Alternative Thinking

Capital Market Assumptions for Major Asset Classes

This issue presents our capital market assumptions for major asset classes. Our primary aim is to explore justifiable frameworks for estimating multi-year expected returns, which investors may then develop or adapt according to their beliefs.

We focus on stock markets and government bonds, but also briefly discuss other assets and strategies.

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

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

First Quarter 2014

Executive Summary

- Investors often need to construct estimates of long-term expected returns for major asset classes. We discuss our take on *how* to do this, highlighting key inputs and the issues associated with them. The main goal is to provide frameworks which investors may adapt according to their own views.
- We focus on stock markets and government bonds, but also look beyond them. Yield-based estimates are often the best starting point, supplemented by considerations of historical average returns and finance theory.
- Our current estimate for U.S. stocks' long-run real return is 4%, lower than in European and emerging markets. Our current estimate for U.S. 10-year government bonds' long-run real return is 1.4%, higher than in many other countries.

Introduction and Framework

This *Alternative Thinking* presents our capital market assumptions for major asset classes. Capital market assumptions are typically made on expected returns and risks. We focus here on multi-year expected returns[1] of stock markets and government bonds, but also briefly discuss other assets and strategies.[2] While we provide point estimates for expected returns, they come with significant uncertainty. Indeed, the frameworks we discuss for how to make such estimates are perhaps more important than the numbers themselves. Here we present expectations for real (inflation-adjusted) annual compound rates of return; the same views for arithmetic nominal mean returns could be 3-5 percentage points higher, an issue we describe in the appendix.

Our return assumptions are made for 5-10 -year horizons.[3] Over such intermediate horizons, initial market yields and valuations are typically the most important inputs. More generally, we argue that expected return assessments should rely on three anchors – current market conditions, historical average returns and finance theory – exploiting our knowledge of each, without being overly dependent on any one. Horizon matters. For extremely long forecast horizons (say, decades), the impact of current market conditions is diluted, so theory and historical average returns matter more. For short horizons (say, some months), returns are largely unpredictable but any predictability mainly reflects market conditions. Momentum and macro environments dominate at such short horizons but tend to wash out at intermediate horizons, leaving value and carry (initial yield) as the best predictors.

Market yields are a good starting point but not the final determinant. Higher yields always reflect some mixture of higher required returns (which we would seek to capture as they tend to predict higher future returns) and market expectations of yield or price moves causing capital losses that offset the initial carry advantage (this part we would like to filter out). For example, abnormally high equity yields in one country can reflect market expectations of abnormally slow future growth instead of high demanded equity premia. For government bonds, abnormally steep yield curves may reflect market expectations of fast rate rises instead of high required bond returns. For credits, abnormally wide spreads could reflect market expectations of larger default and downgrade losses instead of high required credit returns. However, empirically we have found that carry has tended to be a good predictor of future excess returns in all asset

[1] Volatilities and correlations are relatively easier to forecast – both over short and long horizons – than returns because they are more persistent. We may discuss risk assumptions in other reports.

[2] See Ilmanen *Expected Returns* (2011), especially the Foreword and Chapters 1, 8, 9 and 21, as well as *Alternative Thinking* April 2013. Note that the capital market assumptions published here are not directly used in AQR's strategies. We do not have one "house view" and if we did it would have limited impact on most funds that emphasize diversification across many cross-sectional opportunities. These are also not set in stone, as our assumptions may evolve with market conditions and be refined based on new research.

[3] Why not make more tactical forecasts? They require even greater humility than long-term forecasts. Empirically, short-term predictability of asset returns is limited and timing bets are highly concentrated. (We make implicit forecasts given tactical tilts in several AQR strategies, but we think the main risk is taken in strategic allocations.)

