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## Drivers and Implications

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## KEY FINDINGS

- Historically, equity and bond markets have exhibited opposite-sign sensitivities to growth news and same-sign sensitivities to inflation news. According to a simple model, the stock–bond correlation thus depends not on the level of inflation, but on the relative volatility of growth and inflation and the correlation between them.
- Empirically, this model explains around 70% of long-term variation in the US stock–bond correlation, with similar results internationally. It is less successful at explaining short-term fluctuations.
- If a sustained rise in inflation uncertainty drives the correlation higher in the present decade, investors can make up the diversification deficit by raising allocations to alternative diversifiers, such as dynamic liquid alternatives and commodities.

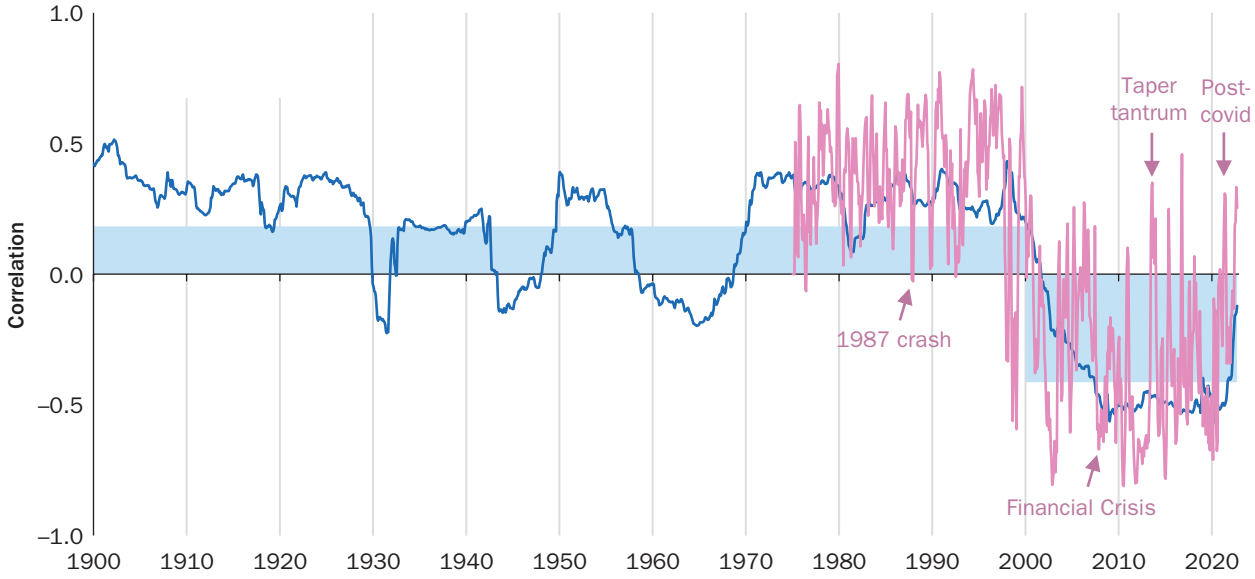
## ABSTRACT

The relationship between stock and bond returns is a fundamental determinant of risk in traditional portfolios. For the first two decades of the 21st century, the stock–bond correlation was consistently negative and investors were largely able to rely on their bond investments for protection when equities sold off. But this was not the case in the previous century, and macroeconomic changes—such as higher inflation uncertainty—could lead to a reappearance of the positive stock–bond correlation of the 1970s, 80s, and 90s. This would have broad implications for investors, either increasing portfolio risk or forcing allocation changes likely to reduce expected returns. This article analyzes the implications for investors of a change in this "golden parameter" and presents a simple macroeconomic model to help understand its drivers, supported by international empirical evidence. Finally, it explores the role of alternatives in making up the potential diversification deficit in a positive stock–bond correlation world.

