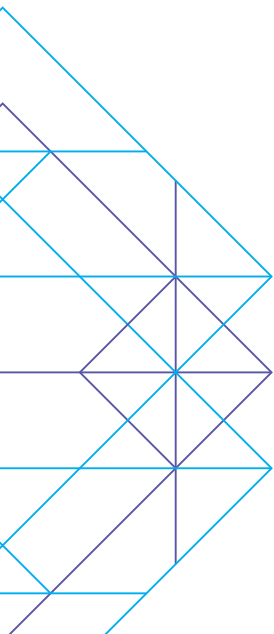




October 2021

When Stock-Bond Diversification Fails

Managing inflation risk in investor portfolios



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The quarter century from the mid-1990s to 2020 was a period of credible central banks across developed markets, low and stable inflation, and well-anchored inflation expectations. Yet, unprecedented monetary stimulus, dating back to the Global Financial Crisis, coupled with extraordinary fiscal stimulus and potential supply chain disruptions stemming from the Covid-19 pandemic, has raised renewed concerns about the potential for upside shocks to inflation.

In 2021, inflation increased sharply, reaching 5.4%¹ in the U.S. for the year ending in June, and maintaining that rate three months later. Perhaps even more notably, U.S. core CPI, which strips out more volatile energy inputs (often the cause of major swings – both positive and negative) exceeded 4% for the first time since the early 1990s. Many have cited “base effects” and idiosyncratic (and likely short-lived) pressures on individual components of the Consumer Price Index, e.g.,

used car prices, as a reason why these pressures may not persist. Longer-term expectations remain fairly well-anchored as of September 2021.² At the same time, uncertainty around the future path of inflation should prompt investors to question how different inflationary outcomes can impact their portfolio. This is the subject of this article and the outline is as follows.

We first introduce measures that isolate the “news” components of inflation and are therefore most relevant to asset prices. Using these measures, we evaluate the sensitivity of traditional markets – stocks and nominal bonds – to inflation, showing potential underperformance in environments of rising or surprisingly high inflation. In other words, the diversification that stocks and bonds have historically provided in growth shocks may weaken if high inflation rears its head.

We next evaluate other asset classes that are often considered to offer more

¹ Bloomberg, Bureau of Labor Statistics.

² While the 5-year breakeven inflation rate at 2.5% was the highest for more than a decade, the 5-year 5 years forward rate (a measure of longer-term expectations), was at a less exceptional 2.2%, a level exceeded for substantial periods of the 2010s.

resilience to inflation, including real estate, commodities, and inflation-linked bonds. We show that allocations to some (but not all) of these asset classes can provide valuable diversification in inflationary episodes and thus reduce portfolio sensitivity to inflation.

Diving deeper into the relationship between asset classes and inflation, we see an empirical tendency for equities to also underperform during periods of *falling* inflation – potentially due to these episodes having coincided with adverse growth shocks in our sample. This pattern highlights the benefit to investors of strategies that might offer upside inflation

protection without suffering in disinflationary recession outcomes. We present two active strategies that seem to fit this bill – price trend following and macro momentum. These strategies have tended to outperform during both upside and downside inflation surprises, i.e., they have shown “convexity” to the inflation environment.

We conclude by analyzing the impact on a traditional portfolio of an allocation to a “real return” basket, including commodities, TIPS breakevens, price trend, and macro momentum, showing meaningfully improved resilience to the inflation environment.

I. Challenges, Caveats and Metrics

There are many challenges associated with the analysis of sensitivity of asset prices to inflation. Macro variables, such as inflation, can be slow moving with some degree of predictability. Asset prices likely already reflect prevailing levels of inflation, and instead respond to inflation *news*. Therefore, when measuring sensitivities it is critical to extract the news component of inflation. To do so, we combine two measures of the “information content” of realized U.S. inflation:

1. Year-on-year CPI inflation minus CPI for previous 1-year period (“change”)
2. Year-on-year CPI inflation minus 1-year forecast at start of period (“surprise”)

Both can be thought of as measures of the surprise in inflation – with the first using a simple “random walk” model for the path

of expectations (previous year’s inflation sets expectations for next year’s), and the second using surveys as a proxy for market expectations. While neither is perfect, the combination of the two metrics (standardized so they have equal influence³) may serve to reduce noise in either one. By focusing on quarterly overlapping year-on-year periods, we avoid seasonal effects and mitigate the role of publication lags. We construct a corresponding metric for U.S. GDP growth, as a control variable.

The choice of sample period is an important and non-trivial one: there is a clear trade-off between including more data versus focusing on more recent periods with greater relevance and better data quality and availability. Long histories of inflation span different monetary systems not fully applicable to the current era. In addition, some relevant assets have had a

³ Changes tend to be larger in magnitude than surprises, so a simple average gives more weight to them. By scaling the two series to have the same standard deviation before averaging, we ensure equal weight is given to surprises, to which asset returns tend to have higher sensitivity.

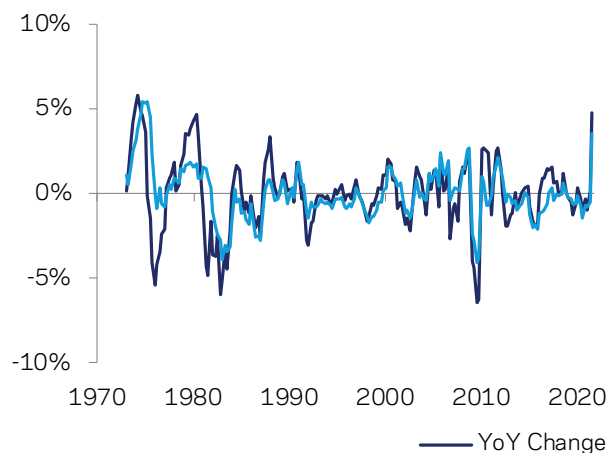
relatively brief existence.⁴ On the other hand, more recent periods contain few inflationary episodes. As a middle ground, we choose to analyze the 50-year period from 1972 to 2021, which is relevant to the current regime, allows us to test a wide range of assets and strategies, and still encompasses a wide range of different

inflation environments as shown in **Exhibit 1**. In making this choice, we accept some risk that the Great Inflation of the mid-70s to early-80s may drive some sample-specific results. Our analysis focuses on U.S. inflation, where the best data are available, but we find similar patterns in other major markets.⁵