Exhibit 1 | *Building expected returns for equity markets*

	E	DY	G	DDM=DY+G	avg(E,DDM)
	Adj. Shiller Earnings Yld	Dividend Yield	Earnings Growth Est.	DDM Yield	Real Equity Yield
U.S.	4.4%	1.8%	1.8%	3.6%	**4.0%**
Euro-5	6.8%	3.0%	1.6%	4.6%	**5.7%**
Japan	3.9%	1.4%	1.6%	3.0%	**3.5%**
U.K.	6.5%	3.3%	1.8%	5.1%	**5.8%**
Australia	6.0%	3.7%	1.9%	5.5%	**5.8%**
Canada	5.1%	2.7%	1.7%	4.3%	**4.7%**
Emerging-5	7.2%	2.7%	2.8%	5.5%	**6.3%**

Source: Bloomberg, Consensus Economics and AQR. Estimates as of December 31, 2013. "Euro-5" is a GDP-weighted average of Germany, France, Italy, the Netherlands and Spain; "Emerging-5" is a simple average of China, South Korea, Taiwan, Brazil and South Africa. Return assumptions are subject to change.

classes.[4] Thus, we make only modest adjustments to initial market yields.

Short-term realized performance can, as 2013 demonstrated, deviate hugely from our best guesses at long-term expectations, but this does not necessarily prove those expectations invalid. Even if we correctly forecast a moderately higher long-term return for one market than another, volatility ensures that the more attractive market may likely underperform in, say, 4 years out of 10. Long-term expected return estimates are nevertheless useful and often required of investors.

Equity Markets

We measure the expected real return on various equity markets by averaging two common approaches:

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. Many industry participants favor forward-looking operating earnings but these are often overoptimistic. We prefer trailing, as-reported earnings but use multi-year averages to smooth the excessive cyclicality in annual earnings. Thus, we like the Shiller E/P ratio which compares 10-year average (real) earnings with today's (real) equity prices.[5]
2. **DDM yield:** According to the dividend discount model (DDM), the expected real return on equities is a sum of dividend yield (DY), expected trend growth in real dividends or earnings per share (G), and expected change in valuations (ΔV), that is: DY+G+ΔV.[6] We use the first two terms – country-specific dividend yield and country-specific real growth rate – but assume no mean reversion in valuations.

Both approaches (and thus the average, our bottom line) currently point to an expected real return near 4% in the U.S and Japan, and closer to 6% in emerging markets, Europe and Australia, as shown in **Exhibit 1**.[7] Historical context for these four markets is shown in **Exhibit 2**.

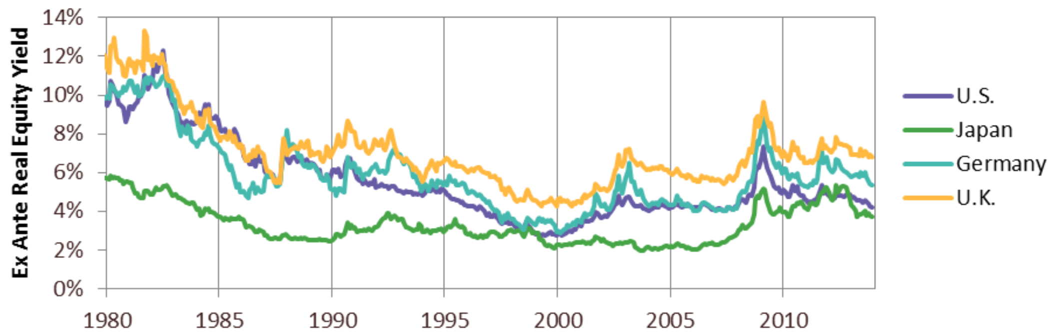
[4] Ilmanen (2011), chapters 13 and 22; and "Carry" by Koijen, Moskowitz, Pedersen, Vrught (2013).

[5] Our adjusted Shiller E/P scales up the normal Shiller E/P by 1.075 to correct for the fact that the 10-year average of a series that grows over time will systematically underestimate its current value (here we assume a trend annual growth rate of 1.5% in real earnings per share and a 5-year average "staleness" to current earnings: 1.5% x 5 = 7.5%). We use this simple 1.075 scalar even if we assume a slightly different growth in earnings per share for some countries.