For most of the last 100 years, equities have served as the dominant return generator in many portfolios, with bonds as the chief diversifier. In the last 20 years, however, the relationship between the two asset classes has been quite different from earlier history, as Exhibit 1 shows. Bonds have not just diluted equity risk—as they did for most of the 1900s—but have tended to deliver positive returns when equity markets suffered losses. For younger investors, this reassuring offsetting behavior has been their only experience (except for a few brief episodes of simultaneous stock and bond losses, such as the 2013 "taper tantrum," visible in the short-term pink line on the chart). But go back a bit farther, and history tells

## EXHIBIT 1

**Rolling Correlation between US Equity and US Treasury Returns, January 1, 1900–September 30, 2022**




**NOTES:** Rolling 10-year series based on overlapping three-month returns at monthly frequency. Rolling three-month series based on overlapping three-day returns at daily frequency. Shading shows average correlations in the 20th and 21st centuries.

a different story, one in which a negative stock–bond correlation (henceforth, SBC) has been the exception, not the rule.[1]

What could be the catalyst for a reemergence of the positive SBC we have seen historically? Some investors assumed that record low short-term interest rates and bond yields would threaten stock–bond diversification, fearing that yields would not be able to fall further to cushion equity losses. However, low yields in themselves have not been a major problem for stock–bond diversification.[2] While some markets with deeply negative yields may have seen some impairment of stock–bond diversification at times, the last decade has proved that, in general, strong diversification is still possible in a low yield environment. Indeed, the 2010s saw the stock–bond correlation hover around its lowest value in the last 120 years. Others have pointed to the level of inflation, noting that inflation rates were generally higher during periods of positive SBC. But was that the real catalyst?

In this article, we begin by illustrating the implications of a changing SBC on portfolio risk and return. We then explore the theoretical drivers of the SBC and create a framework for understanding it. We find the key determinant to be not the level of inflation but the relative importance of inflation uncertainty and growth uncertainty—as well as the relationship between growth and inflation news. Finally, we discuss ways investors could prepare for the possibility of a higher SBC and provide a menu of alternative diversifiers that could help create portfolios more resilient to this outcome.

[1] See Ilmanen (2003) for early evidence of the correlation sign change and literature references. See Shiller and Beltratti (1992) for an even earlier treatment from the era of positive SBC. Importantly, most literature, including this article, focuses on virtually default-free government bonds such as US Treasuries. Equity correlations are clearly higher for corporate bonds or sovereign bonds with higher perceived default risk. These can be thought of as having a default-free component and a spread component. For corporates, the spread risk is correlated to equity risk (see Asvanunt and Richardson 2017). On the equity side, we focus on the broad market but also discuss bond correlations for different sector and style portfolios.

[2] See Brooks (2021) for a discussion of the drivers of bond yields, including the impact of potential lower bounds.

## IMPLICATIONS OF A CHANGING STOCK–BOND CORRELATION

Before we consider the drivers of stock–bond diversification, we ask: why does it matter? What would the consequences be of a higher SBC? Most obviously, a higher SBC would mean greater risk for stock–bond portfolios. In Exhibit 2, Panel A, we show (in dark blue) the expected volatility of a 60/40 stock–bond portfolio at different levels of assumed correlation between the two asset classes. If the SBC rises from −0.5 to +0.5, 60/40 portfolio volatility increases by around 20%.[3] The red lines show the impact on two measures of downside risk—12-month value at risk (VaR) and largest drawdown—based on simulated data. Both increase by about 30% from left to right.[4]

Such a change in risk profile might require meaningful allocation changes, as we illustrate in Panel B. If risk tolerance stays the same, investors would need to decrease their equity allocation to maintain constant portfolio risk, and this equates to lower expected returns for the portfolio (a reduction from 3.5% return at −0.5 to 3.0% return at +0.5). In other words, asset class diversification is not just about risk—it's about returns, too.

Note that for pension funds and other investors with explicit liabilities, the impact of the SBC is more ambiguous. A negative correlation is not at all helpful if it means assets shrink at the same time that liabilities grow because of falling discount rates (as occurred during the Global Financial Crisis). Conversely, a positive correlation is not so bad if it means both sides of the balance sheet move together.

Also, pension funds' bond holdings may be primarily intended as liability hedges rather than equity risk diversifiers. This means that while some investors may only now be looking beyond bonds for diversification, many pension funds are already familiar with the search for alternative diversifiers.

