Better Diversification in the Low Expected Return World

Antti Ilmanen
Principal

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Today’s Presenter

Antti Ilmanen,  
Principal, Portfolio Solutions Group

Antti Ilmanen, a Principal at AQR, manages the Portfolio Solutions Group, which advises institutional investors and sovereign wealth funds, and develops AQR’s broad investment ideas. Before AQR, Antti spent seven years as a senior portfolio manager at Brevan Howard, a macro hedge fund, and a decade in a variety of roles at Salomon Brothers/Citigroup. He began his career as a central bank portfolio manager in Finland. Antti earned a Ph.D. in finance from the University of Chicago and M.Sc. degrees in economics and law from the University of Helsinki. Over the years, he has advised many institutional investors, including Norway’s Government Pension Fund Global and the Government of Singapore Investment Corporation. Antti has published extensively in finance and investment journals and has received the Graham and Dodd award and the Bernstein Fabozzi/Jacobs Levy award for his articles. His book Expected Returns (Wiley, 2011) is a broad synthesis of the central issue in investing. Antti recently scored a rare double in winning the best-paper and runner-up award for best articles published in 2012 in the Journal of Portfolio Management (coauthored articles “The Death of Diversification Has Been Greatly Exaggerated” and “The Norway Model”).
Low Expected Return World
21th Century Does Not Promise As High Returns As 20th Did

Forward-Looking Real Returns Are Low For Both Main Asset Classes

Expected Real Return of U.S. Stocks, Bonds and a 60/40 Portfolio
January 1900–December 2014

Today:
- Equity Real Yield: 3.7%
- Bond Real Yield: 0.2%

Versus History:
- Equity Real Yield:
  - 8th percentile: 3.7%
  - 4th percentile: 2.3%
- Bond Real Yield:
  - 1st percentile: 2.3%

Sources: AQR, Robert Shiller’s web site, Koizicki-Tinsley (2006), Federal Reserve Bank of Philadelphia, Blue Chip Economic Indicators, Consensus Economics. Stocks are represented by the Standard & Poor’s 500 Index since 1957, and bonds are represented by long-dated Treasuries. The 60/40 Portfolio is 60% Stocks and 40% Bonds. The equity yield is a 50/50 mix of two measures: 50% Shiller E/P * 1.075 and 50% Dividend/Price + 1.5%. Bond yield is 10 year real Treasury Yield over 10 year inflation forecast as in Ilmanen (2011). Scalars are used to account for long term real Earnings Per Share (EPS) Growth. 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. Past performance is not a guarantee of future performance. Please read important disclosures in the Appendix.
And It Is Not Just U.S. Stocks and Bonds…
Non-U.S. Stocks Somewhat Less Expensive, Non U.S. Bonds More Expensive

Expected Real Return of Non-U.S. Stocks and Bonds, and U.S. T-Bills
January 1980–December 2014

Sources: AQR, Robert Shiller’s web site, Kozicki-Tinsley (2006), Federal Reserve Bank of Philadelphia, Blue Chip Economic Indicators, Consensus Economics. The real equity yield is a 50/50 mix of two measures: 50% Shiller E/P * 1.075 and 50% Dividend/Price + long-term real earnings-per-share (EPS) growth estimate. The real bond yield is 10-year real Treasury Yield over 10-year inflation forecast as in Ilmanen (2011). The 1.075 scalar is used to account for long term real EPS growth. Non-U.S. equity and bond proxies are weighted 40% Japan, 40% Germany and 20% U.K. Expected real return for T-Bills is survey-based forecast of 10-year average T-Bill yield minus forecast 10-year inflation. 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. Past performance is not a guarantee of future performance. Please read important disclosures in the Appendix.
We believe useful 5-10 year equity market expectations can be built using some basic measures. Prospective real returns remain near 4% in the U.S.; higher in Europe and Emerging Markets.

### Estimating Long-Run Expected Real Returns on Stocks

#### “Real Yield” Estimates Averaged From Two Common Approaches

<table>
<thead>
<tr>
<th></th>
<th>Shiller-Based</th>
<th>Dividend Discount Model Based</th>
<th>Combination</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Adj. Shiller Earnings Yield</td>
<td>Dividend Yield + Earnings Growth Estimate</td>
<td>Real Equity Yield</td>
</tr>
<tr>
<td>U.S.</td>
<td>4.0%</td>
<td>1.9% + 1.8%</td>
<td>3.8%</td>
</tr>
<tr>
<td>U.K.</td>
<td>7.2%</td>
<td>3.6% + 1.6%</td>
<td>6.2%</td>
</tr>
<tr>
<td>Euro-5</td>
<td>6.8%</td>
<td>2.8% + 1.5%</td>
<td>5.5%</td>
</tr>
<tr>
<td>Japan</td>
<td>4.2%</td>
<td>1.5% + 1.4%</td>
<td>3.5%</td>
</tr>
<tr>
<td>Emerging Mkts</td>
<td>7.9%</td>
<td>2.8% + 2.5%</td>
<td>6.6%</td>
</tr>
</tbody>
</table>