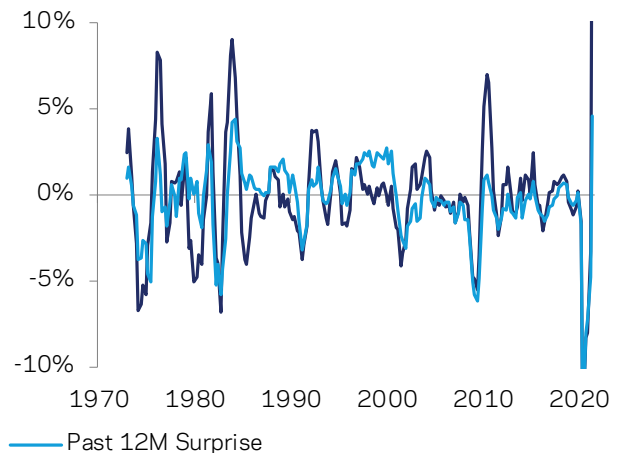
Exhibit 1: Historical U.S. 12-Month Inflation and Growth Changes and Surprises

Jan 1972 - Jun 2021

a. Inflation Metrics



b. Growth Metrics



Source: Fed Survey of Professional Forecasters, U.S. Bureau of Labor Statistics, Bloomberg and AQR. Data at quarterly frequency. Changes are calculated as simple difference between year-on-year inflation and year-on-year inflation 12 months earlier. Surprises are calculated as simple difference between year-on-year inflation and 1-year forecast 12 months earlier. Please read important disclosures in the Appendix.

II. The Sensitivity of Traditional Markets to Inflation

We start by analyzing the sensitivity of traditional markets to inflation. We analyze a portfolio of domestic equities represented by the S&P 500 index, bonds represented by a 10-year U.S. treasury index, and a 60/40 combination of the two, as shown in **Exhibit 2**.

Chart A shows the correlations of the three portfolios to our inflation metric and its components. All three have negative sensitivity, indicating a tendency to underperform during inflationary episodes. The result for bonds is unsurprising: a claim on a fixed set of nominal cash flows is intuitively less valuable when prices have

4 The first Treasury Inflation Protected Securities (TIPS) were introduced in the U.S. in 1997. Other markets, e.g. the U.K. (1981) have had longer histories, while others, e.g. Germany (2006) have had shorter still.

5 Specifically, we examine the sensitivities of euro-area equity and government bond portfolios to changes in euro-area inflation, and find very similar results to those set out below for U.S. assets.

risen unexpectedly.⁶ The result for stocks may be less obvious – if companies’ earnings can increase along with the CPI, leaving stock investors with a claim on real cash flows, then shouldn’t stocks be unimpacted by inflation? There may be several reasons why not: not all companies may have the flexibility to adjust prices, investors may have a tendency to discount the real cash flows of stocks with nominal discount rates,⁷ investors may anticipate higher real rates as an eventual consequence, or the economic inefficiencies and uncertainty associated with inflationary episodes may impair real growth and/or drive an increase in risk aversion and required return for risky asset classes such as equities. The last explanation is consistent with analysis later in the paper showing that stocks may be short “inflation volatility” as well as having some linear negative exposure. In the appendix we show results for equity sectors and for non-U.S. equities, and these results suggest some tilts which could be made within the equity allocation to increase inflation resilience.⁸ Finally and intuitively, the 60/40 portfolio has sensitivity between that of stocks and bonds.⁹

Chart B shows partial correlations of stock and bond returns to both inflation and growth variables. This two-factor analysis accounts for any interaction between the two macro variables. Although during this particular sample, our growth and inflation news metrics

were lowly correlated on average, controlling for growth raises explanatory power and statistical confidence. The panel illustrates the perniciousness of inflation, relative to growth, for holders of 60/40 portfolios. While the two components have strong diversification along the growth dimension,¹⁰ with stocks having positive exposure and bonds negative, this diversification is sorely lacking when it comes to inflation.¹¹

Chart C digs deeper into the effect described in Chart B by specifically evaluating the statistical diversification potential of stocks relative to bonds in “growth news dominant” and “inflation news dominant” environments. We partition periods into those when the magnitude of growth surprise exceeds that of inflation surprise and those when the opposite is the case. We see that during periods when growth news has dominated, the stock-bond correlation has been near zero. This has represented a majority of the time since 1990 and is one explanation for the environment of low-to-negative correlation between stocks and bonds that investors have enjoyed. However, in the periods when inflation news has dominated, stocks and bonds have been positively correlated. Unlike growth news which tends to drive stocks and bonds in opposite directions, inflation news (especially to the upside) tends to drive them in the same direction.¹²

6 We focus here on Treasuries but we also tested credit. Credit excess returns exhibit a mild negative sensitivity to inflation. Corporate bonds have a strong sensitivity due to the accompanying rates risk.

7 Consistent with the so-called “money illusion”.

8 We tested a proxy for private equity, combining buyout (private) and levered small-cap (public) indices, which has a negative sensitivity too.

9 We find some evidence of time variation during our sample period, with stronger sensitivities from 1972 to 2000, and weaker sensitivities thereafter. On the one hand, this raises the possibility some structural change has weakened sensitivities. On the other, it could suggest that a return to a more volatile inflation environment would see stronger sensitivities than the full-sample averages we report here.

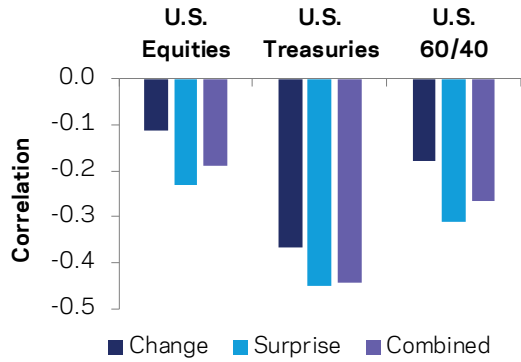
10 That said, the tendency of a 60/40 portfolio to be dominated by stock risk means that it is still “growth exposed”. Investors (particularly those with an ability to take leverage) may seek to improve the growth diversification of this portfolio by improving the risk balance between the two – generally achieved by using leverage to increase the risk in the bond portfolio.