There may be another indirect consequence of a higher SBC. Economic reasoning would suggest bonds' negative equity beta since 2000 contributed to their high valuation, as investors were willing to hold bonds at a lower expected return given their valuable diversification. Of course, realized returns were high, not low, during this period. But this need not be at odds with lower expected returns as investors may have expected mean reversion in yields (and policy rates) that never manifested. If this is true, the reemergence of a positive SBC, by making bonds less-valuable diversifiers, would probably also raise their yields. This would make the transition even more painful for stock–bond investors, but in the long term, it may increase bonds' expected returns.

## WHAT DRIVES THE STOCK–BOND CORRELATION?[5]

To determine what drives variation in the SBC we need to understand the fundamental macroeconomic drivers of stock and bond returns: growth and inflation. Positive growth news raises equity investors' expectations of future cash flows and, hence, equity prices. It also raises expectations for short-term interest rates, through both the systematic response of central banks and through its influence on the

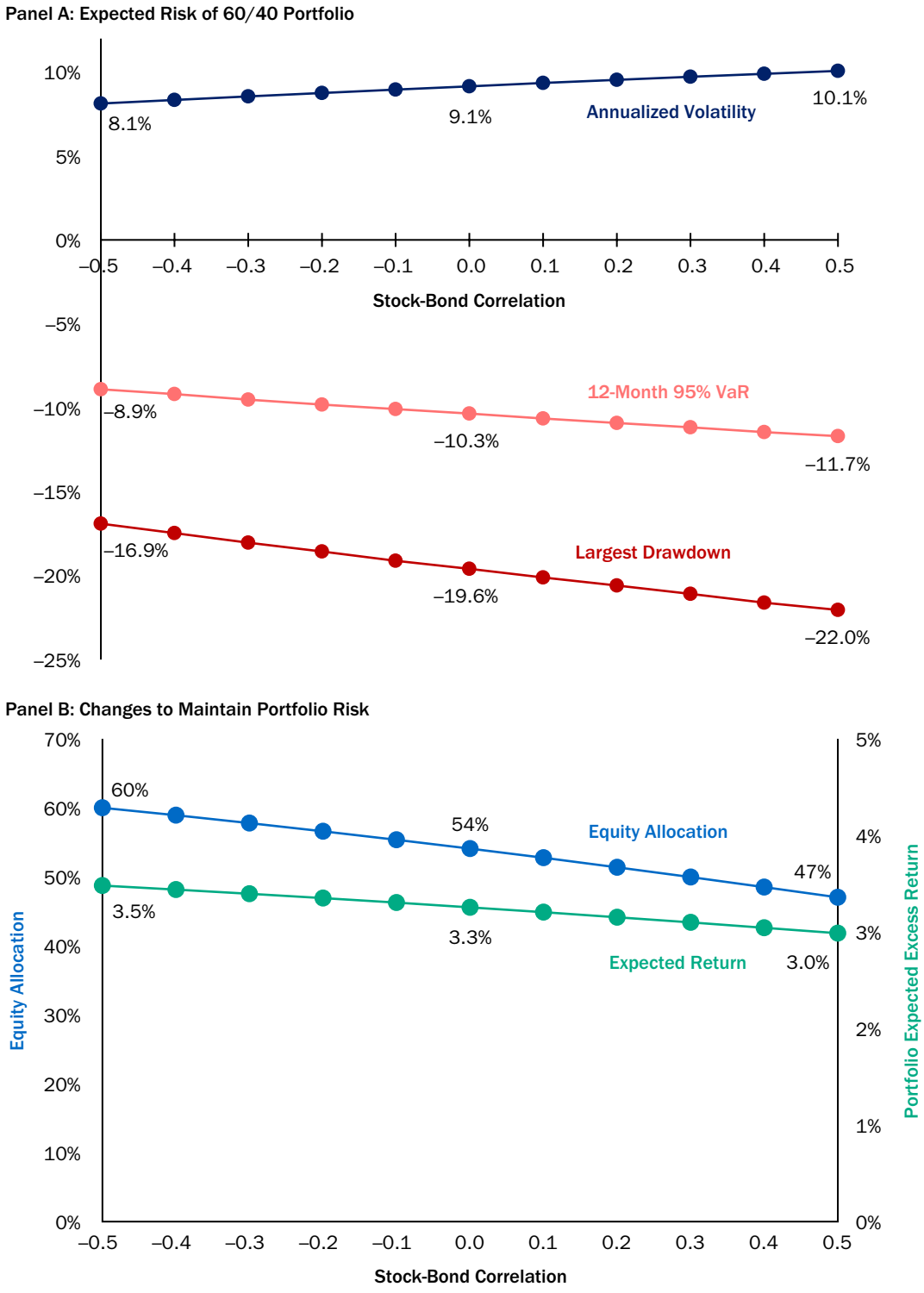
[3] How meaningful is a 20% increase in volatility? If stocks and bonds were zero correlated it is the difference between a 73/27 and 60/40 stock–bond mix. In a nutshell, meaningful!