As of December 2014. Source: AQR. Data description: The real equity yield is an average of two approaches - the Shiller earnings yield (using 10-year earnings) scaled by 1.075 (embedding an annual real EPS growth of 1.5%), and the sum of dividend yield plus an estimate of long-term real growth of earnings-per-share. U.S. is based on the S&P 500; U.K. on the FTSE 100; “Euro-5” is a GDP-weighted average of MSCI equity indices of Germany, France, Italy, the Netherlands and Spain; Japan is based on the Nikkei; and “Emerging Mkts” is based on the MSCI Emerging Markets index. 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. Please read important disclosures in the Appendix.
Low Long-Run Expected Returns
What Would Be the Impact of Mean-Reverting Valuations? Worse.

Though we do not assume mean-reverting valuations, we believe there is some evidence for it.

Equities and bonds are currently* 1.8% and 2.6% below their 60-year average real yields, respectively.

Simple mean-reversion regressions predict a 0.8% and 1.2% rise in equity and bond real yields, respectively, over the next 5 years.

The impact on returns would be higher for equities (longer duration, no rolldown cushion).

(Mean-reversion coefficients are near -0.5 here with “out of sample” data (assessing valuations only vs. their past history). When in-sample evidence is used from 1881-2009, the regression coefficients are -0.53 for equities and -0.51 for bonds.)

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*As of September 2014. Sources: AQR, Robert Shiller’s web site, Kozicki-Tinsley (2006), Federal Reserve Bank of Philadelphia, Blue Chip Economic Indicators, Consensus Economics. The Equity Real Yield is a 50/50 mix of two measures: 50% Shiller E/P * 1.075 and 50% Dividend/Price + 1.5%. Bond Real Yield is 10 year real Treasury Yield over 10 year inflation forecast as in Ilmanen (2011). Scalars are used to account for long term real Earnings Per Share (EPS) Growth. 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. Past performance is not a guarantee of future performance. Please read important disclosures in the Appendix.
Promising Forecasting Ability; Timing is Difficult in Practice
Correlations May Not Translate to Profitable Signals

- Simple quintile analysis implies hindsight bias
- Out-of-sample contrarian strategies tend to linger on extreme signals
- E/P generally trended lower since 1950s, causing the strategy to be underinvested on average

Sources: * Smoothed earnings yield from Robert Shiller’s website. U.S. equity market returns from Global Financial Data (GFD), Ibbotson/Morningstar and Datastream. Realized equity return calculations from AQR. ** Hypothetical U.S. equity timing strategy rebalances each quarter, applying a tactical weight of 0.5, 0.75, 1.0, 1.25 or 1.5 depending on latest Shiller E/P quintile, based on a rolling 60-year sample. Returns are gross of transaction costs and fees. Past performance is not a guarantee of future performance. These are not the returns of actual portfolios and are for illustrative purposes only. Hypothetical performance results have certain inherent limitations, some of which are disclosed in the Appendix hereto.
Contrarian market timing strategies have struggled in recent decades in all major asset classes while simple trend-following strategies fared well.

## Hypothetical Sharpe Ratios of Simplest Market-Timing Strategies Based on Styles

<table>
<thead>
<tr>
<th>Asset Class</th>
<th>Value-Based Timing</th>
<th>Momentum-Based Timing</th>
</tr>
</thead>
<tbody>
<tr>
<td>Equity Indices</td>
<td>-0.17</td>
<td>0.38</td>
</tr>
<tr>
<td>Bonds</td>
<td>-0.31</td>
<td>0.84</td>
</tr>
<tr>
<td>Commodities</td>
<td>-0.24</td>
<td>0.25</td>
</tr>
</tbody>
</table>

Source: AQR. Hypothetical market timing strategies take a long or short position in an equally-weighted basket of assets, with the size of the position determined by a standardized average value or price momentum signal across the assets. The three asset class baskets consist of 8 developed equity index futures, 6 developed 10-year government bond futures, and 8 commodity futures respectively. Hypothetical performance gross of transaction costs and fees, with weekly rebalancing. These are not the returns of actual portfolios and are for illustrative purposes only. Past performance is not a guarantee of future performance. Hypothetical performance results have certain inherent limitations, some of which are disclosed in the Appendix hereto.
Focus on Better Diversification (& Be Humble on Forecasts)
We Believe Strategic Diversification Beats Tactical Concentration