11 To give a sense of economic significance, equities’ and bonds’ betas to our inflation metric are -2.2 and -1.3 respectively, meaning that a 1% rise in inflation over 12 months is associated with a reduction in returns of 2.2% and 1.3%. The full sample average returns are 5.6% for equities and 1.7% for bonds, in excess of cash. See Exhibit 4 for additional insight into the economic impact of inflation shocks.

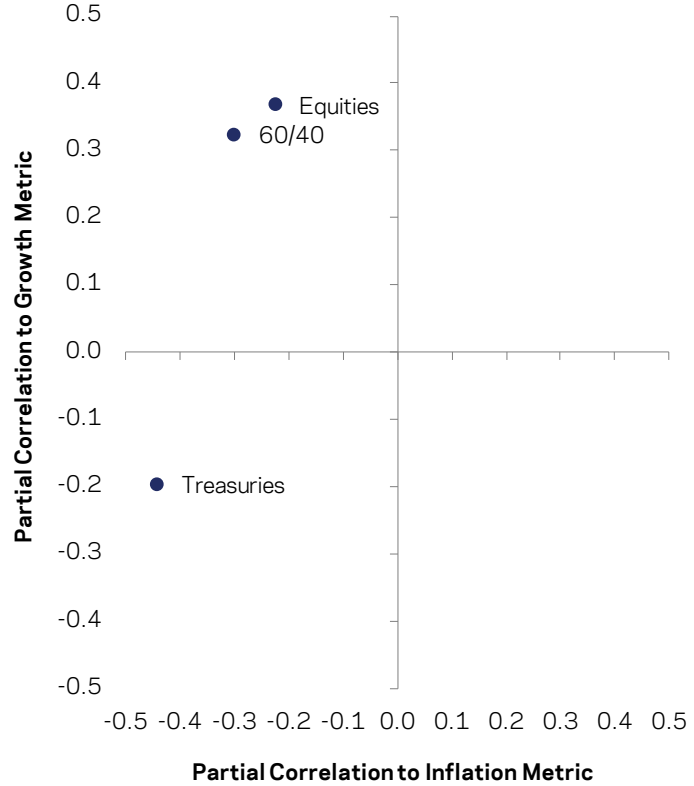
12 The topic of time-varying correlation between asset classes is an important one deserving of more in-depth study. For a richer and more complete analysis, see Brooks and Ilmanen (2022).

Exhibit 2: Historical Inflation and Growth Sensitivities of U.S. Equities and Treasuries 1972-2021

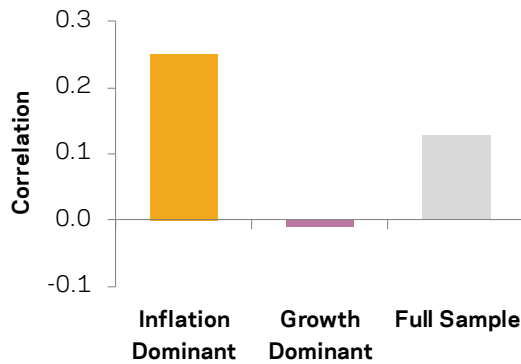
a. Inflation Sensitivity



b. Growth and Inflation Sensitivities



c. Stock-Bond Correlation



Source: AQR, Bloomberg, Survey of Professional Forecasters, U.S. Bureau of Labor Statistics. Sensitivities are simple (chart a) and two-factor partial (chart b) correlations to inflation and growth metrics described in main text. See Appendix for details of asset class proxies.

III. Exploring Real Assets

If neither stocks nor bonds will offer investors refuge in periods of rising inflation, we look to additional assets that may in **Exhibit 3**. The first is a simple proxy for U.S. real estate that combines popular listed and unlisted indices (FTSE Nareit All REITs and NCREIF Property Index respectively). This composite has a substantial negative sensitivity to inflation changes (albeit slightly milder than equities). The resilience of a given real estate investment will depend on how easily revenues can rise with inflation. But the asset class likely also shares some of equities’ exposure to the instability and risk aversion associated with higher inflation, as well as some bond-like exposure to mortgage rates.

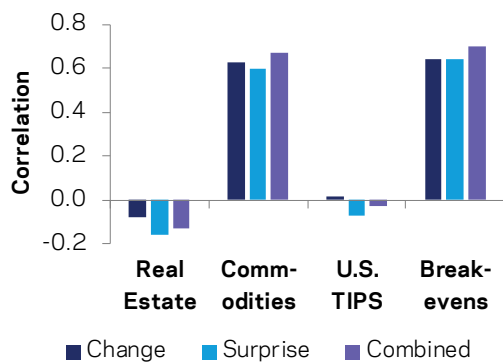
We next analyze a basket of commodities represented by the S&P GSCI Index. Here, we see a meaningful positive inflation sensitivity. This stands to reason – commodities are physical assets whose prices may be expected to rise in an inflationary scenario where a fiat currency (like the U.S. dollar) devalues. Commodity prices – including retail gasoline and food prices – are also a key input to many components of the CPI. It’s worth noting that in our data sample, the most extreme episodes of inflation – occurring in the 1970s and 1980s – were catalyzed by rising energy prices, making it unsurprising that commodities as an asset class shows high sensitivity. While this raises the possibility that the result is specific

to this sample, energy inputs remain one of the most volatile components of the CPI with the ongoing potential to drive future inflationary episodes. An analysis of commodity sub-sectors (see Appendix) finds some heterogeneity across sectors, with energies having the strongest empirical sensitivity. Precious metals, often cited as potentially attractive inflation hedges due to their role as

