



Alternative Thinking

Should Investors Worry About Rising Real Yields?

Many investors worry about the current level of real yields which are low from a historical perspective. Low real yields — not just on bonds but on most assets — anchor long-term future returns to low levels. A sharp increase in real yields would be even worse news as it would trigger sudden capital losses, but rising real yields are not a foregone conclusion. If real yields rise, they need not rise together and are more likely to exhibit a gradual normalization, which would be a more benign outcome than a sharp rise.

Still, given common worries about bond-related tail events, we document the response of various asset classes and strategies in historical episodes of sharply rising real bond yields. Overall, investor portfolios tend to suffer less in bond-related tail events than they do in equity-related tail events.

Second Quarter 2014

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Executive Summary

A thirty-year decline in real yields of all assets — not just bonds — has given large windfall gains to a generation of investors. But given today's very low real yields, many investors worry whether it is now payback time, and if we are due for a period of rising real yields. If they rise, how fast will they rise? And what will be the impact on portfolios? Does the macroeconomic reason for rising real yields matter? We attempt to answer these questions, and provide evidence on the effects of rising real yields on investment returns. Although we believe that low real yields imply low prospective real returns over extended horizons, we are more sanguine about the likelihood and potential impact of near-term increases in real yields.

Since many investors are especially concerned about *sharply* rising *bond* yields, we focus on this risk. We start with an analysis of the current environment and various yield scenarios. It is not a foregone conclusion that real or nominal yields will rise any time soon; a secular stagnation or a financial crisis could push them even lower. If real yields rise, the pace and the economic backdrop will influence asset market responses. We think gradual yield normalization is more likely than a sharp reversal, allowing the carry from steep yield curves to offset capital losses from rising yields. And if the growth environment is benign, other asset classes may diversify bond losses.

It may be helpful to analyze bond-bearish investors' tail risk scenarios head-on from a historical perspective. Thus, we drill into various investments' performance during past episodes of sharp real yield increases. Bonds fared poorly in such episodes, as expected, but the performance of other asset classes was much less consistent, providing diversification benefits. Equities fared well in many of these episodes despite their super-long duration, but stumbled along with bonds in several rising yield episodes associated with Fed tightening. Long/short strategies proved to be particularly appealing diversifiers because they resemble zero-duration

investments. Overall, these bond-related tail events were meaningfully less damaging to most investor portfolios (either 60 stock/40 bond or risk-balanced types) than were equity-related tail events.

We recognize that the current situation may be unprecedented and, in any case, we only have a limited set of historical episodes to study. These are relevant for tail risk analysis but should not be seen as base-case scenarios. Ultimately, constructing well-diversified portfolios may be the best way to mitigate most tail risks.

Setting the Stage: Is It Payback Time?

Exhibit 1 puts the current environment into historical perspective, showing both U.S. stocks and bonds within their 10th percentile richest levels since 1900; that is, their expected real returns are lower today than in more than 90% of their history since 1900.¹ And because both asset classes are rich at the same time, their 60/40 composite is even richer, at the 2nd percentile.

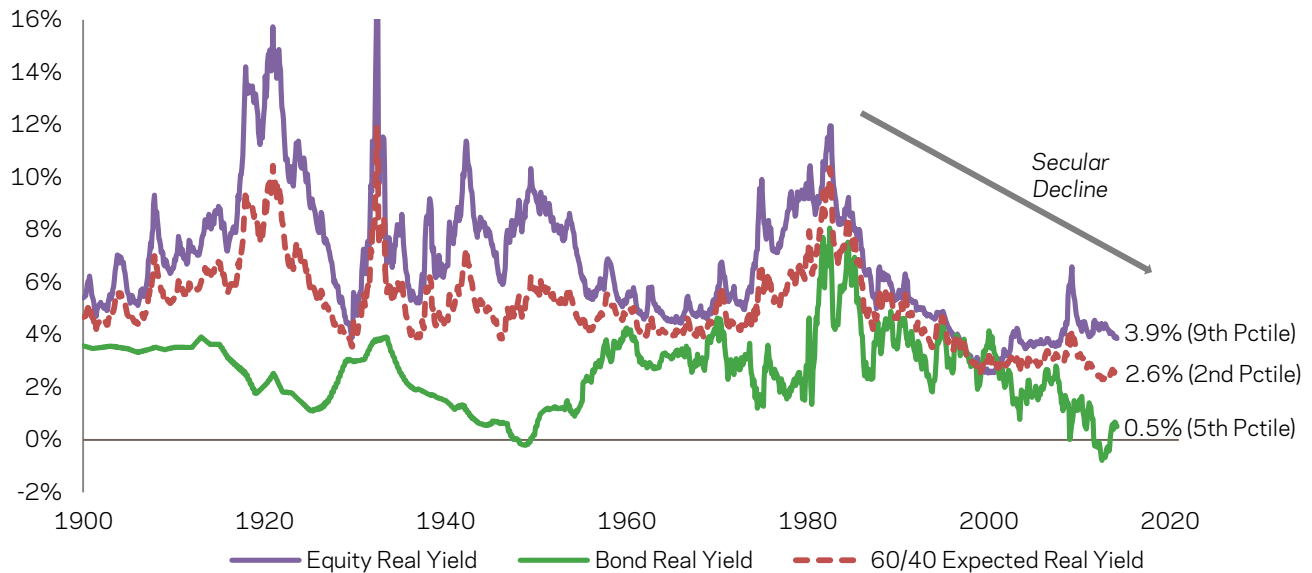
The secular decline in real yields since the early 1980s is not just a U.S. phenomenon; we can find similar and often sharper real yield declines in most other countries² and in other asset classes.³ All of

¹ Our expected real returns are based on real yields (and embed a growth assumption for equities) but assume no mean reversion in market valuations; for details, see *The 5% Solution* (2012) or *Alternative Thinking*, January 2014. Stocks are represented by the Standard&Poor's 500 Index since 1957 and before it other broad indices of large-cap U.S. stocks. The equity real yield is a 50/50 mix of two measures: Shiller's (10-year average, cyclically adjusted) Earnings/Price ratio * 1.075 and Dividend/Price + 1.5%. Scalars are used to account for long term real Earnings Per Share (EPS) Growth. Bond real yield is the difference between the 10 year Treasury yield over survey forecasts of next-decade average inflation (based on several surveys, as in Ilmanen (2011)). Stock market data and Treasury yields are from Robert Shiller's website, inflation expectations data are from Kozicki-Tinsley (2006), Federal Reserve Bank of Philadelphia, Blue Chip Economic Indicators, and Consensus Economics. We use only U.S. data because global yield and survey data are only available since late 1980s, but since then the global results are broadly similar to those shown here for the U.S.

² For example, using Consensus Forecasts data, the ex-ante real 10-year yield in the U.S. fell from 4.5% to 0.8% between 1990 and 2013. Over the same period, the ex-ante real 10-year bond yield in Japan fell from 5% to -0.7%, in Germany from 6% to 0%, and in the U.K. from 7% to -0.3%. Admittedly, those 1990 real yield levels appear to be all-time highs in these three countries, whereas U.S. saw even higher real yields (7-8%) in the early 1980s.

³ Given that cash earns a negative real return in the major economies, it is



Exhibit 1 | *Expected Real Returns on U.S. Stocks and Bonds, 1900-2014*

Source: AQR, Robert Shiller's website, Kozicki-Tinsley (2006), Federal Reserve Bank of Philadelphia, Blue Chip Economic Indicators, Consensus Economics. See footnote 1 for explanations.

this has resulted in huge windfall gains for a generation of savers.⁴ But is it now payback time? The answer is affirmative in a very long-term sense but likely negative in the short-term and more dramatic sense. The question is whether we will only have to endure low income (carry) due to low starting yields, or also suffer from capital losses if real yields sharply revert to higher levels.