**Good and Bad News on Forecasting**

**Good News:** We can identify long-run return sources that may be useful strategic holdings (“Strategic Beats Tactical”)
- Several alternative beta premia besides major market risk premia

**Bad News:** Tactical (near-term) predictability is limited. Humility is needed.
- Any timing efforts face a higher bar when we start with a well-diversified portfolio. Timing skills must be exceptional to simply offset the foregone diversification in concentrated bets.

**Good and Bad News on Diversification**

**Good News:** Small forecasting edges can be magnified by diversification (“Many Beats Few”)
- Diversification across lowly correlated investments may help to smooth portfolio returns and thus boost Sharpe ratio (SR)
- If we assume similar SRs for all building blocks (say, long-only asset class premia and long-short style premia all have SRs of 0.2-0.3), a well-diversified long-only portfolio may not be able to reach SR > 0.5, while a well-diversified style premia portfolio could, thanks to its greater breadth

**Bad News:** Diversification requires meaningful shorting and leverage to be most effective
- Long-only investors are often forced to risk concentration, with portfolios typically dominated by equity market risk

Please read important disclosures in the Appendix. Diversification does not eliminate the risk of experiencing investment losses.
Better Diversification Is Bold
Most Institutions Hold Risk-Concentrated Portfolios
Many Portfolios Are Dominated by One Source of Risk

36-Month Correlation to MSCI World
January 1990–March 2012

Source: AQR. Provided for illustration purposes only. The Global 60/40 portfolio consists of the MSCI World Index and the Barclays Capital Global Aggregate Index (Hedged to USD). The Endowment Proxy consists of S&P 500 Index (8%), MSCI ACWI ex-U.S. (7%), MSCI EMG (5%), Barclays Capital Global Aggregate Index hedged to USD (11%), Barclays Capital Global HY Index hedged to USD (4%), HFRI fund-weighted index (26%) as absolute return proxy, Russell 2500 Value as PE proxy (17%) and FTSE EPRA/NAREIT and S&P GSCI (11% each) as two real asset proxies. The Hedge Fund Index is the HFR fund-weighted index. Chart above shows 36-month rolling correlations. 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. Past performance is not a guarantee of future performance. Please read important disclosures in the Appendix.
Style Premia Can Help Risk Diversification – Especially If L/S
What Are the Major Styles?

Research has identified 4-5 styles that have historically generated positive long-run returns across a variety of asset groups and arguably deserve meaningful strategic allocations in investor portfolios*

Four Market-Neutral Styles

<table>
<thead>
<tr>
<th>Style</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Value</td>
<td>The tendency for relatively cheap assets to outperform relatively expensive ones</td>
</tr>
<tr>
<td>Momentum</td>
<td>The tendency for an asset’s recent relative performance to continue in the near future</td>
</tr>
<tr>
<td>Carry</td>
<td>The tendency for higher-yielding assets to provide higher returns than lower-yielding assets</td>
</tr>
<tr>
<td>Defensive</td>
<td>The tendency for lower risk and higher-quality assets to generate higher risk-adjusted returns</td>
</tr>
</tbody>
</table>

One Directional Style

| Trend   | The tendency for an asset’s recent performance to continue in the near future |

Examples of Single-Style Long-Only Premia (“Smart Beta”)
Familiar Long-Term Evidence of Excess Returns Among U.S. Stocks*

*Sources: AQR. Ken French Data Library and CRSP/Compustat data. The three first graphs (Value, Momentum and Profitability) show the average annualized returns of equal weighted quintiles relative to the average annualized returns of an equal weighted portfolio of all stocks in the CRSP universe. Benchmark is the average annualized returns of an equal weighted portfolio of all stocks in the universe. In the last graph (Low-Risk), portfolios are formed by sorting stocks on realized market beta and dividing the stocks into quintile portfolios; returns are excess of cash. Equity Universe includes all U.S. equities. For all charts, quintiles are equal weighted. These are not the returns of an actual portfolio AQR manages and are for illustrative purposes only. Past performance is not a guarantee of future performance.
Long-only portfolios can be improved with style tilts, but ...  
• Long-only portfolios are dominated by market beta, thus are less diversifying  
• Tilts typically provide less active and more constrained exposure, not fully capturing both sides of the return source  
• Smart beta portfolios often apply one style tilt in one asset class in long-only form