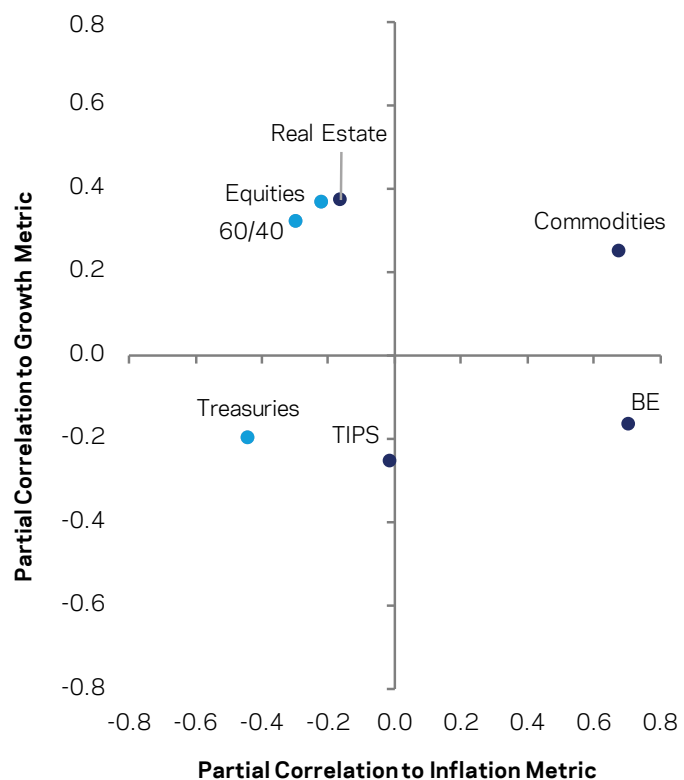
an alternative store of value in scenarios where faith reduces in fiat currencies, also score quite strongly. Of note, the broad commodity basket has a stronger sensitivity than any individual commodity sector, highlighting the benefits of a diversified allocation, which may provide protection in a broader array of inflationary scenarios.

Exhibit 3: Historical Inflation and Growth Sensitivities of Alternative Assets 1972-2021

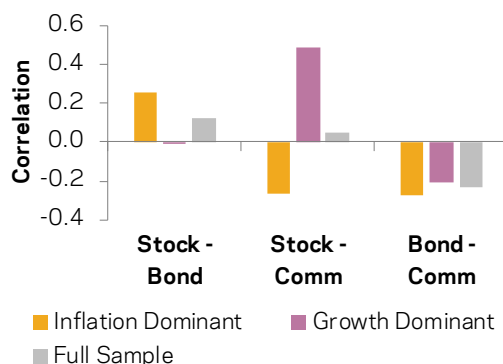
a. Inflation Sensitivity



b. Growth and Inflation Sensitivities



c. Stock, Bond and Comm Correlations



Source: AQR, Bloomberg, Survey of Professional Forecasters, U.S. Bureau of Labor Statistics. Sensitivities are simple (chart a) and two-factor partial (chart b) correlations to inflation and growth metrics described in main text. See Appendix for details of asset class proxies.

Finally, we analyze inflation-linked bond strategies including outright allocations to Treasury Inflation Protected Securities (TIPS), as well as an “Inflation Breakeven” (BE) strategy which pairs a long TIPS position with a duration-matched short position in a nominal

treasury security. Given the short available history for TIPS, we simulate a longer data set using nominal bond yields and inflation forecasts so that we can perform analysis for our full data sample.¹³ In the analysis, TIPS show near zero inflation sensitivity, which

13 We subtract long-term inflation forecasts from nominal yields to get ex ante real yields, and then use these to derive synthetic implied TIPS returns. Forecast sources are based on availability: 1972-1978, statistical estimates by Kozicki-Tinsley (2006); 1978-1989, average of 2-3 available surveys (Hoey, Livingston, Survey of Professional Forecasters, Blue Chip Economic Indicators, Consensus Economics); 1990-1997, Consensus Economics.

is intuitive. TIPS principal and coupon are adjusted for inflation such that holders (to maturity) are guaranteed a fixed real return that does not vary with the level of inflation – consistent with a zero correlation. The primary driver of shorter-term TIPS returns is variation in real interest rates, to which TIPS have duration exposure; the empirical finding indicates that this variation has been unrelated to our inflation metric on average.

In contrast, the BE position shows a strong positive correlation comparable to that of commodities. Importantly, the positive correlation of BE is greater than the spread between the observations for TIPS and nominal bonds; by hedging out real interest rate sensitivity, the BE achieves a purer exposure to changes in inflation expectations.

As in Section I, we next explore the relationship to inflation conditioned on growth in Panel B. Recall that for stocks, bonds and 60/40, we observed negative inflation

sensitivity in all cases. For the new assets, we see more heterogeneity in the inflation dimension. Real estate sits disappointingly close to equities, commodities and inflation breakevens retain their positive inflation sensitivity even when controlling for growth, while TIPS remains near-zero related to inflation. In terms of growth sensitivity, real estate and commodities are positively related, while TIPS and BE are negatively related.

The study of real assets also provides an opportunity to extend the correlation analysis from Section I to commodities. While commodities consistently diversify bonds across environments, their diversification relative to stocks manifests most pronouncedly in periods when inflation news dominates; in periods where growth shocks are larger (as in the 2010s), they have a positive correlation. Economic intuition and empirical evidence indicate real assets can provide good diversification in inflation-dominant periods.

IV. Non-Linearities and Alternative Strategies

So far, we have reported the sensitivity of traditional and real assets to inflation and growth news using linear correlation metrics. But what if investments exhibit different sensitivities to upside and downside inflation shocks? In **Exhibit 4** we display potential non-linear effects by conducting a trile sort of returns relative to the inflation environment. In particular, we separate periods when our combined inflation news metric has a z-score less than -1, a z-score between -1 and 1, and a z-score greater than 1. In each of these periods, we report the average return for selected asset

classes, scaled to 10% volatility for ease of comparison.

Starting with traditional assets, we see that while both stocks and bonds underperformed during inflationary environments as previously noted, they had differing reactions when inflation news was negative. Bonds strongly outperformed in these environments, while stocks underperformed their average. The 60/40 portfolio falls in between, though also shows mild underperformance. One possible cause of the ‘frown’ pattern for stocks is that

adverse growth shocks may have coincided with (or caused) many of the disinflationary shocks in our sample. In the appendix we show upside and downside correlations controlling for growth, and find the non-linear pattern to be weaker but still visible. This remaining non-linearity may be the result of an imperfect proxy for growth, or caused by heightened risk aversion from investors in environments where the combination of economic shocks and policy responses has driven inflation away from central bank targets in either direction.¹⁴

For commodities and inflation breakevens, the empirical relationship appears linear, with strong outperformance in inflationary periods and strong negative performance in the opposite. This raises a potential concern in significant allocations to these assets: portfolio losses during disinflationary adverse growth shocks may be exacerbated. It would therefore be attractive to find solutions that offer inflation protection without other economic exposures that may compound existing portfolio risks.