[6] This approximate relation can also be expressed in nominal terms by adding (expected) inflation to equity returns on the left-hand side and to dividend growth on the right-hand side. The relation also applies to realized returns and allows an insightful decomposition of historical average stock market returns.

[7] These are local real returns. To convert these to the expected returns seen by a foreign investor, we must first correct for any difference in expected inflation in the two countries, and then correct for the expected cash rate differential (if hedged) or the expected exchange rate return (if

Exhibit 2 | *Historical context: ex-ante real equity yields 1980-2013*



Source: Bloomberg, Consensus Economics and AQR. Return assumptions are subject to change.

Key questions: The DDM framework may be especially useful for investors who want to use their own inputs in capital market assumptions. Each of the three building blocks of real equity returns can be debated:

- Yield, DY, is naturally proxied by the dividend yield. But since especially in the U.S., firms have partly replaced dividends with share buybacks, some observers suggest using a buyback-adjusted dividend yield or adding, say, 0.5% to dividend yields to capture this effect. A counterargument is that the relevant adjustment is net buybacks, which have averaged less than zero even in recent decades (as gross share issuance has exceeded gross buybacks).
- Growth, G, (more specifically, the trend real growth in dividends per share (DPS) or earnings per share (EPS)) could be assumed to be constant, say, 1.5% per annum, loosely based on the post-WWII evidence in the U.S.[8] It is a common error to assume too high G, as many investors do not realize that long-run EPS growth has persistently lagged GDP growth (and lagged even more the optimistic analyst forecasts of earnings growth). We discuss G further below.
- Change in Valuations, ΔV, is hardest to predict accurately. We would rather assume zero ΔV unless current valuations are unprecedented, such as during the tech bubble. Equity market valuations do tend to exhibit slow mean reversion, but it is plausible that Shiller P/E ratios could remain at the elevated levels of the past 20 years, especially if bond yields and inflation rates remain relatively benign. Assuming mean reverting valuations would tend to compound the return impact of abnormally high (or low) initial yields by assuming further capital gains (or losses) when yields revert to 'normal' levels.[9]

Focus on G: We allow *some* country-specific variation in G guided by real GDP-per-capita growth data.[10] Our latest bottom-line G estimate is near

unhedged). For many developed markets these corrections may be small.

[8] Longer histories point to lower estimates, more recent histories to higher estimates. Dividend growth rates and international evidence point to slightly lower estimates. See Ilmanen (2011, ch. 8 and 16, and references therein).

[9] As we assume no mean reversion in valuation ratios (except maybe at extreme conditions) we are less bearish than observers who expect Shiller P/Es to revert to their long-run mean near mid-teens. We thus predict about 4% real annual return for U.S. equities instead of near zero (the prediction if one assumes both low starting yields and capital losses from normalizing valuations). On the other hand, we are less bullish than observers who use valuation ratios based on analyst forecasts of pro-forma earnings; these are available only since 1980s and are upward-biased for many reasons. Another key debating point is that according to some bullish commentators, changing accounting regulations have made reported earnings more conservative in the past decade, whereas some bearish commentators claim that firm managements have become more incentivized to boost and smooth earnings (and pro-forma earnings give them more room to do this). It is hard to empirically judge the net impact of such changes, so we like our position between either extreme view.

[10] We start with a survey forecast of next-decade average real GDP growth (published by Consensus Economics), subtract a slow-moving measure of the population growth rate in each country, and then "shrink", or adjust, each country's estimate halfway toward a cross-country average (near 2%).

1.8% for the U.S. and the developed markets average, and near 2.8% for the emerging markets average. These are slightly below historical average G estimates since 1990 (2.0% for the U.S., 2.1% for developed and 3.1% for emerging).

- We recognize that GDP growth does not translate directly to corporate profits or earnings growth, which partly motivates incorporating a cross-country average.[11]
- GDP-per-capita growth is conceptually closer to EPS and DPS growth than is GDP growth, and long-run historical growth rates are more similar after subtracting population growth. We tend to anchor our G estimates to the long-run U.S. experience (near 1.5% for real EPS), but we allow here slightly higher anchors (near 2%), justified by the growing use of share buybacks or by faster earnings growth in recent decades.