Real Bond Yields: Understanding the Drivers

We focus here on bond-related tail events partly because default-free bond yields are the common element in all assets' discount rates. When assessing why real bond yields are so low today and whether they will stay that way, it helps to consider their two components: expected real short rates and required

bond risk premia (or term premia). The former is closely related to monetary policy and business cycles, the latter has more secular drivers.

- Central banks traditionally influence expected real short rates in a procyclic fashion. So-called Taylor rules suggest that central banks try to raise real policy rates when faced with strong real growth (overheating) and/or rising inflation expectations amid mature business cycle expansions. We have not seen such policy tightening since the mid-2000s. After the global financial crisis, persistent slack in major economies coupled with low inflation prompted many central banks to effectively target negative real short rates as well as to try to directly influence bond risk premia through large-scale asset purchases (or quantitative easing, QE).⁵

no wonder that all assets have been bid to low yields and thus low prospective total returns compared to history. (Low real short rates influence all assets' total returns, but policymakers may also have succeeded in encouraging investors to take greater risks, resulting in lower required risk premia in various asset classes.)

⁴ Naturally, entry points matter. Japanese equity investors starting in 1990 or U.S. equity investors starting in 2000 have not received windfall gains even over a long holding period. The results are most impressive for those who started in the early 1980s.

⁵ It bears stressing that central banks cannot directly control the level of real short rates, let alone bond yields, as these are market prices that are influenced by a variety of factors. Textbooks emphasize that equilibrium real yields reflect the balance between desired saving and investment. A savings glut from emerging economies has been one well-established determinant of low real yields, apart from the aforementioned easy monetary policies and low required bond risk premia. Other contributors related to net savings include demographic developments and the



- The main drivers of required bond risk premia are more secular than cyclical: an inflation risk premium (which has dwindled from its elevated levels in the 1980s when the inflation level and its volatility were high) and a CAPM⁶-related premium (which was positive in the 1970s-80s but which has reduced required Treasury yields since the stock-bond return correlation turned negative in the late 1990s).

Exhibit 2A decomposes the 10-year nominal Treasury yield history into three parts — expected inflation, expected real rate, and bond risk premium (BRP) — based on semiannual consensus forecasts of the next-decade average inflation rate (dark red line), average T-bill rate (turquoise line), and the 10-year nominal Treasury yield (blue line). The real bond yield is the gap between the nominal Treasury yield and expected inflation and shown separately in **Exhibit 2B** with its two individual components. Both expected real short rates and the BRP peaked at around 3-4% in the mid-1980s, and are now only marginally positive. Expected real short rates ranged between 1% and 3% for a quarter-century, 1986-2010, before falling to a 0-1% range, now 0.5%. The BRP fell earlier toward zero as the inflation risk premium declined amidst the Great Moderation and improving central bank credibility, while the negative stock-bond correlation began to justify a negative ‘safe-haven’ premium. The BRP has been hovering around zero and even negative levels for the past decade, as economists persistently predicted a yield rise that was not to come despite growing debt issuance. If anything, yields fell further thanks to a bond-friendly economic backdrop and healthy demand for bonds. In addition to private investors buying Treasuries for their safe-haven and liability-matching services,

corporate sector’s limited investment demand reflecting structural changes related to the IT revolution or more cyclical scars from the global financial crisis. As important, the deleveraging process in many major economies is hardly complete. Both public and consumer debt are at historically high levels, so a sustained period of very low real yields may be needed to bring down these debt levels in an orderly way.

⁶ CAPM, or the Capital Asset Pricing Model, which relates a security’s expected return to its sensitivity (beta) to a risk premium — typically the equity risk premium.

foreign central banks accumulated Treasuries for their reserves, and the Fed became the biggest buyer with its QE after the global financial crisis. The BRP troughed at near -1% in 2012 and reverted to near zero during the 2013 bond sell-off.

Four Scenarios for Real Bond Yields

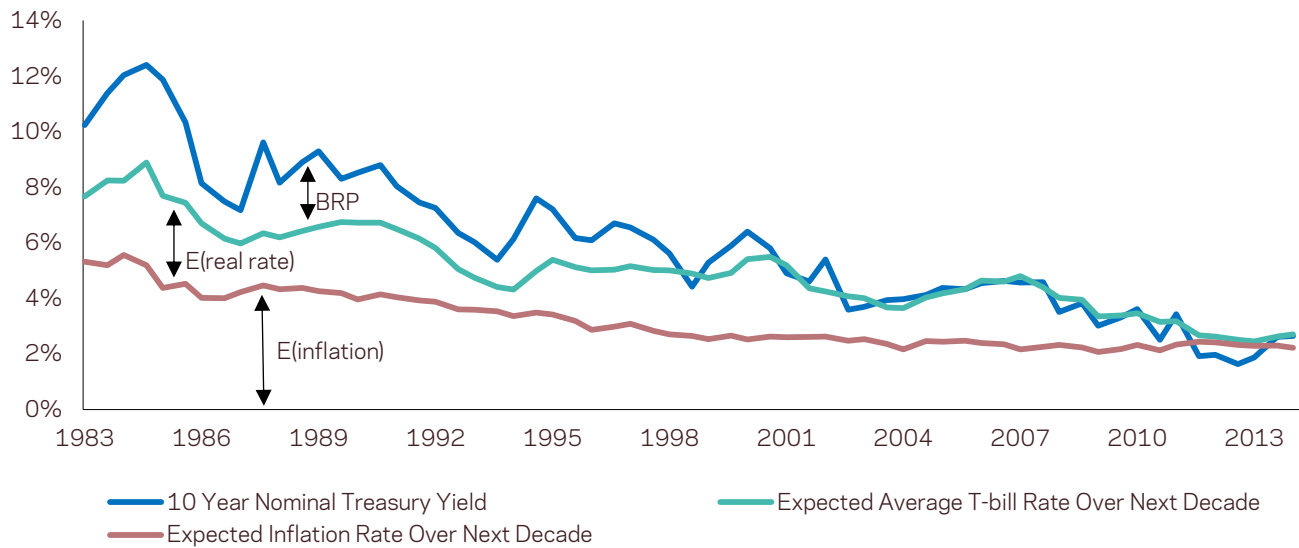
Before evaluating the possibility of sharply rising real yields, we review a set of four more plausible outcomes and their impact on stocks, bonds and a 60/40 combination of them.