We introduce two active strategies:¹⁵

1. A hypothetical **trend following** strategy that takes long and short positions in global macro instruments based on trailing 1-, 3- and 12-month price trends.

2. A hypothetical **macro momentum** strategy that takes long and short positions in global macro instruments based on 12-month trends in economic variables including inflation, growth, international trade, monetary policy and risk sentiment.

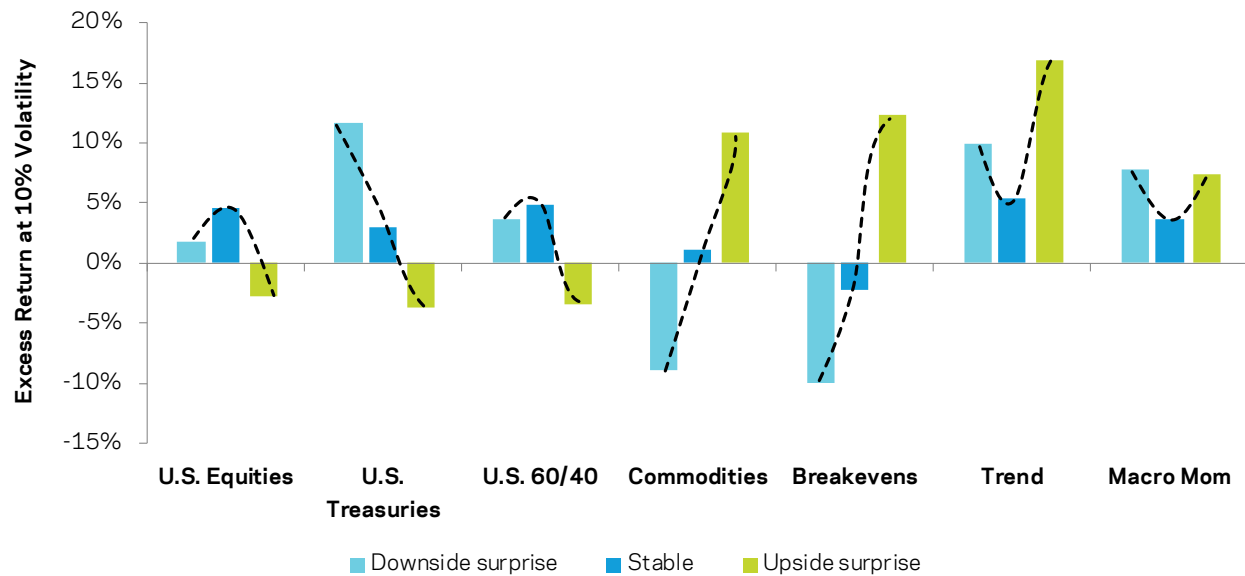
Both of these strategies tend to have the opposite characteristic of stocks; they are seen to benefit from inflation news in either direction. The “convexity” property of price trend following strategies with respect to equity market outcomes has been well documented:¹⁶ not only have these strategies been profitable on average but a preponderance of returns are accrued in extreme market environments. Here, we see the convexity extends to macroeconomic news. This characteristic is also inherited by the macro momentum strategy which directly incorporates trends in inflation, among other things, in forming its positioning. An interpretation of this result is that environments of extreme inflation news and associated price reactions do not occur out of the blue; they tend to be persistent enough that trend following strategies can pick up on them at some point in the cycle and position accordingly. Conversely, in the stable inflation environments in which stocks have done best, these strategies have tended to underperform.

14 It is difficult to identify economic causes from our data and further study may be warranted. One potential concern with disinflationary episodes is a loss of central bank ability to conduct traditional monetary policy due to possible lower bounds on nominal interest rates.

15 Our choice of these two, among many, alternative strategies is motivated by an economic prior on potential sensitivity to inflation, given their ability to take meaningful directional risk to inflation sensitive assets. Other “market neutral” alternative strategies may be expected to have limited sensitivity (see Ilmanen, Maloney and Ross, 2014), while conversely, those that load on equity or bond market factors (like the aforementioned private equity, or long-biased credit) would be expected to inherit the sensitivity of those market factors.

16 See for example Hurst, Ooi and Pedersen (2017).

Exhibit 4: Frowns, Smirks and Smiles - Tritile Sort of Returns Relative to Inflation Environment 1972-2021



Source: AQR, Bloomberg, Survey of Professional Forecasters, U.S. Bureau of Labor Statistics. Downside and upside surprise periods are defined as periods when inflation news metric has z-score <-1 and >1 respectively, with the rest of the sample categorized as stable. See Appendix for proxies and construction of hypothetical portfolios. Hypothetical performance results have certain inherent limitations, some of which are disclosed in the Appendix.

V. Putting It All Together

So far, we have seen that both components of traditional stock-bond portfolios have tended to underperform when inflation rises, indicating a concentrated exposure to upside inflation shocks. We also presented several “real assets” and active strategies that had the opposite characteristic and tended to outperform in these periods. How should investors holding predominantly stock-bond portfolios consider allocating to these additional assets? It depends on the objective. If the focus is simply to address upside inflation risk, they may choose an allocation to the purest hedge: inflation breakevens. In doing so, they should recognize that this allocation, while helping address inflation concerns, might incur a

cost over the long term.¹⁷ This may still be an attractive option, particularly if the objective is to implement a tactical “trade” on inflation based on a shorter-term view.