[4] Implications would be directionally similar for any portfolio dominated by stocks and bonds and for alternative measures of risk. For stock–bond portfolios with better risk balance and hence more diversification (such as 40/60), the impact of a change in correlation would be even larger.

[5] There is an extensive literature on stock–bond comovement, typically examining interactions between real rates, expected cash flow growth, and expected inflation. See, for example, David and Veronesi (2016), Baz, Sapra, and Ramirez (2019), or Campbell, Sunderam, and Viceira (2017), and references therein.

## EXHIBIT 2

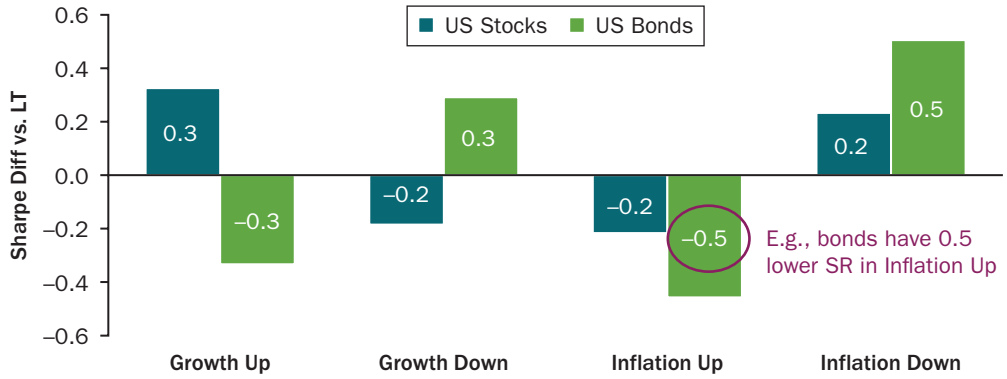
### Implications of Changing Stock–Bond Correlation for a 60/40 Portfolio




**NOTES:** Hypothetical 60/40 stock–bond portfolio based on assumption of 15% volatility for stocks and 4% volatility for bonds, with 0.3 Sharpe ratio for each asset class. Volatility, VaR, and drawdown estimates are medians from 100,000 10-year simulations with monthly, normally distributed returns. For Panel B, we solve for the weights required to maintain portfolio volatility (assuming -0.5 SBC as the base case) as we increase the stock–bond correlation assumption.

## EXHIBIT 3

### Sharpe Ratio Differentials by Macroeconomic Environment, January 1, 1972–June 30, 2022




**NOTES:** US Stocks are the S&P 500. US Bonds are nominal 10-Year US Treasuries. Each quarterly 12-month period is classified as "up" or "down" by comparing the indicator value to its full sample median. The growth indicator is an average of two normalized series: 1) the Chicago Fed National Activity Index (a monthly composite of 85 indicators of US economic activity) and 2) the surprise in industrial production growth over the past year (difference between realized IP growth and Survey of Professional Forecasters forecast a year earlier). The inflation indicator is also an average of two normalized series: (1) the level of year-on-year inflation and (2) the inflation surprise (difference between realized inflation and Survey of Professional Forecasters forecast a year earlier).

equilibrium real interest rate (or "r-star"), so bond prices fall.[6] In other words, stocks and bonds have opposite-signed sensitivities to growth news. What about inflation? Positive inflation news directly reduces the value of bonds' fixed nominal cash flows, as well as raising short-term interest rate expectations, so prices fall. Equities, in theory, give investors a claim on real cash flows, but in practice, rising inflation has usually been associated with falling stock prices. Stocks and bonds therefore have same-signed sensitivities to inflation news.[7]

Exhibit 3 illustrates this contemporaneous relationship using the binary framework of Ilmanen, Maloney, and Ross (2014). We divide 50 years of data into "up" and "down" growth and inflation regimes and calculate the risk-adjusted return (Sharpe ratio) of stocks and bonds in each regime. The chart shows the difference in Sharpe ratio for each asset class in each regime, compared with its full-period average.