1. **Yields (real and nominal) fall instead of rise:** There is less scope for yield declines from today’s low levels, but long-term bond yields outside Japan are still quite far from the zero bound and we now know that real yields can become negative. The scariest outcome is one where nominal yields are near the zero bound and real yields are positive due to deflation. Prominent commentators, such as Larry Summers, have stressed the real possibility of a secular stagnation given insufficient investment demand as well as the dangers of a deflationary trap where real economies are unable to find balance at full employment. In such a scenario, stocks and 60/40 portfolios could suffer badly, and government bonds’ safe-haven qualities would be highly valued.
2. **Yields (real and nominal) stay unchanged for a prolonged period:** An unchanged yield curve scenario would make long-dated Treasuries strong performers due to carry and rolldown. For example, as a 10-year Treasury ages into a 9-year bond, it rolls down the curve by some 15bps, earning about 1.2% rolldown return (ca. 8-year duration * 0.15% = 1.2%). Thus, the expected nominal return (or “rolling yield”) of a 10-year Treasury assuming an unchanged curve next year (with 10-year yield at 2.6% and cash near



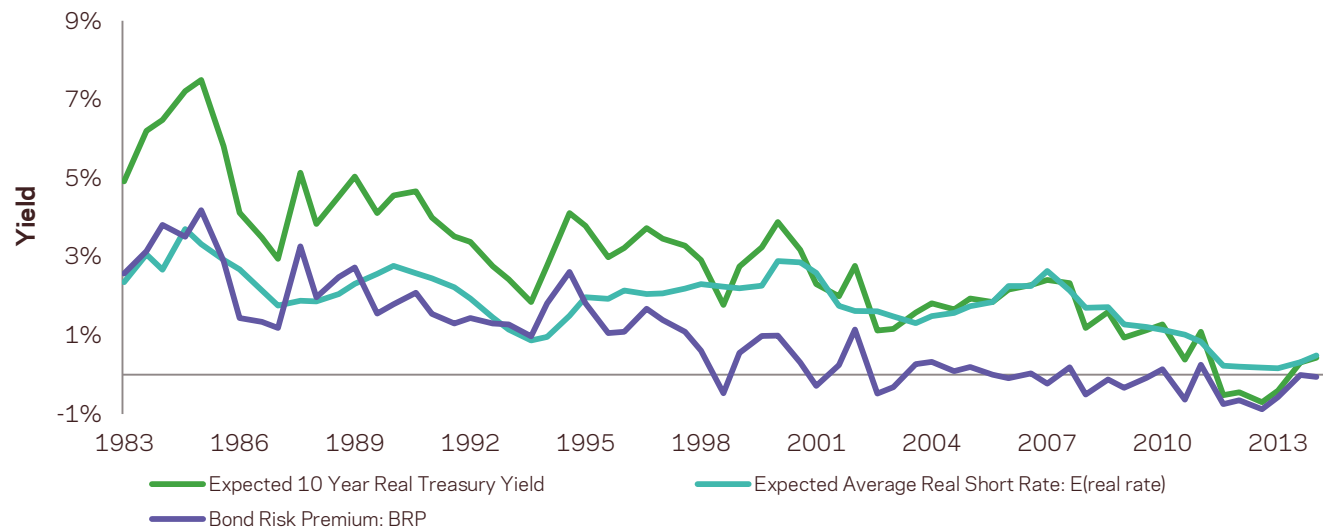
Exhibit 2 | *Decomposition of the 10-Year Treasury Yield Using Survey Data, 1983-2014*

A. *Adding Up Three Components Into The Nominal Yield*



Source: AQR, Robert Shiller's website, Kozicki-Tinsley (2006), Federal Reserve Bank of Philadelphia, Blue Chip Economic Indicators, Consensus Economics. See footnote 1 for explanations.

B. *Plotting The Expected Real Bond Yield And Its Two Individual Components*



Sources: AQR, Blue Chip Economic Indicators. (The patterns would be broadly similar over time if we used term structure models such as Fed's Kim-Wright (2005) instead of the semiannual Blue Chip economist survey data.)

zero) is almost 4%. This scenario might be the most benign for stocks and 60/40 portfolios.⁷

⁷ See *Alternative Thinking*, July 2013, for more on rolling yields, break-even forward yield curves, etc. The report stresses the relevance of rolling yields because, empirically, an unchanged yield curve has been a

reasonable base case for future outcomes, clearly better than the forward-implied yield curve or the historical mean yield curve. The report ends with one interesting factoid: a 200bp rise in the curve over a year would cause a 10-year Treasury milder negative returns (-10.6%) than a 100bp fall in the curve would cause it positive returns (+12.4%), thanks to curve steepness and so-called convexity effects (larger price impact for a yield fall than a yield rise). So any asymmetry in yield outlook may be offset by opposite asymmetric return consequences.



3. **Yields (real and nominal) rise gradually:** This scenario would not necessarily cause net losses to bond-holders, as steep yield curves imply that the market already has priced in some yield increases.⁸ Gradual yield increases along the forward path may be many policymakers' preferred outcome, as such normalization would likely cause the smallest number of casualties. This scenario would not be as benign for stocks and 60/40 portfolios as an unchanged yield curve would be, unless the growth outlook improves significantly.⁹
4. **Real yields stay unchanged, or rise or fall mildly, while inflation expectations and nominal yields rise sharply:** We suspect that investors would price in upward inflation surprises pretty quickly and real yields on nominal bonds would incorporate an inflation premium. This scenario would hurt nominal bonds — as well as risky assets and 60/40 portfolios. Historically, high inflation has hurt both earnings growth and equity valuations, thus equity returns. Inflation-protection assets (TIPS, commodities) and long/short strategies (recall, zero duration helps) could smooth portfolio performance. However, long-run inflation expectations still appear well-anchored today because of central bank credibility, slack in major economies, and demographic prospects, among other things. Thus, this

⁸ Forward-implied yield curves show the break-even levels of future yields at any horizon that would cause capital losses big enough to just offset long-dated bonds' carry advantage over cash (or, rather, the horizon-matching riskless rate). Currently, the steep curve provides about 35bps cushion against rising 10-year Treasury yields over the next year and about 120bps over five years. For 10-year TIPS at 0.45%, the break-even cushion is 25bps over the next year and about 75bps over five years. Separately, in economist surveys, consensus predicts somewhat faster yield rises than the forwards. It is debatable whether the near-unanimity in economist surveys is a convincing bearish signal or a contrarian indicator. In any case, consensus has been wrong on yields for most of the past two decades. One day, it will be right.

⁹ An AQR white paper *Can Risk Parity Outperform If Yields Rise* (2013) showed that over a very long period of rising Treasury yields between 1947 and 1981, a simple risk parity portfolio would have outperformed a 60/40 portfolio thanks to its better diversification and curve steepness which offset bond market losses from rising yields. Risk parity did underperform 60/40 during a sharp yield increase between 1979 and 1981, however. That study focused on nominal yield changes but the results would be similar for real yield changes.

scenario seems unlikely, at least for the next few years.

We are humble when it comes to forecasting macroeconomic developments, but if forced we would predict a gradual increase in real yields. Many central banks may do their best to achieve a slow normalization, even when they taper their bond purchases and start considering the timing and pace of rate hikes. In our opinion, if inflation problems do not arise central bankers will likely stay behind the curve on policy tightening.¹⁰ This would allow bondholders to benefit from positive carry (which can offset capital losses), while other asset classes would likely be aided by a more benign growth environment. Yet, accidents can happen, and investors should hold portfolios that can survive various tail events, including sudden increases in real yields. We will analyze below some especially severe tail events for bond investors.

Real Yield Changes and Investment Returns: What Relationship Should We Expect?

Before turning to evidence, we start with some theory (or accounting relations). The real value of most investments can be analyzed as 1) the sum of expected cash flows discounted by a rate that reflects a riskless real yield (common element) and 2) some risk premia (that differ across assets). This is why a large rise in real bond yields (the first component) can hurt virtually all long-only investments — stocks, bonds, real estate and other less-liquid investments — at the same time.