A different approach is to seek to improve macroeconomic diversification across compensated return sources. From this perspective, commodities may be an attractive allocation given the combination of positive inflation exposure with a long-term positive risk premium. This is consistent with “risk parity” approaches where equity, bond and commodity allocations are typically given equal prominence in portfolio construction. Our analysis (not reported here) confirms that

¹⁷ Investors may be expected to pay to hedge or insure against inflation risk, assuming there is a positive inflation risk premium. This may be offset to some extent by a (time-varying) liquidity premium due to the lower liquidity of TIPS relative to their nominal counterparts.

a risk parity portfolio may be more resilient to inflation shocks.¹⁸

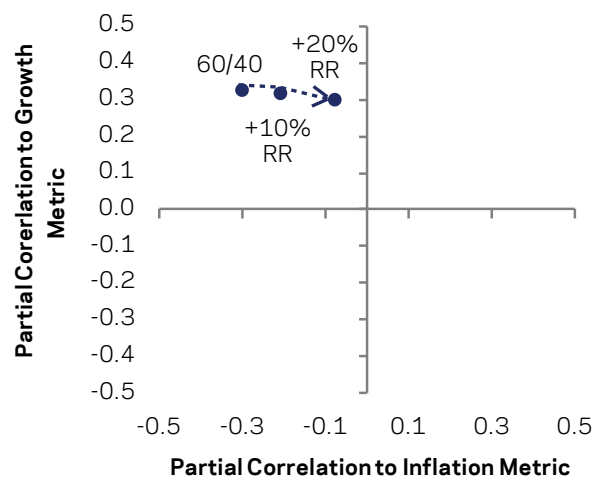
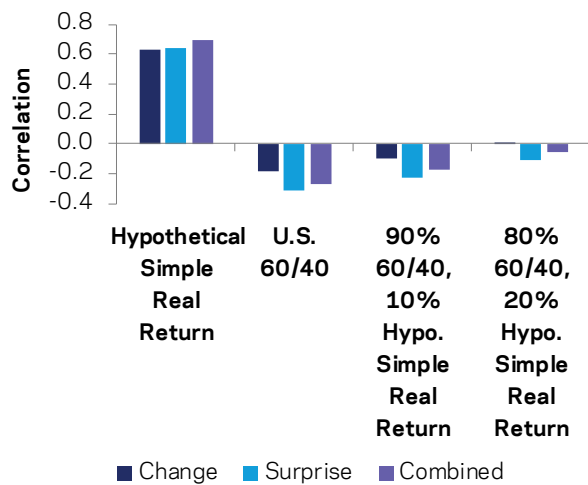
Lastly, an investor may seek to dilute portfolio macroeconomic exposures via allocations that hedge such exposures, such as market-neutral alternatives, or strategies exhibiting positive exposure to economic extremes, such as the trend and macro momentum strategies described in this paper.

We take a balanced approach by creating a “simple real return” strategy with a 25% risk allocation to each of inflation breakevens, commodities, trend, and macro momentum. We compare the results for this portfolio, along the dimensions previously considered, with those of the traditional 60/40 portfolio, and portfolios that start with 60/40 and allocate

10% or 20% to this new portfolio (Exhibit 5), though of course investors may choose individual components most suited to their objectives.

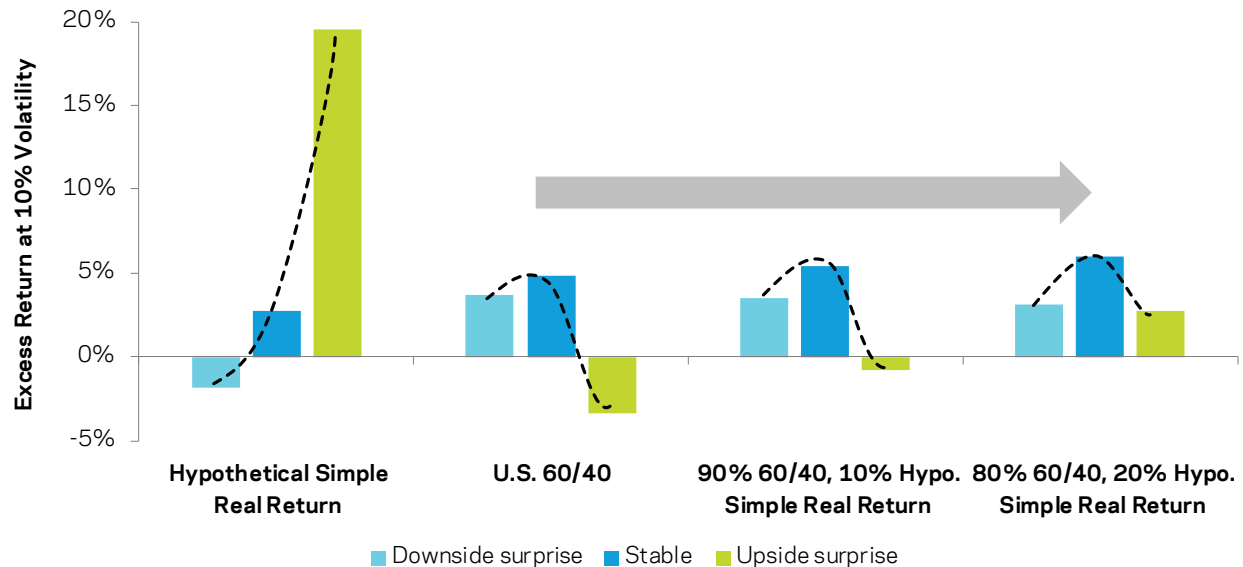
As expected, we find that the hypothetical real return portfolio has a large positive inflation sensitivity - a correlation to our inflation metric of near 0.7 - with or without the growth control variable. Thus, even moderate allocations to this hypothetical portfolio can reduce the negative correlation of 60/40 to near zero. A 20% allocation shifts the correlation from -0.27 to -0.05 (from highly statistically significant to insignificant). In our tritile sort, we see that the tendency of 60/40 to underperform in inflationary environments is ameliorated meaningfully by an allocation to this real return portfolio.