Intuitively, equities strongly prefer "growth up" environments, while bonds exhibit the opposite relationship. With regards to inflation, both asset classes prefer "inflation down," although bonds' sensitivity is noticeably stronger. Regressions of returns on proxies for growth and inflation news show similar results.

So, empirically, we find that stocks and bonds have opposite sensitivities to economic growth but directionally similar sensitivities to inflation. In other words, growth shocks drive stock and bond returns in opposite directions, while inflation shocks drive them in the same direction. The *relative importance* of growth and inflation news, therefore, suggests itself as potential driver of the SBC. In the next section, we set out this hypothesis more formally and then test it on nearly a century of data across several markets.

[6] A higher discount rate also puts downward pressure on equity prices, but empirically the change in expected cash flows has tended to dominate this discount rate effect for equities.

[7] This tendency has been well-documented and the reasons much discussed, perhaps starting with Lintner (1975). Possible drivers can be broadly categorized as behavioral or rational, with the former including investors' tendency to discount real cash flows with nominal discount rates (the so-called "money illusion"), and the latter including inflation's impact on firms' operating efficiency, political uncertainty, and long-term expectations for real rates.

## A SIMPLE MODEL TO UNDERSTAND THE SBC

In the previous section, we showed empirical evidence confirming the intuition that stocks and bonds have opposite sensitivities to economic growth, and similar sensitivities to inflation. Now we use this relationship to create a simple model linking unexpected returns to inflation and growth news, assuming that stock returns ($r_t^s$) and bond returns ($r_t^b$) are driven by growth shocks ($e_t^g$) and inflation shocks ($e_t^\pi$).

$$r_t^s - E_{t-1}r_t^s = b_g^s e_t^g + b_\pi^s e_t^\pi \quad (1)$$

$$r_t^b - E_{t-1}r_t^b = b_g^b e_t^g + b_\pi^b e_t^\pi \quad (2)$$

where $b_g^s > 0$ and $b_\pi^s, b_g^b, b_\pi^b < 0$

Stocks like growth but dislike inflation

Bonds dislike growth and inflation

According to this model, the covariance between stocks and bonds is

$$\text{cov}_t(r_s, r_b) = (b_{s,g}b_{b,g})\sigma_{g,t}^2 + (b_{s,\pi}b_{b,\pi})\sigma_{\pi,t}^2 + (b_{s,g}b_{b,\pi} + b_{s,\pi}b_{b,g})\sigma_{g,\pi,t} \quad (3)$$

When growth variance is high, SBC tends to be negative

When inflation variance is high SBC tends to be positive

Growth–inflation covariance can also matter—see later

The covariance tends to be negative when growth variance is high (the betas of stocks and bonds to growth are positive and negative respectively—so their product is negative) and positive when inflation variance is high (the betas of stocks and bonds to inflation are both negative, so their product is positive). This is consistent with our intuition from the previous section that stocks and bonds are stronger diversifiers when growth news dominates and weaker diversifiers when inflation news dominates.

We can translate this logic from stock–bond covariance to correlation.[8] Covariance is effectively a volatility-scaled correlation, so any driver of covariance will have the same directional impact on correlation. A consistent model for the SBC links it to growth volatility, inflation volatility, and the growth–inflation correlation:

$$\hat{\rho}_{s,b,t} = c_0 + c_g\hat{\sigma}_{g,t} + c_\pi\hat{\sigma}_{\pi,t} + c_{g,\pi}\hat{\rho}_{g,\pi,t} + \varepsilon_t \quad (4)$$