Source: AQR. For illustrative purposes only.
We believe a **multi-strategy** approach can:

- Provide better diversification than a single-style / single-asset approach
- Reduce transaction costs and fees via netting
- Enable more patient style investing
The Cube: Three Complementary Perspectives on a Portfolio
From Each Side Can Ask if Portfolio Has Balance (or Desired Imbalance)

The Cube: Asset Class, Strategy Style and Underlying Macro Factor Perspectives to Investing

Many Institutional Portfolios Imply a Lopsided Cube

Source: AQR. Provided for illustrative purposes only.
1. Asset Class Diversification: Long-Only Market Risk Premia

Evidence on All Three Sides of the Cube, First Between Asset Classes

Avoiding equity concentration via risk parity can give a good strategic base for long-only investing. Diversification can boost portfolio Sharpe ratio – though leverage needed to reach 10% volatility.

Risk Allocation in Risk Parity...

... Is Supported by Long-Run Evidence 1971-2013

Source: AQR. Data from January 1971–December 2013. Inflation risk historical Sharpe ratio is calculated using commodities return data as Inflation-Protected Securities were not available for the majority of the observation period. The Equal Risk Weight Strategy is a simulated portfolio, constructed by AQR by allocating risk equally across three asset classes: stocks, bonds and commodities, using the following indices in strategy construction: MSCI World Index (stocks), Barclays Capital U.S. Government Index and Ibbotson Government Index (before 1976) [bonds], and S&P 500 GSCI Index (commodities). The simulated portfolio targets an equal amount of volatility from each asset class every month. Realized Sharpe Ratios are based on each asset class/index gross monthly returns in excess of the 3 month T-bill. 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. Charts are for illustrative purposes only and are based on AQR volatility and correlation estimates. Exposures are subject to change without notice. Please read important disclosures in the Appendix.
2. Alternative Risk Premia Diversification: Style Perspective

Style Premia Have Given Tailwinds in Many Asset Groups

Hypothetical Gross Sharpe Ratios of Long/Short Style Components Across Asset Groups
January 1990–December 2013

Source: AQR. Above analysis reflects a backtest of theoretical long/short style components based on AQR definitions across identified asset groups, and is for illustrative purposes only and not based on an actual portfolio AQR manages. The results shown do not include advisory fees or transaction costs; if such fees and expenses were deducted the Sharpe ratios would be lower. Please read performance disclosures in the Appendix for a description of the investment universe and the allocation methodology used to construct the backtest. Hypothetical data has inherent limitations, some of which are disclosed in the Appendix hereto.
3. Macro Diversification: Mapping Investments to Macro Risks
Hypothetical Performance Across Growth and Inflation Environments

Source: Bloomberg, AQR. Global Equities is the MSCI World index. Global Bonds is a GDP weighted composite of Australian, German, Canadian, Japanese, U.K. and U.S. 10-year government bonds. Commodities is an equal dollar-weighted index of 24 commodities. Long-Short Style Premia are backtests of style premia as described herein. Global 60/40 takes 60% Global Equities and 40% Global Bonds. Simple Global Risk Parity uses trailing 12-month volatility and long-term correlation assumptions to target equal risk-contributions from a portfolio of Global Equities, Global Bonds and Commodities. Simple Style-5 is an equal weighted composite of the five long/short style premia. Please see Appendix for more details on the construction of the return series and macroeconomic environmental indicators. The analysis is based on hypothetical returns gross of trading costs and fees. Hypothetical performance results have certain inherent limitations, some of which are disclosed in the Appendix hereto. Past performance is not a guarantee of performance.
Which Macroeconomic Risks Matter to Investors?
Five Challenging Macroeconomic Environments

Source: AQR. Please see slides in the Appendix for more details on the construction of the macroeconomic environmental indicators.
Performance in Real Yield, Volatility, Illiquidity Environments
Diversified Portfolios Can Still be Sensitive to Volatility and Illiquidity

<table>
<thead>
<tr>
<th>Market Risk Premia</th>
<th>Real Yields</th>
<th>Volatility</th>
<th>Illiquidity</th>
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<tbody>
<tr>
<td>1972-2013</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Global Equities</td>
<td>0.31</td>
<td>0.55</td>
<td>0.85</td>
</tr>
<tr>
<td>Global Bonds</td>
<td>0.46</td>
<td>1.07</td>
<td>0.36</td>
</tr>
<tr>
<td>Commodities</td>
<td>0.32</td>
<td>0.27</td>
<td>0.55</td>
</tr>
<tr>
<td>Portfolios</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1972-2013</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Global 60/40</td>
<td>0.40</td>
<td>0.49</td>
<td>0.08</td>
</tr>
<tr>
<td>Simple Style-5</td>
<td>1.76</td>
<td>1.74</td>
<td>1.52</td>
</tr>
</tbody>
</table>