Most earnings yield and DDM-based estimates of prospective real equity returns are in the same ballpark with each other (4-6%) and only mildly below long-run historical returns. More bullish views tend to rely on optimistic G estimates, while more bearish predictions emphasize mean-reverting (lower) valuations.

Government Bonds and Cash

We turn next to government bonds that are generally deemed to be default-free.[12] For fixed coupons and maturity value, bonds only suffer from interest rate risk (their price varies inversely with market yield changes). Government bonds' prospective nominal returns, especially over long horizons, are strongly anchored by their yields. To assess prospective real returns, we can subtract a (say, survey-based) measure of expected inflation from nominal bond yields.[13]

What adjustments might one make to these yield-based estimates? It boils down to reasonable expectations of future yield changes.[14] Three possible base cases are that the yield curve is expected to stay unchanged, or shift to the levels implied by the forwards, or revert to their historical average levels.

- Using an unchanged yield curve as the base case is equivalent to assuming random walk behavior in yields. If the yield curve is upward-sloping (as it normally is), this implies rolldown gains when bond yields fall simply due to their ageing (as they roll down the unchanged curve). Expected returns then exceed the yield. For example, the 10-year Treasury with its current yield of 3.0% and 20bp annual rolldown has an expected annual (nominal) return of 4.6%, given an unchanged curve. This would also be the expected annual return of a multi-year constant-maturity 10-year strategy.
- Using the implied forward yield curve as the base case means that each bond should earn the same return as the horizon-matching riskless asset. (This is by construction: forward yields are calculated as break-even future yields that would exactly offset any bond's initial yield (carry) advantage over the riskless asset with same-sized capital losses.) For example, if the 10-year Treasury yield over the next five years rises from 3.0% to 4.3%, as forwards imply, long-term Treasuries should earn the same annual return (1.3%) as the 5-year Treasury. Thus a scenario where forwards are realized is a neutral

[11] This "shrinkage" is a compromise between in our opinion two faulty views: using the same G for all countries versus using country-specific GDP growth forecasts. Relying fully on the latter would be misleading: while emerging economies have experienced significantly faster GDP growth in recent decades than developed economies, emerging markets do not tend to have a similar edge in DPS or EPS growth or in equity returns.

[12] We will not analyze bonds in countries like Greece and Italy where default risks (or Eurozone breakup risks) add meaningful 'credit' spreads to sovereign yields. For G-3 country bonds, these effects are deemed minimal (as countries with their own printing press are thought more likely to resort to inflation and financial repression than to defaults). Still, some critics argue that such thinking may be careless as CDS spreads even for these countries have occasionally widened in recent years.

[13] We could also study directly the (real) yields of inflation-linked bonds, which are sometimes contaminated by some illiquidity or other premia. Our yield forecasts for inflation-linked bonds are close to our real return forecasts for nominal bonds.

[14] Capital gains (losses) caused by yield declines (increases) are well approximated by the product of (minus) bond duration and the yield change. Over short horizons these capital gains or losses often dominate bond return fluctuations, but over long horizons their (pro-rated) impact on annual returns tends to be more modest.

one where neither bond bulls nor bears (duration longs or shorts) outperform cash.

- Using the mean reversion assumption, bond yields will rise to their historical average yields. Specific models or assumptions are needed to determine the mean reversion speed and mean level (how long a historical window?). A quick reversion to 5% or higher mean yields (without time to benefit from the positive carry implied in the steep yield curve) would be a bond-bearish scenario. A more gradual reversion, or a mean yield below forwards, would be a bond-bullish scenario despite rising yields.

Which of these base cases is best supported by empirical evidence? In our view the first one of an unchanged yield curve (random walk): steeper yield curves have predicted higher bond returns as bonds have tended to retain their carry and rolldown advantage. A purely evidence-based observer would be bond-bullish and only tilt expected bond returns higher due to rolldown gains. Yields have historically shown little tendency to shift toward forward-implied yields or to revert toward long-run mean yield levels. The latter idea has especially missed the mark in the past century, which has been rather characterized by "mean-averting" tendencies in nominal yields due to some persistent up- and down-trends in inflation rates. Real yields have exhibited clearer mean-reversion tendencies.