Model predicts this should be negative

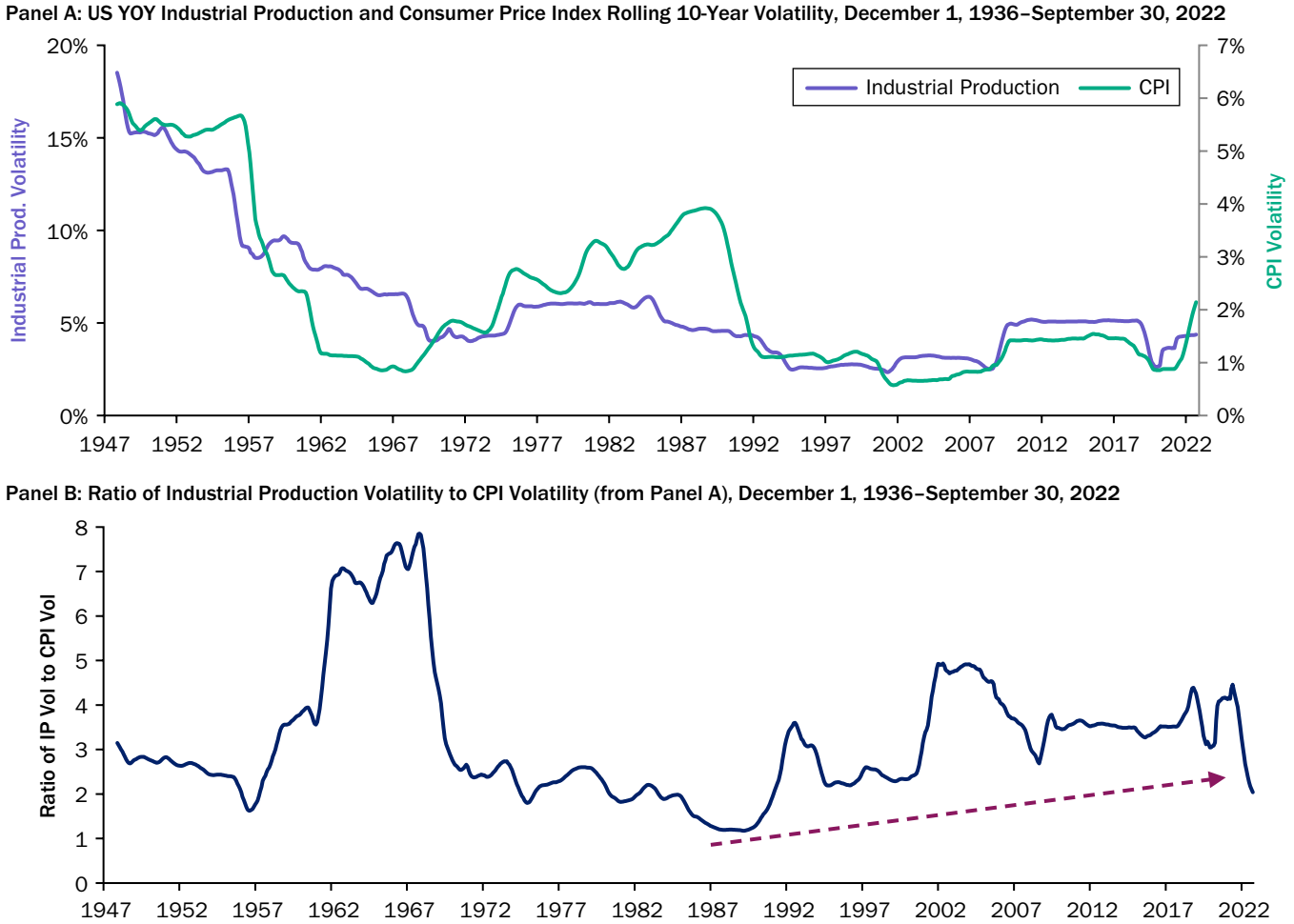
Model predicts this should be positive

We can estimate the coefficients in this model directly by using historical data to estimate its left-hand side (LHS) and three right-hand side (RHS) variables. For *growth uncertainty,* we use rolling 10-year volatility of year-on-year changes in US industrial production, and for *inflation uncertainty,* we use rolling 10-year volatility of

[8] Using a correlation as dependent variable presents statistical challenges, as it is bounded and highly nonnormal near the boundaries. We tested the application of the Fisher transformation to mitigate these challenges. However, because neither the SBC nor the growth–inflation correlation approach +1 or –1 in our sample, the transformation makes very little difference to the results presented.

