note to readers in United Kingdom:** This material is being provided to you by AQR Capital Management (Europe) LLP, a UK limited liability partnership with its office at Charles House 5-11, Regent St., London, SW1Y 4LR, which is authorised and regulated by the UK Financial Conduct Authority ("FCA"). **Note to readers in Dubai:** AQR Capital Management (Europe) LLP (DIFC Representative Office) is regulated by the Dubai Financial Services Authority of the Dubai International Financial Centre as a Representative Office (firm reference number: F007651). Its principal place of business is Unit 34, Level 12, The Gate Building, DIFC, Dubai.

AQR Capital Management, LLC
Two Greenwich Plaza, Greenwich, CT 06830
p: +1.203.742.3600 I f: +1.203.742.3100 I w: aqr.com