Exhibit 5: Impact of ‘Real Return’ Allocation on Historical Inflation Sensitivities 1972-2021
a. Inflation Sensitivities b. Growth and Inflation Sensitivities



18 Risk parity typically includes larger nominal bond exposure than 60/40, but also introduces commodities. The inflation sensitivities of these two differences are offsetting. But in aggregate, we find risk parity to be the more resilient across both growth and inflation regimes.

c. Tritile Sort of Return by Inflation Environment



Source: AQR, Bloomberg, Survey of Professional Forecasters, U.S. Bureau of Labor Statistics. Sensitivities are simple (chart a) and two-factor partial (chart c) correlations to inflation and growth metrics described in main text. 'RR' is hypothetical simple real return as defined above. Downside and upside surprise periods (chart c) are defined as periods when inflation news metric has z-score <-1 and >1 respectively, with the rest of the sample categorized as stable. See Appendix for proxies and construction of hypothetical portfolios. Hypothetical performance results have certain inherent limitations, some of which are disclosed in the Appendix.

VI. Conclusion

Recent economic events have increased concerns around the potential for unexpectedly high inflation - a scenario that our empirical analysis suggests may be challenging for stock-bond portfolios. Not only are such portfolios concentrated in terms of asset exposures, with equity risk dominating, but also in terms of *inflation* exposure, with both components tending to have worse-than-average returns during inflationary outcomes. In the case of bonds, this exposure has been linearly negative, while equities show some tendency to underperform during falling inflation periods as well.

By studying alternative assets we can identify potential solutions. Some real assets, notably

commodities and inflation breakevens, have meaningful positive inflation sensitivity, though real estate and unhedged TIPS show negative and near-zero inflation correlations respectively. In addition, active strategies such as trend following and macro momentum show positive convexity to the inflation environment, i.e., the opposite characteristic to that of equities.

Allocations to a diversified combination of commodities, inflation breakevens, global macro, and trend following can thus help meaningfully to offset a traditional portfolio's concentrated exposure to inflation.

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Appendix

Inflation Sensitivities for Additional Assets and Sectors

Exhibit A1 Panel A shows inflation sensitivities for 11 U.S. equity sectors. While the broad market has a negative sensitivity, the sectors show considerable variation. The energy sector stands out as having thrived in times of rising inflation, while real estate, materials and industrials have shown more resilience than other sectors. The most vulnerable sectors have been consumer staples (often considered bond-like) and consumer discretionary, where eroding purchasing power may hit hardest.

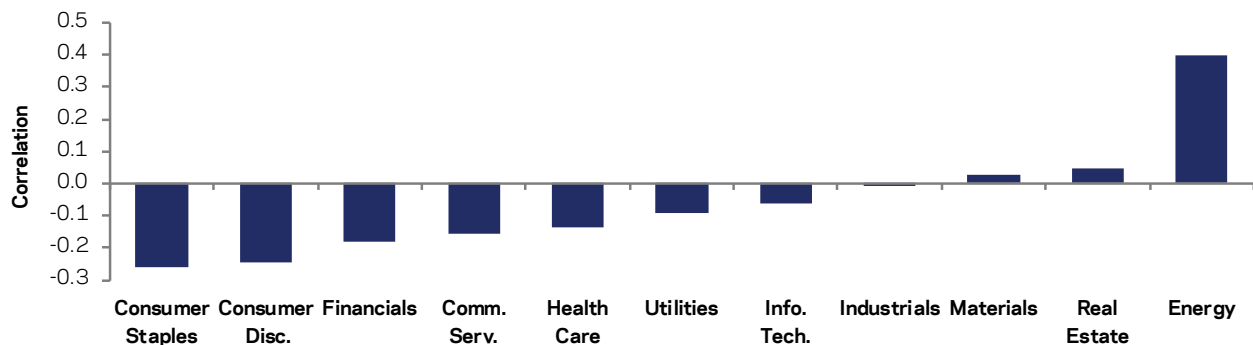
Panel B compares inflation sensitivities of U.S. equities and unhedged non-U.S. developed

market equities. Unhedged international equities have tended to offer more resilience when inflation rises, partly because episodes of domestic inflation tend to put pressure on the local currency. International assets may be less helpful in the case of a global inflation shock.

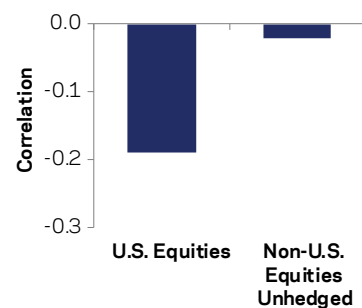
Panel C shows sensitivities for commodity sub-sectors and portfolios. Broad portfolios (whether equal- or production-weighted) have sensitivities as high as, or higher than, the highest individual sector, as well as having earned substantially higher risk-adjusted returns than narrower sector investments over the long term (see Levine et al., 2018).