The nature or *cause* of the rise should matter, too. It matters whether the cause is cyclical (business cycle and monetary policy cycle) or secular (long-term trend), whether it reflects changing expected real policy rates or required bond risk premia, whether it coincides with rising or falling inflation expectations, and so on. For example, we would

¹⁰ Despite large liquidity injections in recent years, central banks have not been able to generate enough inflation to reach their inflation target levels (which are usually near 2%).



expect tighter monetary policy motivated by a strong growth outlook to be better news for risky assets than tighter monetary policy motivated by inflation concerns.¹¹

All investments are not equally sensitive to changes in real bond yields. Sensitivity depends on (i) the investment's duration or volatility and (ii) its correlation with real yield changes:¹²

Bonds

Bond market relations are straightforward and relatively well-known:

- i. **Duration:** The duration effect dominates within a given bond market, where correlations across bonds tend to be very high. A bond's instantaneous price change (excluding carry) is well approximated by $-\text{Duration} \times \text{Yield Change}$ (e.g., 0.5% yield rise for a 7-year duration bond implies -3.5% capital loss). Likewise, a bond's return volatility is proportional to its duration. Longer-duration bonds are thus more volatile and have greater return fluctuations for given yield changes.
- ii. **Correlation:** The correlation effect becomes more important across markets. Nominal and real (inflation-linked) government bonds within one country tend to be highly correlated, especially when expected inflation

¹¹ The relation between prospective real yields and expected inflation is more complex and often nonlinear. Rising expected inflation tends to boost both real policy rates (based on typical Taylor rules) and required inflation risk premia and thus real yields on nominal bonds; however, deflationary expectations can also boost forward-looking real yields and still coincide with falling nominal bond yields unless they are already close to zero. Also, the required real yields on equity markets tend to rise with both high inflation and deflation and be at their lowest when inflation rates (and real bond yields) are low and stable.

¹² Of course equity market beta, the most common sensitivity measure investors study, depends on the same two qualities. An asset's equity market beta (the regression slope) is the product of the relative volatility of the asset versus the equity market and the correlation between the two. Duration is a commonly used sensitivity measure within bond markets - which can be computed without any statistical estimation based on some simplifying assumptions. It is the approximate capital loss (gain) for a 1% increase (decline) in yields in an ideal world of parallel yield curve shifts, where all bonds are perfectly correlated and duration differences only reflect relative volatilities. In addition, duration (slightly adjusted by $1 + \text{yield}$) measures the effective length of the investment - a present-value weighted average maturity of all expected future cash flows.

is relatively stable as has been the case in the past 15 years. Corporate bonds in the U.S. as well as government bonds in other countries have somewhat lower but still almost always positive yield correlation (and negative return correlation) with U.S. real bond yield changes.

Stocks

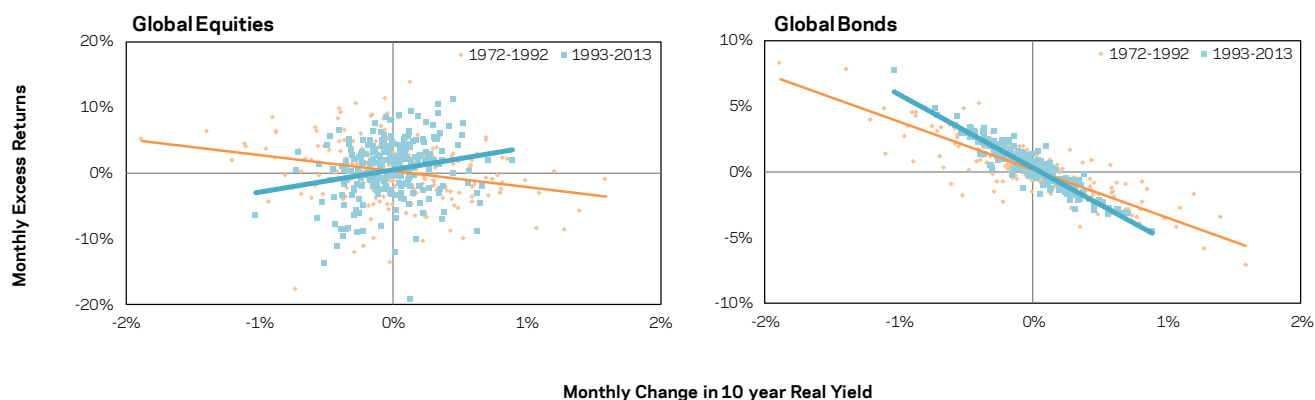
The sensitivity of equities to real yield changes is ambiguous. On one hand, equities have an extremely long duration if we consider their expected cash flows. On the other hand, equities have much lower and less stable correlations with real bond yield changes than any bonds. Thus, it is not surprising that the literature on equity market sensitivity to real yields took two distinct paths (and came up with very different estimates):

- i. If expected cash flows are treated as certain, equities can be viewed as a perpetuity with a never-ending dividend stream with a duration equal to the inverse of dividend yield. For example, a dividend yield of 2% implies an extremely long equity market duration of 50.
- ii. If we empirically regress equity returns on (real) bond yield changes, the long-run slope estimate can be near zero, reflecting the near uncorrelated nature of the two main asset classes. But this estimate conceals significant time-variation from, say, -20 to +20 when equity markets have been negatively or positively correlated with bond markets for extended periods.

A helpful way to think about the difference between these two approaches is that the first approach presumes that equity returns only fluctuate due to changes in real riskless yields. But the discounted cash flow framework reminds us that all else is not constant. Equity returns fluctuate also because their expected cash flows change with market perceptions of the growth outlook, and the discount rate reflects various risk premia besides the riskless rate. Changes in these other determinants can offset the impact of real yield changes. The best-known



Exhibit 3 | Scatterplotting Global Equity and Bond Returns on Monthly Changes in U.S. 10-Year Real Bond Yield, Contrasting 1972-1992 and 1993-2013



Source: AQR. Global Equities is the MSCI World index net of dividends. Global Bonds is a GDP-weighted composite of Australian, German, Canadian, Japanese, U.K. and U.S. 10-year government bonds.

example is that cyclical optimism on economic growth can boost both expected equity cash flows and real yields, and the positive numerator (cash flow) effect on equity prices can overwhelm the adverse denominator (discount rate) effect.¹³

Other Investments

Commodities: If we view duration as a measure of an investment's length, durations would be hard to measure and would seem to vary a lot across commodities. Perishable agricultural commodities have very short durations, while industrial metals and energy have longer ones, and precious metals have the longest. However, the correlation effects seem to dominate, and the empirical sensitivities of commodities to real yield changes tend to be modest (perhaps positive for growth-related commodities and negative for gold).

Illiquids: As with equities, many illiquid real assets — land being the extreme case — have extraordinarily long durations, so their discounted value should depend heavily on real yield levels.¹⁴

¹³ The same is true for various risk premia but we are not aware of evidence that the ex-ante levels of various risk premia would vary inversely with real riskless yield levels. If anything, both equity and bond (inflation) premia were historically high in early 1980s when real riskless yields were elevated and low in 2000s when real yields were lower.

¹⁴ This also explains why real estate can be a surprisingly poor inflation hedge as an investment: capitalized values may be low during high-inflation periods such as 1970s. The more investments offer cash flows

However, price-smoothing understates true volatilities and correlations.