## EXHIBIT 4

### Data Inputs for Our Simple Model




**NOTES:** US YOY Industrial Production is the 12-month change in Industrial Production. US YOY Consumer Price Index is the 12-month change in the CPI for All Urban Consumers: All Items in US City Average. Panel A is the rolling 10-year realized volatilities of these two series. Panel B is the ratio of the two series in Panel A.

year-on-year percent changes in CPI, both going back to 1936. The third explanatory factor is the *correlation between growth and inflation*, which we proxy with the rolling 10-year correlation between 12-month changes in industrial production and 12-month percentage changes in CPI. We plot our first two explanatory variables in Exhibit 4, Panel A, and their ratio in Panel B. The relative importance of growth uncertainty was trending upwards over the last few decades (red arrow), which is consistent with a fall in stock–bond correlation according to our model. The peak in the early 60s coincides with an earlier dip in the SBC, as shown in Exhibit 1.

We can now use this data to run the regression in Equation (4), using the rolling 10-year US SBC as our dependent variable. The results are shown in Exhibit 5 ("3-Factor" column) and confirm our hypothesis that the SBC is negatively related to growth risk and positively related to inflation risk. Statistical significance is hard to judge in this setting, where our variables are already estimated quantities and we have few independent (10-year) observations. But the economic significance is substantial: an inflation risk beta of 12 implies that a fall in inflation volatility from, say, 4% to 1%

## EXHIBIT 5

### Stock–Bond Correlation Regression Results, December 1, 1936–September 30, 2022

| | 3-Factor | 4-Factor |
|---|---|---|
| Intercept | –0.1 (–1.6) | –0.1 (–1.9) |
| Growth Volatility | –2.0 (–2.2)* | –1.8 (–2.1)* |
| Inflation Volatility | 12.6 (5.4)* | 11.7 (4.0)* |
| Growth–Inflation Correlation | –0.4 (–5.9)* | –0.4 (–5.6)* |
| Inflation Level | | 0.5 (0.4) |
| $R^2$ | 71% | 71% |

NOTES: The table shows regression coefficients with *t*-statistics in parentheses. Asterisks denote relationships significant at the 95% confidence level. US stocks are the S&P 500. US bonds are nominal 10-Year US Treasuries. For the regressions, the LHS variable is the rolling 120-month stock–bond correlation. Growth is the 12-month change in industrial production. Inflation is the 12-month change in the CPI. Growth Volatility and Inflation Volatility use a rolling 10-year window. Growth–Inflation Correlation is the rolling 10-year correlation between growth and inflation. *t*-Statistics are based on Newey–West adjusted standard errors using 119 lags, although this may not fully account for the impact of overlapping observations.

(as occurred from the late 1980s to the early 2000s) is associated with a decline in the SBC of 3% × 12 = 0.36. During periods when growth uncertainty is dominant, as in the last two decades, the SBC is likely to be negative. If we expect higher inflation uncertainty in the 2020s, we might also expect to see a rising SBC.

It is also interesting to note the apparently statistically significant *negative* beta on the third variable—the growth–inflation correlation. This is intuitive: Based on the empirical evidence that stocks have a stronger sensitivity to growth and bonds have a stronger sensitivity to inflation, Equation (3) tells us this coefficient will be negative.[9] During periods in which the economy is moving along a stable Phillips curve (positive growth–inflation correlation), the SBC is more likely to be negative. In the next section, we provide more discussion on the role of this third variable.

What about the *level* of inflation? This is often cited as a determinant of the SBC, but if we add it as a fourth variable in our regression ("4-Factor" column in Exhibit 5), the loading is not significant and the $R^2$ is unchanged. In other words, once you control for inflation *uncertainty*—which is what should matter according to our model—the level of inflation is not a big driver of the SBC. Inflation level and volatility are related—inflation has tended to be more volatile when the level is high—but the distinction is important for a clearer understanding of possible future changes in the SBC. What matters is the magnitude of inflation news relative to growth news, not the direction of that news.

We use the coefficients from Exhibit 5 and our rolling 10-year RHS variables to generate a fitted SBC at each point in time. Exhibit 6 shows this fitted SBC plotted alongside the realized rolling 10-year SBC. The fitted SBC is a good visual match, reflecting the high explanatory power of these three variables (an $R^2$ of 71%).[10] The model captures well the lower-frequency changes in the SBC (positive from the late 1960s through the mid 1980s; negative after 2000), although it misses some of the shorter-lived movements (see the next section).