Given that current real yields are still abnormally low (in many countries negative, especially at short maturities), it seems reasonable to assume some normalization. Moreover, not just market forwards but also economist survey consensus as well as central bank projections predict rising real and nominal rates from the partly-artificially low levels caused by QE. Assuming an unchanged yield curve would not be consistent with the survey and policymaker forecasts of rising rates.[15]

One approach to building an expected return estimate is to start with the yield of a constant-maturity portfolio (Y), add on the rolldown gains in an unchanged yield curve scenario (RR), but then add the return impact of assuming that yields will rise halfway toward levels implied by forwards over the next five years (FΔY). For example, if the 10-year Treasury yield were to rise from 3.0% to 3.7%, halfway toward the forward-implied 4.3%, a 10-year constant maturity strategy should earn 3.6%.[16]

We use these estimates as a baseline in **Exhibit 3** but concede that they depend on the yield view and are approximate. Readers can weigh differently the effects of roll-down and (their own) yield outlook. For judging prospective bond returns, we believe the key question is the net tilt away from current bond yields – is it toward higher returns thanks to rolldown gains in an unchanged steep curve scenario or toward lower returns due to (mean-reversion or macro-based) expectations of rising yields?

It is important to note that we quoted *nominal* returns throughout this section. Expected real returns would be about 2.2% lower given consensus forecasts of U.S. long-term inflation: 3.6% - 2.2% = 1.4%, as shown in **Exhibit 3**. The expected real return on long Treasuries is historically low but not extreme (near 10th percentile over the past century), and easily exceeds the expected real return on cash (T-bills). Bonds may be expensive but cash is more expensive.

[15] If yield levels were not exceptionally low from a historical perspective we would not assume the mean-reversion (rising yield) tendencies we assume now. At the same time, it is likely that the yield curve would not be as steep as it is today if there were not as obvious mean-reversion prospects.

[16] This 3.6% annual return reflects the approximate sum of three terms: 3.0% bond yield (Y), the 1.6% annual rolldown gains (RR ≈20bp x Dur 8), and the partly offsetting 1.0% annual capital losses caused by the gradual yield rises (FΔY ≈ 0.62% x Dur 8 / pro-rating 5 years).
The choice of yields rising halfway toward the forwards is an ad-hoc compromise. Future research may guide us to use (instead of this) survey-based or econometric estimates of future yield rises.

Exhibit 3 | *Building expected returns for government bonds*

	Y	RR	FΔY	I	Y+RR+FΔY-I
	10Y Nominal Govt. Yield	5Y Rolldown Return	Half Fwd-Imp Yld Chg Return	10Y F/C Inflation	Exp Real 10Y Bond Return
U.S.	3.0%	1.6%	-1.0%	2.2%	**1.4%**
Japan	0.7%	0.7%	-0.7%	1.4%	**-0.7%**
Germany	1.9%	1.1%	-1.0%	1.9%	**0.2%**
U.K.	3.0%	0.9%	-0.9%	3.3%	**-0.3%**
Australia	4.2%	0.8%	-0.9%	2.6%	**1.6%**
Canada	2.8%	1.5%	-0.7%	2.0%	**1.6%**

Source: Bloomberg, Consensus Economics and AQR. Estimates as of December 31, 2013. Return assumptions are subject to change.