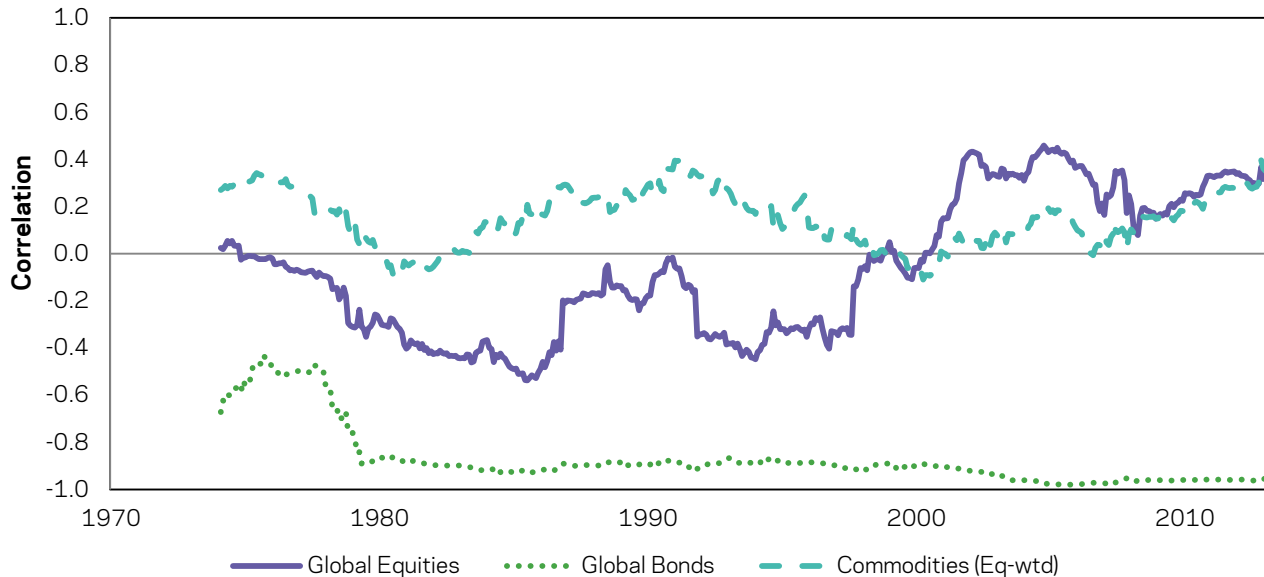
Long/short strategies: Duration-hedged, credit-Treasury positions (long corporate bonds, short Treasuries) and dollar-neutral long/short style portfolios (such as value and defensive strategies) are close to zero-duration investments and thus more resilient to real yield changes.

Empirical Results: Long-Run Correlations with Real Yield Changes

The main message is that nominal bond returns are consistently negatively correlated with real bond yield changes, while equities and other investments have much lower and less-stable correlations. The scatterplots in **Exhibit 3** show the stock and bond relationships with real yield changes over two different periods: 1972-1992 (orange) and 1993-2013 (turquoise). The relationship is stable over time for bonds, while for equities the correlation was negative for 1972-92 and positive for 1993-2013.¹⁵

that are adjusted frequently, the shorter the duration, e.g., commercial real estate with annual adjustments in the rental rate.

¹⁵ A key reason for the sign flip in this correlation seems to be the stabilization of inflation level and volatility. During the inflationary 1970s both stocks and bonds were cheap and both then saw their discount rates fall during the Great Moderation. During the past two decades of stable inflation, growth news have been the key macro-driver of asset class

Exhibit 4 | *Rolling 60-Month Correlations Between Asset Class Returns and Real Bond Yield Changes*

Source: AQR. Global Equities is the MSCI World index net of dividends. 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. 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 back.

Rolling 60-month correlations in **Exhibit 4** confirm the sign change for equities around the millennium and also show that an equal-weighted composite of commodity futures has exhibited near-zero or mildly positive correlation with real yield changes for much of the history. (The results are broadly similar for a production-weighted composite of commodity futures.)

The pattern that 'growthy' assets have a more positive (or less negative) correlation with real bond yield changes goes beyond stocks versus bonds, and is consistent with the idea that more optimistic cash flow expectations can offset the adverse impact of higher discount rates. Beyond the exhibits shown, we note that:

- Relative performance between credits vs. Treasuries, small-cap vs. large-cap stocks, as

returns, and growth surprises tend to push stock and bond returns to opposite directions. Flight-to-quality episodes have further contributed to the negative return correlation between the two asset classes. See Ilmanen (2003) "Stock-Bond Correlations" in the *Journal of Fixed Income*. (We stress that the positive correlations between stock returns and bond yield changes imply negative correlations between stock and bond returns.)

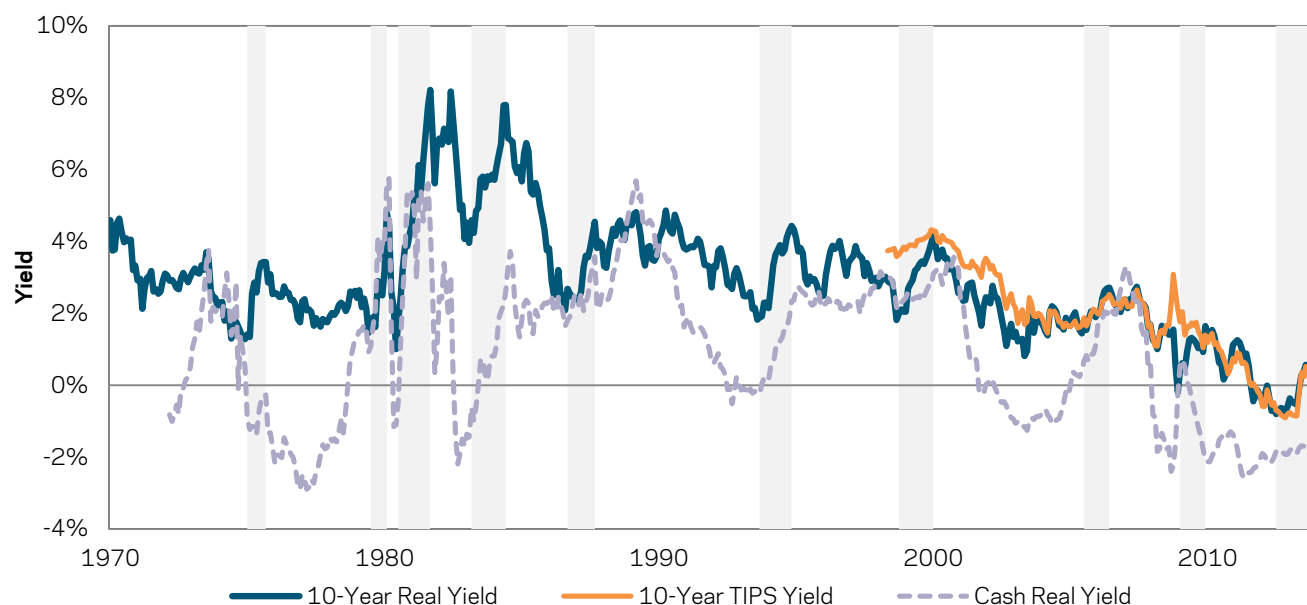
well as emerging vs. developed markets — all of which are possible proxies for illiquidity premia besides being growth thermometers — exhibit a mild positive correlation with real bond yield changes. In contrast, most long/short style premia we study are liquid and do not have a systematic growth bias, so they have a near-zero correlation with real bond yield changes.

- Across U.S. industries, cyclical sectors (business equipment, consumer durables, manufacturing) have a mild positive correlation with real bond yield changes, while more defensive sectors (utilities, healthcare, finance and consumer nondurables) have a mild negative correlation. The cyclical sectors also tend to have higher volatilities and equity market beta above 1, unlike the defensive sectors.
- Across commodity futures, 'growth' commodities like copper and oil have mild positive correlations with real bond yield changes, while soft agricultural products and gold have lower correlations.