Source: AQR. Global Equities is the MSCI World index. Global Bonds is a GDP-weighted composite of Australian, German, Canadian, Japanese, U.K. and U.S. 10-year government bonds. Commodities is an equal weighted index of 24 commodities. Global 60/40 is 60% Global Equities and 40% Global Bonds. Simple Style-5 is an equal-dollar-weighted composite of five long/short style premia. Style premia analysis is based on hypothetical returns gross of trading costs and fees. Please see Appendix for more details on construction of return series and macroeconomic environmental indicators. Hypothetical performance results have certain inherent limitations, some of which are disclosed in the Appendix hereof. 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. Past performance is not a guarantee of future performance.
How About the Tail Risk of Sharply Rising Real Bond Yields?
Ten Episodes of Sharply Rising Real Yields

Sources: AQR, Bloomberg. Ex-ante real yield is 10-year bond yield minus survey-based measure of expected inflation over following 10 years. Past performance is not a guarantee of future performance.
Diversified Portfolios May Be More Resilient
Combination of Styles Has Held Up Well in Rising Real Yield Episodes

Source: AQR. See Alternative Thinking, October 2013, or the AQR white paper Exploring Macroeconomic Sensitivities (2013) for details of how these strategies are constructed. Briefly, Global Equities is the MSCI World index net dividends. U.S. Equities is the S&P 500. Global Bonds is a GDP-weighted composite of Australian, German, Canadian, Japanese, U.K. and U.S. 10-year government bonds. U.S. Bonds are US 10-year Government Bonds. Commodities is an equal-dollar-weighted index of 24 commodity futures. Commodities (GSCI) is the GSCI Commodities Index. Global 60/40 takes 60% Global Equities and 40% Global Bonds. Simple Global Risk Parity uses trailing 12-month volatility and long-term correlation assumptions to target equal risk-contributions from a portfolio of Global Equities, Global Bonds and Commodities. Simple Style-5 is an equal-weighted composite of five long/short style premia (value, momentum, carry, defensive, trend) harvested in many asset classes. The analysis is based on hypothetical returns gross of trading costs and fees. Hypothetical data has certain inherent limitations, some of which are disclosed in the Appendix hereto. 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. Past performance is not a guarantee of future performance.
Practical Considerations
Smart Harvesting Matters as Much as Return Sources
Pay Attention to Every Step of the Investment Process

Why Do We Favor Strategic Over Tactical Allocations?

Tactical Predictions Are Imprecise And The Hurdle is High

Tactical style timing/rotation is at least as difficult as market timing. Moreover, the hurdle on timing skills is higher due to greater “forgone diversification” (next slide).

We believe that strategic diversification across return sources we believe in beats tactical timing.
• Boldly take advantage of that free lunch (if you can stomach the three dirty words…)
• Most investors are arguably strategically underweight the major style premia. Increasing strategic allocations is the first-order business
• We do not know that risk balance between style premia is optimal but it is an excellent starting point given our belief in diversification

Our research on tactical timing signals suggests they are not a Holy Grail.
• We rarely find a major Sharpe ratio improvement versus stable style allocations, except when we succumb to overfitting and hindsight biases
• If anything, continuation/momentum signals offer more hope than contrarian/value signals
• We keep researching but do not expect that tactical tilts deserve more than a supporting role in style investing – partly due to the impact of forgone diversification

Source: AQR. Please read important disclosures in the Appendix.
Tactical Investors Forgo Diversification
This May Create a Measurable Performance Hurdle

Not enough to be right “51% of the time”. The hurdle is especially high for portfolios with more diversified investments, or for more aggressive tilts.