T-bills: The prospects for cash returns depend on the expected path of inflation and of real cash rates. Long-term inflation expectations have been extremely well anchored. Economist forecasts in the U.S. have stayed in the narrow range between 2.1% and 2.7% for the past 15 years (now 2.2%), and market-based break-even inflation rates are also stable. A more imminent question is the pace at which real cash rates normalize from their exceptional negative levels (still below -1% in the U.S.). "Slowly", says the forward guidance from central banks, and we have little reason to doubt this. World economies and financial institutions do not appear ready yet for the medicine of steeply rising real yields, suggesting that a persistent low expected return environment may remain with us for several years. Interestingly, market forwards and economist expectations predict that real U.S. cash rates will normalize to above 1% (nominals to above 3%) by 2018, overall averaging about 0.2-0.6% for the next 5-10 years.[17]

[17] We can conceptually decompose the 10-year Treasury yield into three parts: average expected inflation and the average expected short-term real rate over the next decade, plus a required bond risk premium (or term premium). (The first two sum to the expected nominal cash rate, the latter two sum to the expected real bond yield.) We cannot observe these components directly but might estimate them with the help of survey data or term structure models (purely statistical models or macro finance models). We could use surveys if forecasts for the next decade were available both for the expected inflation and expected short-term rates. Alternatively, we could use macro-finance models whose assessments of the short-rate path is often based on Taylor rules which capture central bank policy reactions to different growth and inflation environments. Here we mix consensus forecasts of U.S. inflation with the Kim-Wright (2005) model estimates of forward rates, term premia and short-rate expectations (this model relies both on statistical estimates and survey data) which are regularly published on the Fed website.

The big picture, then, is that the real expected returns for U.S. assets over the next 5-10 years are just north of 0% for cash, above 1% for long-term Treasuries, and above 4% for equities. Broadly speaking, asset class prospects are similar for other countries, though in an international comparison U.S. prospective real returns are on the low side for equities and on the high side for bonds (see Exhibits 1-3). These yield- or value -oriented estimates have historically been reasonably good predictors of subsequent 5-10 -year returns. However, their predictive ability over short horizons – and thus market timing ability – is quite limited.

Other Investments

Credits

Traditionally, government bonds are deemed to offer riskless cash flows, while other bonds offer uncertain cash flows. We believe it is important to use option-adjusted spreads when analyzing corporate bonds with embedded (call/put/conversion) options or mortgage-backed securities with prepayment options. And even when a bond's cash flows are fixed, they are subject to default risk, which can only reduce future returns. Thus, the yields of such credit-risky bonds (or their yield spreads over duration-matched Treasuries) overstate the expected return (or excess return).

How much should we discount the spreads for expected credit losses? The empirical answer based on default data since 1970s is 'very little' for top-rated bonds and 'about half' for speculative-grade (junk) bonds. Note that because our forecast horizon is 5-10 years, we care less about the current cyclical conditions than short-horizon investors do.[18]

Commodity Futures

Unlike bonds and equities, commodities do not have obvious starting yields to use as anchors. Thus, historical average returns are a more important anchor (even though long commodity cycles may mean that average returns for individual decades vary significantly from a multi-decade average). To get a long-run return estimate for the asset class, we constructed an equally weighted index of commodity futures going back to 1947.[19] The simulated index earned a compound average excess return over cash of around 5% from 1947 to 2013, with a realized Sharpe Ratio of 0.38. Contrary to popular belief, virtually all of the excess return over this period has come from spot price changes and diversification gains, rather than futures roll returns. (This is also true for investors in the S&P GSCI index since 1970.)

Theoretical justifications for a positive reward for holding a commodity futures portfolio include a premium for producers' hedging demand (possibly attenuated by the increasing role of financial index investors), positive equity beta, growing scarcity of commodities, or so-called diversification return.[20]

Finally, we can study statistically the time series predictability of commodity returns, regressing a broadly diversified index's return on its carry (backwardation/contango), past momentum and long-run mean-reversion. We find less time-series than cross-sectional predictability. Over short horizons, carry and momentum have some timing ability, but over a five-year horizon, all three regression slope coefficients are insignificant (carry has the largest t-stat of 1.0, while the intercept has a t-stat near 3). Thus, tactical forecasts tied to current market conditions do not appear to predict long-term returns that meaningfully differ from the historical mean experience. However, given today's low real yields in other asset classes and the greater commodity demand by institutional investors, it may be reasonable to assume somewhat lower returns in the coming decade than in the past.