Exhibit 5 | History of Real Treasury Yields Since 1970s

A. Time Series Plot of Real Yields, With Ten Rising Real Yield Episodes Shaded



B. Statistics on Ten Rising Real Yield Episodes

| Episode | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
|--|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|
| Years | 12/74-09/75 | 06/79-02/80 | 06/80-09/81 | 02/83-06/84 | 08/86-09/87 | 08/93-11/94 | 09/98-01/00 | 06/05-06/06 | 12/08-12/09 | 06/12-12/13 |
| Monetary Policy Change in Fed Tightness | -1.2% | 3.0% | 2.8% | 1.4% | 0.4% | 1.4% | 0.0% | 1.1% | -1.8% | -0.5% |
| Growth: Change in CFNAI (Z-score) | 4.31 | -0.24 | 2.27 | 0.92 | 0.56 | 0.68 | 0.37 | -0.45 | 2.76 | 0.54 |
| Inflation Change in CPI YoY | -4.4% | 3.3% | -3.4% | 0.7% | 2.8% | -0.1% | 1.3% | 1.8% | 2.6% | -0.2% |
| Change in Real Yields | +2.1% | +3.3% | +7.2% | +3.8% | +2.5% | +2.6% | +2.3% | +1.3% | +1.8% | +1.4% |
| Number of Months | 9 | 8 | 15 | 16 | 13 | 15 | 16 | 12 | 12 | 18 |

Sources: AQR, Bloomberg. Yields are calculated in the same way and from the same sources as in Exhibit 2.

Empirical Results: Periods of Sharply Rising Real Bond Yields

We now drill into ten 'tail' episodes of sharply rising real bond yields over the past 40 years; they are represented by the shaded areas in **Exhibit 5A**. We measure real yield changes by the monthly change in the U.S. ex-ante real bond yield, whose level is the difference between the 10-year nominal Treasury yield and consensus forecast of next-decade inflation (see footnote 1). **Appendix 1** describes other

candidates and explains why we prefer to use the change in the U.S. ex-ante real bond yield.¹⁶

We first characterize the ten episodes by providing further information in **Exhibit 5B**. As discussed, the macro backdrop can explain why real bond yields rose; some backdrops may be less benign than

¹⁶ Earlier AQR whitepapers have explored related topics. *Inflation in 2010 and Beyond* (2010) analyzed the inflation sensitivities of various investments. *Can Risk Parity Outperform If Yields Rise?* (2013) analyzed the effects of secular increases in Treasury yields. *Exploring Macroeconomic Sensitivities* (2013) analyzed the performance of asset class and style premia in different macro environments, including real yields (but there our indicator combined both levels and changes in short and long real yields).

others (e.g., Volcker's Fed tightening 'to kill inflation' in 1981 despite a deep recession clearly was not friendly for growth-oriented assets). Most episodes coincided with tighter Fed policy (policy stance is proxied by an average of real short rates and yield curve inversion; we show the change in policy tightness), stronger growth (proxied by the change in the Chicago Fed National Activity Index), and rising inflation (proxied by the change in CPI YoY). Exceptions are highlighted by red numbers: 1st, 9th and 10th episodes did not coincide with Fed tightening, 2nd and 8th not with stronger growth, and 1st, 3rd, 6th and 10th not with rising inflation. It may be worth noting that starting valuations on stock and bond markets were more attractive in the earlier episodes and yet these tended to trigger worse asset market performance. During stagflationary episodes, both asset classes began cheap in historical comparison but became even cheaper.

Turning to investment performance, **Exhibit 6A** shows numerical detail on cumulative excess returns over cash for various investments in each episode. The last columns also present summary statistics for the whole period (1972-2013). **Exhibit 6B** provides graphical evidence on the same data to visualize the main results.

Bonds

U.S. and Global Bond excess returns were negative in virtually all episodes. One exception is that global bonds mildly outpaced cash in the first episode (1975), which only captures the aftermath of the first oil crisis when inflation was already falling fast and monetary policies were eased.

Stocks

U.S. and Global Equity excess returns were typically positive (negative in only three episodes). Yet half of the episodes (2nd, 3rd, 4th, 6th, 8th) had clearly lower equity returns than others: 1979-80, 1980-81, 1983-84, 1993-94, 2005-6. All five episodes coincided with Fed tightening, while the five other episodes with higher equity returns (1st, 5th, 7th, 9th, 10th) coincided with improving growth conditions (which presumably is

more likely when the Fed is not tightening). Equities often show benign performance when real bond yields rise, but the current generation of investors may not recall that there have been prominent counterexamples where equities were vulnerable.

Other Investments

A diversified portfolio of commodity futures performed well in most episodes but it lost money in 1980-81 (a terrible period for all investments) and in the most recent period. Energy-dominated commodity indices fared poorly also in 1975 and 1993-94. Credits quite regularly outpaced duration-matched Treasuries.

A global 60/40 portfolio tended to outperform a simple global risk parity portfolio (an equal-risk composite of stocks, bonds and commodities) in these tail events. (The reverse is true for equity-related tail events.) Both portfolios suffered their worst losses during the 1980-81 stagflation, but also the 1979-80, 1983-84 and 1993-94 episodes saw negative excess returns for both. Perhaps surprisingly, both portfolios exhibited comparable negative correlations with real yield changes (-0.3 and -0.4, as shown in the last column). The reason is that equities actually had a mild negative correlation with real bond yield changes for the full sample, though much lower than that of nominal bonds, while commodities had a mild positive correlation.

Each long/short style premium we analyze — value, momentum, carry, defensive and trend¹⁷ — was profitable in most episodes. The loss episodes varied across styles, providing diversification, but the 2nd,

¹⁷ Four market-natural style premia - value, momentum, carry and defensive - are long/short strategies applied in several asset classes, each scaled to target or realize 10% annual volatility. The fifth style, trend-following, is a market-directional 'cousin' to the momentum strategy. See *Alternative Thinking*, October 2013, or the AQR white paper *Exploring Macroeconomic Sensitivities* (2013) for details of how these strategies are constructed. The analysis is based on hypothetical returns gross of trading costs and fees.