Sharpe Ratios of Model 2-Asset Portfolios
Based on random tactical bets

Breakeven Hit Rates for Tactical Tilts
Tilts must achieve these hit rates just to regain the expected Sharpe ratio of the strategic portfolio

Source: AQR. The model returns above are provided for illustrative purposes only. Arithmetic Sharpe Ratios, assume asset volatilities of 10% and arithmetic Sharpe ratios of 0.5. The “tilting” applies tilts with an average of +/-25% (maximum of +/-50%, i.e., asset weights can vary from 0-100%). The “switching” strategy illustrates the extreme case of tactically switching capital entirely from one asset to the other. Transaction costs will likely further penalize tactical strategies. Please read important disclosures in the Appendix.
Relating Hedge Fund and Risk Premia Investing
Demystifying Hedge Funds - Not Just Alpha

Simple Study: Use long term index data (20 years) to determine
- How much of hedge fund performance can be explained by market premia and alternative premia
- The amount of “alpha” delivered in excess of these market and style premia

Bottom line:
- Market exposures can capture a meaningful portion of the returns of hedge fund industry
- Style exposures may explain most of the rest, leaving a statistically insignificant alpha
- Hedge fund industry had a large positive exposure to momentum style but negative to defensive

<table>
<thead>
<tr>
<th>Credit Suisse Hedge Fund Index</th>
</tr>
</thead>
<tbody>
<tr>
<td># of Months</td>
</tr>
<tr>
<td>Average Return</td>
</tr>
<tr>
<td>Standard Deviation</td>
</tr>
<tr>
<td>Sharpe Ratio</td>
</tr>
<tr>
<td>$R^2$</td>
</tr>
<tr>
<td>Intercepts</td>
</tr>
<tr>
<td>Annualized Alpha</td>
</tr>
</tbody>
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<thead>
<tr>
<th>Style Risk Premia</th>
<th>Beta</th>
<th>t Stat</th>
</tr>
</thead>
<tbody>
<tr>
<td>Value Strategies</td>
<td>0.07</td>
<td>1.7</td>
</tr>
<tr>
<td>Momentum Strategies</td>
<td>0.27</td>
<td>6.6</td>
</tr>
<tr>
<td>Carry Strategies</td>
<td>0.06</td>
<td>1.7</td>
</tr>
<tr>
<td>Defensive Strategies</td>
<td>-0.07</td>
<td>-2.3</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Market Risk Premia</th>
<th>Beta</th>
<th>t Stat</th>
</tr>
</thead>
<tbody>
<tr>
<td>MSCI World</td>
<td>0.24</td>
<td>10.6</td>
</tr>
<tr>
<td>MSCI World Lagged 1 Month</td>
<td>0.07</td>
<td>3.3</td>
</tr>
<tr>
<td>S&amp;P GSCI</td>
<td>0.04</td>
<td>2.6</td>
</tr>
<tr>
<td>Barclays Global Agg</td>
<td>0.38</td>
<td>3.4</td>
</tr>
</tbody>
</table>

Source: AQR. Analysis based on monthly returns of the CS Hedge Fund Index and publicly available index data. Note that the CS Equity Market Neutral Hedge Fund Index reflects Madoff-adjusted data. Style Risk Premia are represented by the hypothetical discounted excess returns, net of t-costs, gross of fees, of AQR proprietary strategies from January 1994–October 2013. Please read performance disclosures in the Appendix for a description of the investment universe and the allocation methodology used to construct the backtest. Hypothetical performance results have certain inherent limitations, some of which are disclosed in the Appendix hereto. Past performance is not a guarantee of performance. 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.
What Is Realistic Future Expectation For Style Portfolios?
Skepticism On Past Success Repeating…Is Warranted

No matter how stringent our criteria, history may overstate future results
• It is important to adjust historical backtest returns for costs and fees
• Even though these styles have been known for a long time, there’s still some “data mining” in everything, and estimates of costs may be too low
• The magnitude of returns from style premia may well be smaller going forward; we assume half or less of historical rewards

But diversification helps – consider the following for a portfolio that allocates equally across uncorrelated strategies
• A portfolio of 4 strategies, each with a 0.4 Sharpe ratio, would have an expected 0.8 Sharpe ratio
• A portfolio of 16 strategies, each with a 0.2 Sharpe ratio, would have an expected 0.8 Sharpe ratio

Thus a diversified portfolio of these strategies may be less reliant on the standalone efficacy of any one style in any one asset class – but very reliant on efficient execution as we magnify small edges

However, to convert the Sharpe ratio advantage into high returns, some leverage will be needed

Source: AQR. Please read important disclosures in the Appendix.
Why Do Many Investors Underutilize Style Premia?