Exhibit A1: Inflation Sensitivities for Additional Assets and Sectors

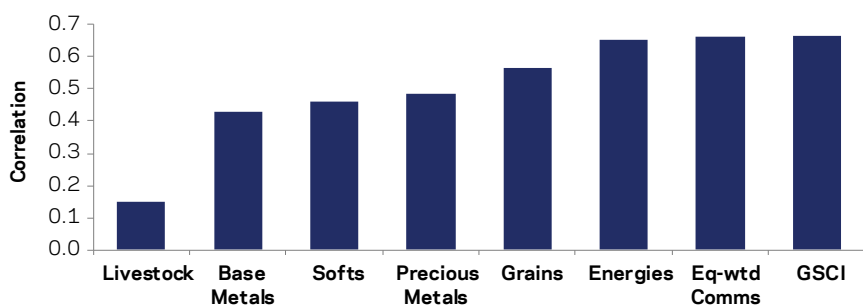
a. U.S. Equity Sectors 1974-2021



b. U.S. and Non-U.S. Equities 1972-2021



c. Commodity Sectors and Portfolios 1972-2021



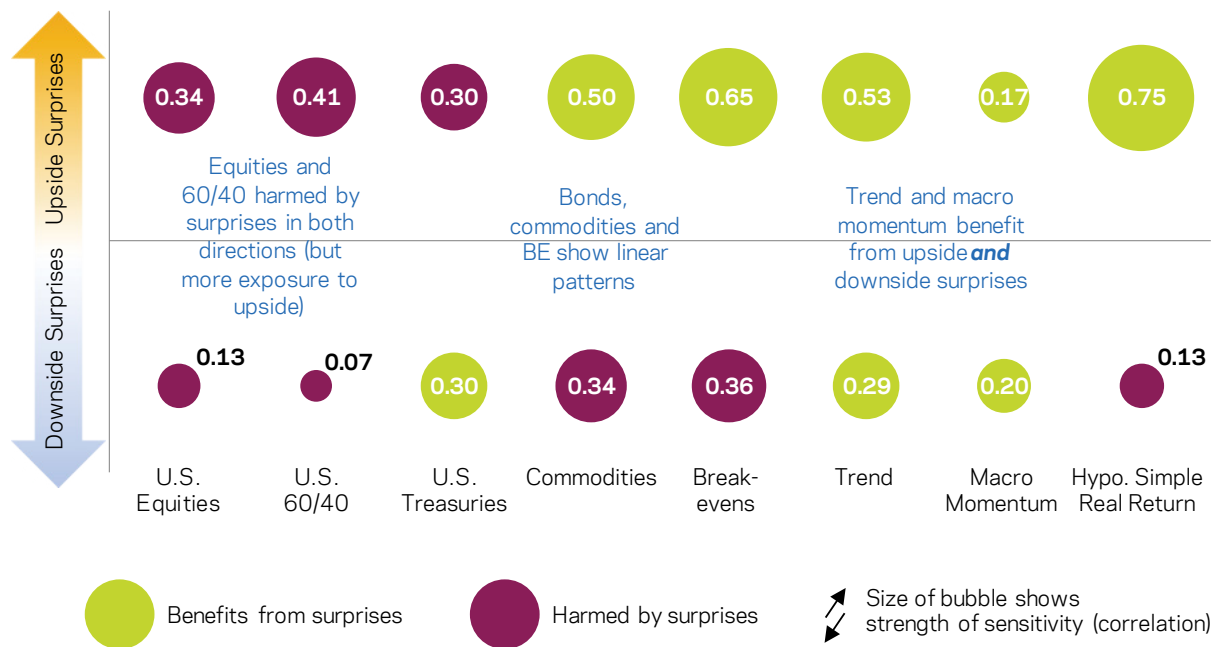
Source: AQR, Bloomberg, Survey of Professional Forecasters, U.S. Bureau of Labor Statistics. Sensitivities are simple correlations to inflation metric described in main text. Base metals data start only in 1977, energies in 1983. See Appendix for details of asset class proxies.

Testing for Non-Linear Inflation Sensitivities After Controlling for Growth

To complement the trile analysis in the main article, we also conduct an upside/downside correlation analysis that controls for growth exposure. We divide our 50-year sample into two sub-samples based on the sign of our combined inflation metric, and compute partial correlations to inflation and growth metrics in each sub-sample. The bubbles in **Exhibit A2** indicate the magnitudes of partial correlations to inflation in the periods of

positive inflation news (top row) and negative news (bottom row). The color indicates the sign: green means the investment has seen outperformance associated with news of that sign, while red means it has tended to underperform. Where an investment has two green or two red bubbles, this indicates a non-linear sensitivity to inflation after controlling for growth. The chart confirms that equity sensitivity retains some non-linearity (negative convexity) after controlling for growth (see main article), and also that trend and macro momentum strategies retain their valuable positive convexity.

Exhibit A2: Upside and Downside Inflation Sensitivities 1972-2021



Source: AQR, Bloomberg, Survey of Professional Forecasters, U.S. Bureau of Labor Statistics. Sample divided into positive and negative inflation metric sub-samples, then for quarterly overlapping 1-year asset returns partial correlations are computed to contemporaneous inflation and growth metrics. Partial correlations to inflation reported in chart. See Appendix for proxies and construction of hypothetical portfolios. Hypothetical performance results have certain inherent limitations, some of which are disclosed in the Appendix.

Asset Class Proxies for Inflation Sensitivity Analysis

Investment	Proxy	Source
U.S. Equities	MSCI U.S. Net TR Index	Bloomberg
Non-U.S. Equities	MSCI World ex U.S. Net TR Unhedged Index	Bloomberg
U.S. Treasuries	10-year U.S. Treasury	GFD
U.S. 60/40	60% U.S. Equities, 40% U.S. Treasuries as defined above	Bloomberg, GFD
B/E Inflation	Long 10-year U.S. TIPS, short 10-year U.S. Treasury	Bloomberg, GFD
U.S. TIPS	From 1997, U.S. 10-year TIPS. Before 1997, synthetic returns based on nominal Treasury yields and survey-based expected inflation.	Bloomberg
Real Estate	50% FTSE Nareit All REITs Index (listed), 50% NCREIF Property Index (unlisted)	Bloomberg
Commodities	S&P GSCI Total Return Index	Bloomberg
Trend Following	Hypothetical trend following strategy as described in <i>A Century of Evidence on Trend-Following Investing</i> by Hurst, Ooi and Pedersen (2017). The strategy goes long markets that have been rising and going short markets that have been falling, betting that those trends over the examined look-back periods will continue. The strategy was constructed with an equal-weighted combination of 1-month, 3-month, and 12-month trend-following strategies for 67 markets across 4 major asset classes: 29 commodities, 11 equity indices, 15 bond markets, and 12 currency pairs. Returns are net of estimated transaction costs and 2 & 20 fees.	AQR
Macro Momentum	Hypothetical long/short and directional strategies applied to 15 equity indices, 9 government bond markets, and 9 currencies, with signals based on the following macro momentum themes as described in <i>A Half Century of Macro Momentum</i> by Brooks (2017): Business Cycle, International Trade, Monetary Policy, Risk Sentiment. The strategy goes long assets for which fundamental momentum is favorable and short assets for which it is unfavorable. Returns are net of estimated transaction costs and 2 & 20 fees.	AQR

Note: All asset class proxies and 60/40 are presented gross of transaction costs and fees.

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The **MSCI U.S. Index** is a free float-adjusted market capitalization index that is designed to measure the performance large and mid cap equities in the United States.

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The **FTSE Nareit All REITs Index** is a market capitalization-weighted index that includes all tax-qualified real estate investment trusts (REITs) that are listed on the New York Stock Exchange, the American Stock Exchange or the NASDAQ National Market List.

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

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.

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