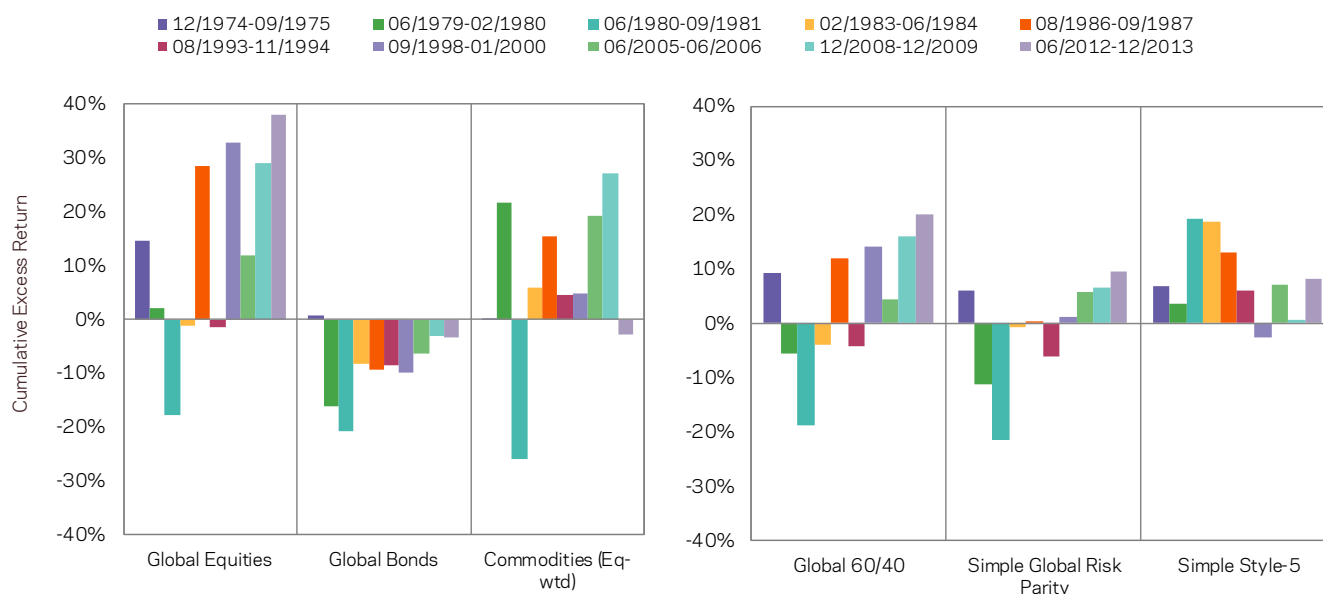


Exhibit 6 | Performance of Various Investments During Ten Episodes of Sharply Rising Real Bond Yields

A. Cumulative Excess Return During Each Period (unannualized compound returns)

| Episode | 10 Episodes | | | | | | | | | | Whole Period (1972-2013) | | | |
|---------------------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|--------------------------|------------------------------|------------------------------|------------|
| | Years | 12/74-09/75 | 06/79-02/80 | 06/80-09/81 | 02/83-06/84 | 08/86-09/87 | 08/93-11/94 | 09/98-01/00 | 06/05-06/06 | 12/08-12/09 | 06/12-12/13 | Average Annual Excess Return | Average Annual Excess Return | Volatility |
| Global Equities | 14.7% | 2.0% | -17.8% | -1.1% | 28.6% | -1.6% | 32.9% | 11.9% | 29.1% | 37.9% | 10.9% | 3.7% | 15.1% | -0.08 |
| U.S. Equities | 18.3% | 2.5% | -10.8% | -2.7% | 25.6% | -3.5% | 29.4% | 4.1% | 25.7% | 39.2% | 10.4% | 5.0% | 15.7% | -0.09 |
| Global Bonds | 0.6% | -16.1% | -20.9% | -8.3% | -9.4% | -8.4% | -10.0% | -6.3% | -3.1% | -3.2% | -7.8% | 3.2% | 6.2% | -0.87 |
| U.S. Bonds | -5.9% | -23.6% | -30.9% | -17.7% | -15.2% | -10.3% | -12.8% | -6.9% | -4.3% | -3.6% | -12.2% | 3.3% | 8.6% | -0.92 |
| U.S. IG Credit Excess | 9.1% | -0.8% | 1.6% | 7.2% | 6.0% | 0.7% | 2.3% | 0.2% | 23.3% | 7.6% | 4.9% | 0.5% | 4.1% | 0.28 |
| Commodities (Eq-wtd) | 0.0% | 21.7% | -26.0% | 6.0% | 15.3% | 4.6% | 4.8% | 19.3% | 27.2% | -2.8% | 5.3% | 6.2% | 15.9% | 0.14 |
| Commodities (GSCI) | -10.4% | 14.8% | -23.5% | 9.8% | 19.5% | -12.7% | 16.9% | 8.9% | 13.3% | 6.5% | 3.0% | 5.3% | 20.2% | 0.09 |
| Value | 35.8% | -11.1% | 8.8% | 10.4% | 14.9% | 12.9% | -9.4% | 0.0% | 5.5% | 11.0% | 6.4% | 6.6% | 8.4% | 0.04 |
| Momentum | -7.0% | 24.1% | 25.9% | 5.5% | 0.7% | 1.6% | 20.0% | 16.4% | -7.8% | 15.5% | 7.9% | 9.2% | 8.2% | 0.00 |
| Carry | 23.3% | -0.9% | 15.0% | 22.0% | 7.4% | 11.1% | -11.0% | 3.0% | 11.9% | -4.6% | 6.4% | 8.0% | 8.0% | 0.07 |
| Defensive | 10.8% | -4.5% | 37.8% | 49.9% | 26.7% | 2.2% | -17.1% | 8.0% | -1.2% | 12.7% | 9.7% | 9.6% | 8.4% | 0.00 |
| Trend | -22.2% | 13.0% | 9.5% | 8.9% | 15.1% | 1.5% | 6.7% | 8.2% | -4.7% | 6.9% | 3.3% | 9.0% | 7.5% | -0.08 |
| Global 60/40 | 9.2% | -5.5% | -18.8% | -3.9% | 12.1% | -4.2% | 14.2% | 4.4% | 15.9% | 20.1% | 3.3% | 3.5% | 9.6% | -0.30 |
| Simple Global Risk Parity | 6.1% | -11.3% | -21.4% | -0.6% | 0.3% | -6.2% | 1.3% | 5.8% | 6.6% | 9.6% | -1.3% | 6.5% | 9.2% | -0.42 |
| Simple Style 5 | 6.8% | 3.6% | 19.3% | 18.7% | 12.9% | 6.0% | -2.5% | 7.1% | 0.8% | 8.3% | 7.0% | 8.5% | 3.9% | 0.02 |

B. Graphical Representation of Main Results



Source: 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. Details for Value, Momentum, Carry and Defensive can be found at the end of this paper. 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 back.

7th and 9th episodes saw three of the five styles losing money. Only the 7th, the tech boom episode (where value, carry and defensive styles

underperformed), saw the diversified Style-5 composite lose money. However, we stress that these returns are overstated as they are gross of



Earlier Historical Episodes

We also analyzed U.S. stock and bond market performance in three earlier episodes of rising real bond yields than we show in Exhibits:5-6. Each episode was quite different with regard to stock/bond responses:

- **Slow Real Rate Rise (1926-33):** Equities lost money over this period after more than doubling before the 1929 crash. Nominal bond yields were stable, while real bond returns were quite high due to deflation.
- **Slow Real Rate Rise (1949-59):** Equities had a superb decade after starting from very cheap valuations, earning 17% annual excess return over cash. Nominal bond yields doubled from 2.3% (still a post-war regulated level) to 4.7%, resulting in -1% annual excess return as yield curves were not particularly steep.
- **Fast Real Rate Rise (1968-69):** Both asset classes lost cumulative about 10% over a 17-month period during which cash earned almost 10%. The real yield increase was prompted by rising inflation concerns and Fed policy tightening. Thus, this episode was the first “modern” one, resembling many episodes that followed.

We have limited data on long/short strategies over these three episodes, but we found that trend-following in macro assets and momentum-based U.S. stock selection strategies fared well in all occasions, while value, size and defensive stock selection strategies had mixed results (some up, some down).

transaction costs and fees.¹⁸ All the style premia and their composite have a near-zero long-run correlation with real bond yield changes, consistent with the idea that their long/short nature makes them akin to zero-duration assets.

Overall, the ten real yield tail events described above, as well as some previous episodes (see Box above) were difficult for long-only investments, but the performance of diversified portfolios was arguably quite benign. After 1981, none of the episodes caused serious damage to investor wealth, in contrast to the worst equity market drawdowns which regularly cause double-digit losses to traditional portfolios. However, we recognize that we face today an unprecedented situation given the QE and low yields, so the statement that “past may not be prologue” is especially pertinent. We also reiterate that tail analysis — whether conditioned on worst bond market moves or stock market moves — should not overly drive portfolio construction. We do not have a crystal ball to tell us how real bond yields will evolve in the coming years, and we prefer well-diversified portfolios that have the best chance to provide robust performance in a variety of outcomes.