The 4 Cs Drive Real-World Investor Behaviour

Mean-variance analysis with even heavily discounted historical return inputs would likely point to large portfolio weights for alternative risk premia (compared with long-only asset classes)

Yet, many appealing and diversifying return sources are only modestly used. Why? “The 4Cs”:

- **Conviction**: investor uncertainty about the sustainability of non-equity premia
- **Constraints**: aversion to leverage, shorting and derivatives
- **Conventionality**: “better to fail conventionally” – Keynes
- **Capacity**: limitations may apply especially for very large investors

The 4Cs also help explain why investors “choose” equity risk concentration and why the diversifying style premia are not likely to be “arbed away” soon

Source: AQR. Please read important disclosures in the Appendix.
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AQR monthly backtests of Value, Momentum, Carry and Defensive strategies are undiscounted, gross of fees and transaction costs, excess of a cash rate proxied by the Merrill Lynch 3-Month T-Bill Index, and scaled to 12% annualized volatility. Each strategy is designed to take long positions in the assets with the strongest style attributes and short positions in the assets with the weakest style attributes, while seeking to ensure the portfolio is market-neutral. The representative Style Premia Composite portfolio is based on the target asset group allocations as noted on page 14, roughly equally risk weighting styles within the asset group, resulting in a style allocation of approximately 32% to Value, 32% to Momentum, 22% to Defensive and 14% to Carry. Please see below for a description of the Universe selection.

**Stock and Industry Selection**: approximately 1,500 stocks across Europe, Japan, U.K. and U.S. Country Equity Indices: Developed Markets: Australia, Canada, Eurozone, Hong Kong, Japan, Sweden, Switzerland, U.K., U.S. Within Europe: Italy, France, Germany, Netherlands, Spain. Emerging Markets: Brazil, China, India, Russia, South Africa, South Korea, Taiwan. Bond Futures: Australia, Canada, Germany, Japan, U.K., U.S. Interest Rate Futures: Australia, Canada, Europe (Euribor), U.K. and U.S. Currencies: Developed Markets: Australia, Canada, Euro, Japan, New Zealand, Norway, Sweden, Switzerland, U.K., U.S. Emerging Markets: Brazil, India, Mexico, Poland, Russia, Singapore, South Korea, Taiwan, Turkey. Commodity Selection: Silver, Copper, Gold, Crude, Brent Oil, Natural Gas, Corn, Soybeans.

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 Morgan Stanley Capital International World Index is a market-capitalization-weighted index composed of company’s representative of the market structure of 23 developed market countries in North America, Europe and the Asia/Pacific Region. There are material differences between an index and the strategy. The Barclays Global Aggregate Index is a flagship measure of global investment grade debt from 23 different local currency markets. This multicurrency benchmark includes fixed-rate Treasury, government-related, corporate and securitized bonds from both developed and emerging markets issuers. There are material differences between an index and the strategy. One significant difference between the indices and the performance presented is that the index performance is weighted on the basis of capitalization whereas the strategy performance reflects a risk-weighted calculation. This difference may have a material affect on the comparison of the indices with the performance of the strategy. The S&P GSCI® is a composite index of commodity sector returns representing an unleveraged, long-only investment in commodity futures that is broadly diversified across the spectrum of commodities.
Building Macro Indicators / Investment Return Series

Macro Indicators

Our first choice was to decide which macro dimensions are most relevant. We chose economic growth, inflation, real yields, volatility, and illiquidity. Monetary policy was another candidate; it is closely related to real yields. We choose to construct macro indicators, or risk factors, mainly based on fundamental economic data, and not based on asset market returns (which are “too close” to the patterns we try to explain). For example, potential market-based proxies of economic growth include equity market returns, the relative performance of cyclical industries, dividend swaps, and estimates from cross-sectional regressions of asset returns on growth surprises. This choice brings its own problems, notably timing challenges as macroeconomic data are backward-looking, published with lags and later revised, while asset prices are clearly forward-looking. The impact of publication lags and the mismatch between backward- and forward-looking perspectives can be mitigated by using longer windows. Thus, we use contemporaneous annual economic data and asset returns through our analysis (past-year data with quarterly overlapping observations).

Arguably, composite growth surprise indices are the best proxies of economic growth news, but such composites are available at best going back to 1990s. Forecast changes in economist surveys as well, but data constraints make us focus on U.S. data. Finally, it is not clear how real economic growth ties to expected corporate cash flow growth (e.g., earnings per share) that influence stock prices or to real yields that influence all asset prices but especially those of bonds.

Each of our macro indicators combines two series, which are first normalized to Z-scores: that is, we subtract a historical mean from each observation and divide by a historical volatility. We use rolling 10-year windows for means and volatilities when normalizing the last three macro indicators. However, for growth and inflation indicators we use in-sample 2012-2013 means and volatilities because we do not have long histories of economist forecasts needed to construct the surprise series below. This choice does not seem to change any major results. When we classify our quarterly 12-month periods into, say, “growth up” and “growth down” periods, we compare actual observations to the median so as to have an equal number of up and down observations (because we are not trying to create an investable strategy where data should be available for investors in real time, we use the full sample median).