Illiquids

For illiquid alternative assets, expected returns are even harder to predict than for liquid asset classes. We leave their numerical analysis to a later date but make some comments. Besides a sometimes significant beta premium, we expect some positive illiquidity premium for such investments. However, we note that recent academic surveys[21] see the empirical record on such premia as weaker than many investors think, perhaps because investors

[18] There are many devils in the details which could point to lower estimates (see chapter 10 in Ilmanen 2011). Very long histories suggest higher default rates than those experienced in recent decades. Top-rated bonds have an asymmetric tendency to suffer downgrade losses versus upgrade gains. Times of historically narrow credit spreads may be followed by mean reversion and thus capital losses. Bond index investors have historically realized a surprisingly small fraction of yield spreads, partly because of their costly tendency to sell bonds (e.g., "fallen angels") soon after they leave the index. Trading costs on corporate bonds are not trivial. Finally, self-financed (levered) bond positions will need an option- and default-adjusted yield spread that exceeds the financing spread between credit-risky and government bonds, before they really offer a positive carry.

[19] This simulated index is rebalanced each month to equal nominal weights to ensure diversification; this approach is simple but consistent over time. The commodity universe grows from 3 in 1947 to over 20 by early 1990s.

[20] Diversification reduces portfolio volatility, which implies that a portfolio's compound return is higher than the weighted average compound return of its constituents. Diversification Return (DR) can be defined as the gap between a portfolio's compound return and its constituents' average compound return. Technically, DR boosts only compound returns (geometric means), not arithmetic means, because the former are penalized by high volatility or variance. (Geometric mean ≈ arithmetic mean return minus half the variance.) DR is most significant when portfolio constituents have high volatilities and low correlations, which makes commodity futures ideal beneficiaries. Even if each individual commodity has a zero expected compound return, a portfolio of them can have a significantly positive compound return. Indeed, between 1993 and 2012, the compound return across 23 major commodity futures averaged essentially zero over cash, while an equal-weighted portfolio of the same 23 commodity futures earned a compound return of 3.2% over cash.

[21] See, for example, De Jong and Driessen (2013) "The Norwegian Government Pension Fund's Potential for Capturing Illiquidity Premiums", at http://papers.ssrn.com/sol3/papers.cfm?abstract_id=2337939.

pay for the return-smoothing characteristics of slow marking to market. Moreover, volatility and Sharpe ratio assumptions are problematic for illiquid assets because of these return-smoothing effects.

Alternative Risk Premia

Alternative risk premia (dynamic long-short strategies in liquid assets, which we refer to as hedge fund premia and style premia) are not our focus here but we provide some general comments.

- Because such long-short strategies can be invested at any volatility level, we think 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.
- Again, we think that balancing historical evidence, theory and starting valuations is helpful. Because the portfolios are dynamic, starting valuations may be the least useful input, unless they are extreme.[22] Historical performance is the natural starting point but some skepticism is warranted. Such evidence should be supported by out-of-sample evidence, robustness over time and across asset classes, economically intuitive explanations, and manageable trading costs. Having reviewed these considerations, we believe in certain "tried and true" strategy styles – notably: value, momentum, carry, defensive – while being skeptical on more elaborate and perhaps over-fitted strategies.
- 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 on asset classes (0.2-0.4), but a diversified composite of alternative risk premia (multiple styles applied across multiple asset classes) can have ex-ante Sharpe ratios of 0.7-1.0, net of trading costs and fees. In contrast, very few long-only portfolios may reach realistic ex-ante Sharpe ratios of 0.5-0.6. For alternative risk premia portfolios, it is plausible to assume a higher Sharpe ratio thanks to more-effective diversification (enabled by the use of techniques such as leverage and shorting which can magnify any edge but which many investors are constrained from using), without assuming high standalone Sharpe ratios.