¹⁸ Being applied investors, we prefer to show performance net of trading costs. However, as our historical analysis goes back to 1970s, we did not have trading cost estimates for all investments we study here.

Concluding Remarks

In case we come across too bond-friendly, we note that many tactical indicators are mildly underweight bonds.¹⁹ However, recall from Exhibit 1 that stocks and bonds are almost equally expensive today from the perspective of a century-long history; thus any mean reversion arguments apply in a similar way to both asset classes.²⁰ Our tactical positions are in any case modest both because the relative stock-bond signals are not very strong and because we calibrate these positions appropriately so as not to lose the more reliable benefits of strategic diversification.

Our main messages are twofold:

First, all (long-only) asset classes are expensive compared to their histories and thus vulnerable to capital losses if real yields mean-revert quickly from their relatively low levels. You could call us long-term pessimists (rather, realists) in that we argue that today’s low real yields imply low prospective real returns for the next decade. However, in

¹⁹ To be clear, AQR does not have one “house view” as different funds may use different timing signals or weight them differently.

²⁰ Actually, when we look at the spread between stocks’ and bonds’ expected returns—which is virtually always positive, as it should be given that equities are the riskier asset—and compare the current value (3.4%) to the century-long average (4.1%), equities appear slightly expensive versus bonds. Most investors are surprised at this result, partly because common comparisons are made using much shorter histories.



contrast to short-term pessimists who emphasize the prospect of sharply rising real yields, especially on bonds, we believe gradual normalization is more likely.

Second, we believe investors should hold portfolios that can *survive* such tail events as those described in Exhibit 6 - just as they should survive equity tail scenarios. Fortunately, bond-related tail episodes have not been disastrous for traditional portfolios, at least since 1981. More generally, our preferred answer involves well risk-diversified portfolios, which ideally include meaningful allocations to long/short strategies that are resilient against rising yields.



Appendix 1. Other Candidates for Measuring Yield Sensitivity

Real Short Rates: These mainly reflect the monetary policy stance. As most investments we study are long-lived assets, the long-term discount rate matters more than cash: long-dated bond yields reflect market's rate expectations and some required term premia that make them more relevant for other long-lived assets. (We also ran the analyses in this report using changes in real short rates instead of real bond yields; the main results were unaffected.)

Inflation-linked bonds (TIPS): TIPS would have allowed historical analysis only since their launch in 1997. And even over this shorter history, TIPS have suffered from illiquidity and supply-demand effects (apparent cheapness due to illiquidity or novelty premium until 2003 and again wide illiquidity premia during the late-2008 market dislocations). Exhibit 5 shows real short rates (short-term T-bill rate minus survey forecast of next-year inflation) and 10-year TIPS yields for comparison.

Nominal Treasury Yields: This measure would include expected inflation and related premia in the U.S. However, long-run inflation expectations have been and remain quite stable since late 1990s, anchored near 2.5%. In any case, over the full sample, the correlation between monthly changes in our ex-ante real bond yields and nominal Treasury yields is 0.95, so our results would be very similar if we used the latter.

Global Bond Yields: This measure would also include expected inflation and related premia. However, only U.S. has survey evidence of long-run inflation expectations going back to 1970s, and proxies based on past inflation are not as good predictors of future inflation as survey forecasts. In any case, the correlations of monthly yield changes are sufficiently high across major economies (and U.S. bond markets amount to almost half of the global markets) that the broad results should be very similar.



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AQR backtests of Value, Momentum, Carry and Defensive theoretical long/short style components are based on monthly returns, 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. 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.

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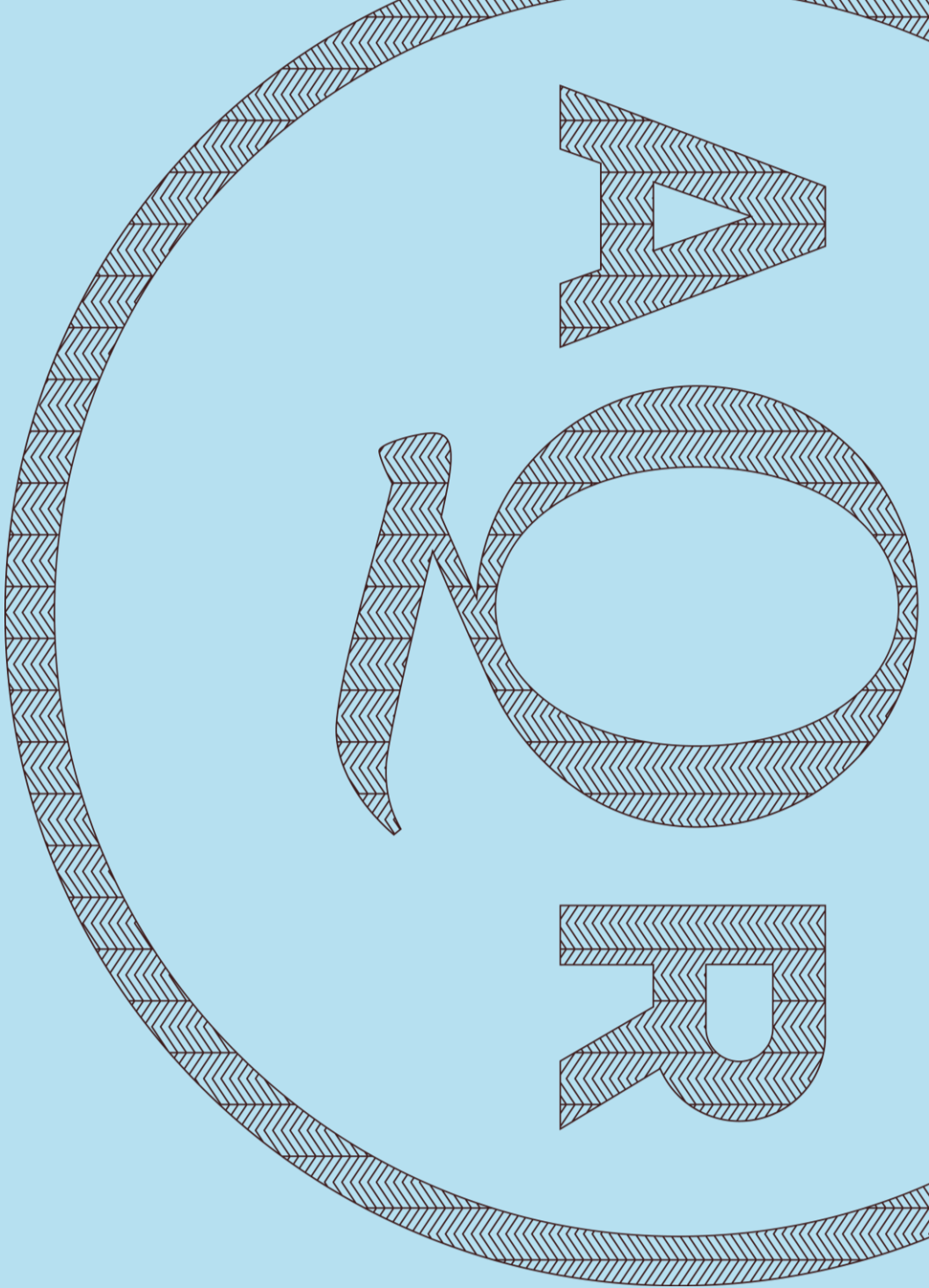
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