The underlying series for our growth indicator are the Chicago Fed National Activity Index (CFNAI) and the “surprise” in industrial production growth over the past year. Since there is no uniquely correct proxy way to capture “growth”, averaging may make the results more robust and signals appropriate humility. CFNAI takes this averaging idea to extremes as it combines 85 monthly indicators of U.S. economic activity. The other series – the difference between actual annual growth in industrial production and the consensus economist forecast a year earlier – is narrower but more directly captures the surprise effect in economic developments. We use median forecasts from the Survey of Professional Forecasters data as published by the Philadelphia Fed. While data surprises a priori have a zero mean, this series has exhibited a downward trend in recent decades, reflecting the partly unexpected relative decline of the U.S. manufacturing sector.

Our inflation indicator is also an average of two normalized series. One series measures the de-trended level of inflation (CPIYOY minus its mean, divided by volatility), while the other measures the surprise element in realized inflation (CPIYOY minus consensus economist forecast a year earlier).

Investment Return Series

The investment return series we study include both asset class premia and style premia. The former are long-only returns but expressed in excess returns over the Treasury bill rate. The latter are long-short returns and scaled to target or realize 10% annual volatility. We subtract no trading costs or fees, which makes a bigger difference for the long-short strategies.

The main asset class premia we focus on are U.S. equities (proxied by the S&P500 index), U.S. Treasuries (proxied by the constant-maturity 10-year return), and commodities (proxied by the S&P GSCI index). For robustness, we also studied global equities (MSCI World), global bonds (GDP-weighted average of 10-year government bonds in six countries), and an equal-weighted composite of 24 commodity futures. In addition, we studied the credit excess returns of investment-grade corporates over duration-matched Treasuries (Barclays index data since 1973) and TIPS returns (using an in-house proxy for inflation-linked bond performance; the series begins already in 1980, well before the first TIPS were issued in 1997).

Style premia series are more difficult to compile, especially because we apply these premia in numerous asset classes. To start histories back in 1972, we splice together different series. Since 1990, we use value, momentum, carry and defensive style premia as described in “Investing With Style” (AQR white paper, 2012) Available upon request. The intuition in the four styles is to buy assets that are cheap, or recently outperforming, or high-yielding, or boring (low-risk) – while selling assets with opposite characteristics. We apply these styles in stock selection, industry allocation, country allocation in equity, fixed income and currency markets, as well as in commodities.

Briefly, we construct market-neutral long-short portfolios in several asset classes (stocks, bonds, currencies, commodities) based on a few indicators in each style. Besides the broadest style composites, we also construct separate style premia for global stock selection (GSS) and global asset allocation (GAA). When we create the composite GAA style premia, we use the same relative risk weights for asset classes as ‘Investing With Style’ (33% equity country allocation, 25% fixed income, 25% currencies, 12% commodities). However, for GSS we use 50/50 risk weights between stock selection within industries and across industries (to be in line with the common but arguably inefficient practice of letting across-industry positions matter as much as within-industry positions), and we also use 50/50 risk weights when we combine GSS and GAA style composites. For 1972-1989, we source value and momentum style returns from “Value and Momentum Everywhere” (journal of Finance, 2013), defensive style returns from “Betting Against Beta” (forthcoming in Journal of Financial Economics, 2013), and GSS carry style premium from dividend yield strategy returns in Ken French’s data library. We construct the GAA carry style premia before 1990 as well as some early histories of GAA value, momentum and defensive styles with AQR in-house backtests.

In addition to the market-neutral “big four” style premia, we use market-directional premia. Trend style applies 12-month trend-following strategy in liquid investments in four major asset classes (GAA). While the style is nearly uncorrelated with equity markets in the long run, at any point in time it can be directionally long or short. We source trend style premia from “Time Series Momentum” (Journal of Financial Economics, 2012) and in-house data extension before 1985.

While the GSS style premia proxies we use since 1990 are market (beta) neutral, the value and momentum premia before 1990, and the carry premium throughout, are ‘only’ dollar-neutral and may contain moderate empirical beta exposures. The defensive style premia are beta-neutral through the whole sample but buy larger amounts of low-risk investments than we sell high-risk investments, which means that they are actually not as defensive as the dollar-neutral quality style. (The general lesson is that we need to be precise in understanding strategy designs. Just as corporate bond positions will have very different market exposures depending on whether they are duration-hedged with Treasuries, market exposures of style premia will depend on the degree of hedging).