[22] We refer here to starting valuations of systematic strategies, not of assets. Indeed, the classic "value" long-short strategy involves buying cheap stocks (or other assets) against rich ones. One can track the relative cheapness of value stocks against other stocks – say, using price/book measures – to assess the tactical attractiveness of the value strategy (and apply similar measures to other assets and styles). However, empirical research shows limited return predictability based on such tactical signals. Style timing seems at least as difficult as market timing. Thus, we prefer strategic holdings in classic alternative risk premia, also because most investors are so "under-invested" in them despite their excellent diversifying characteristics and because tactical timing can easily degenerate into harmful multi-year return chasing.

Appendix: What Exactly Are We Forecasting?

When discussing capital market assumptions, we must be very precise in describing which measure of returns we have chosen, before explaining how we calculate its level. Too often, debates on expected returns are confused by two speakers agreeing in substance but talking about different measures. Some possible choices are illustrated in **Exhibit 4**.[23]

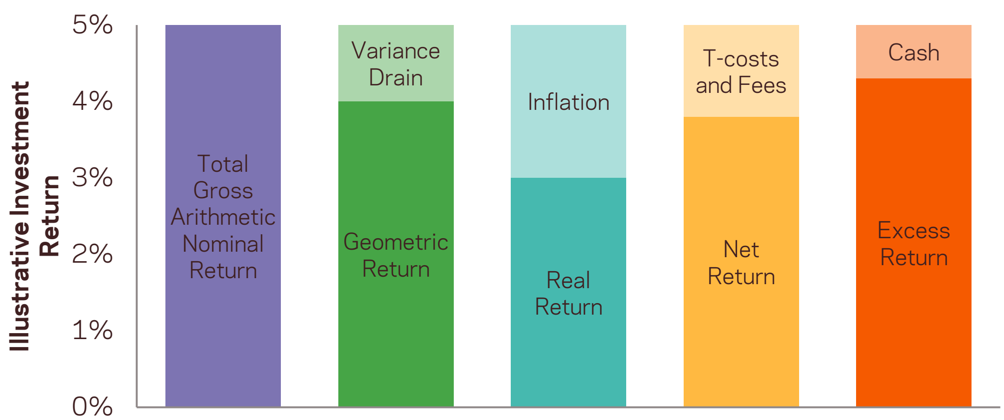
Excess returns over cash are especially useful because they represent the returns of long-short or futures investments[24] and they approximate well currency-hedged excess returns (we simply add local cash to them to get a currency-hedged return).

For simplicity, when assembling our estimates we ignore compounding and interaction effects [a+b rather than (1+a)(1+b)]. We also ignore the "diversification return" that contributes to portfolio geometric mean (GM) returns (arithmetic mean (AM) returns average across assets but GMs don't). Well-diversified portfolios can have higher risk-adjusted returns (GMs or Sharpe ratios) than, say, single asset class premia.

For scalable long-short strategies, we believe the most natural measure of expectation is the long-run Sharpe ratio. This can be multiplied by a target volatility to give the expected arithmetic excess return over cash. We can then adjust for cash income (to get total return), for inflation (to get real return), for fees (to get net return), or for "variance drain" (to get GM return[25]).

For passive stock and bond investments, liquidity and low turnover may enable institutional investors to access market exposure at negligible cost. For less liquid investments and dynamic strategies with higher turnover, both trading costs and fees are likely higher, so it is essential to distinguish between gross and net returns (and 'net of what?').

Exhibit 4 | *Investment returns can be expressed (and decomposed) in many ways*



Source: AQR. For illustrative purposes only.

[23] Of course the time period must also be clear; we present multi-year projections in terms of annual rates of return. This is what most studies do, though a few present cumulative multi-year returns or monthly average returns. Other possible distinctions besides those in Exhibit 4 are between income returns and capital gains/losses as well as between the returns on constant-notional and risk-targeted strategies.

[24] But note that only excess arithmetic returns can be fully scaled by leverage.

[25] The gap between AM and GM mean return is higher for more volatile assets; it is approximately 1.5-2% for assets with volatilities of 17-20% and 0.3-0.5% for assets with volatilities of 7-10%.

Disclosures

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 | f: +1.203.742.3100 | w: aqr.com