Which of our model's RHS variables explain more of the variation in the SBC over time? In Exhibit 7, we decompose the variance of the SBC into its three drivers (as well as the portion that is unexplained by the model). It is clear that *inflation risk* explains much more of the variation than *growth risk*, with the growth–inflation correlation also very important.

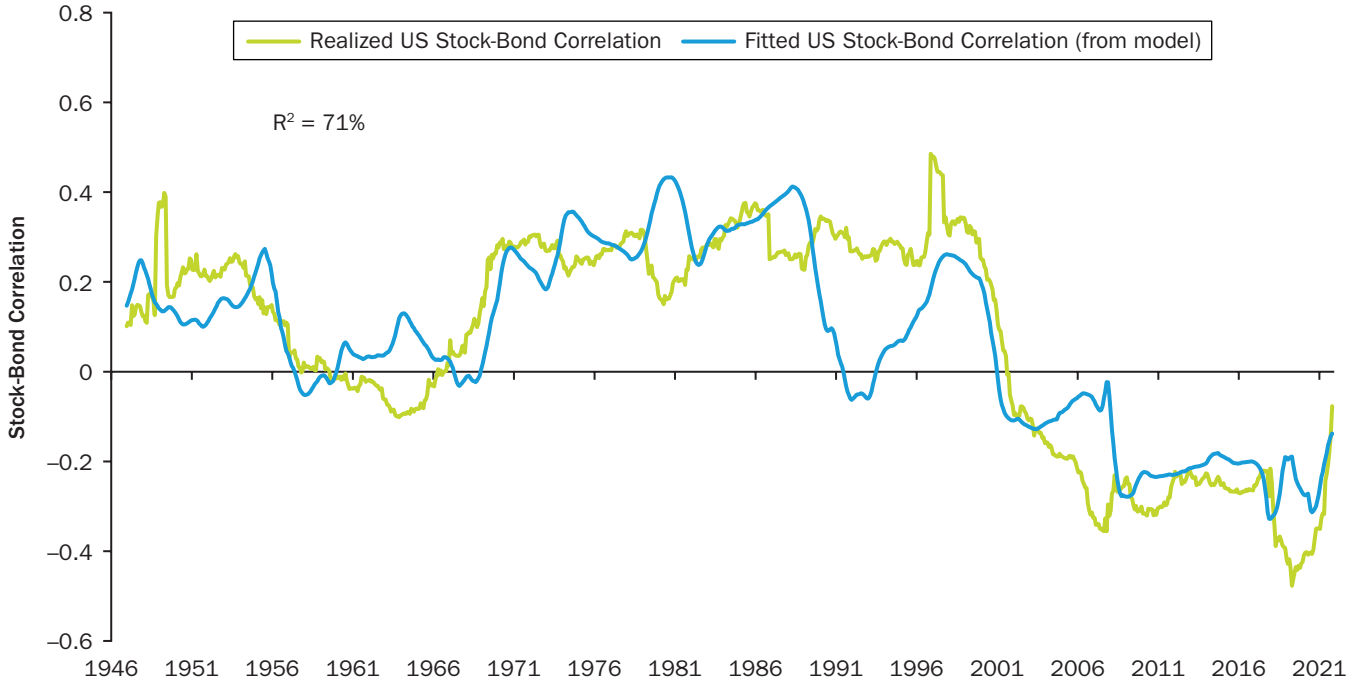
Given the growth–inflation correlation factor's importance in explaining SBC variance, Exhibit 8 charts this variable over time. The correlation between growth and inflation news flips sign around the same time that the SBC's sign changes (in the early 2000s, red arrow)—although in the opposite direction (hence the negative coefficient). Intuitively, this represents a shift from the cost-push inflation shocks and associated monetary policy responses of the 1970s and 1980s to an era of anchored inflation

[9] The third coefficient in Equation (3) is the sum of two products: $b_{s,g}b_{b,\pi} + b_{s,\pi}b_{b,g}$. The first product is negative, the second positive. Given the importance of growth news for stocks and inflation news for bonds, we would expect the first term to dominate and the coefficient to be negative.

[10] Note that this is an explanatory rather than a predictive relationship. In other words, we are testing the extent to which changes in these three variables can explain changes in the SBC during this period.

## EXHIBIT 6

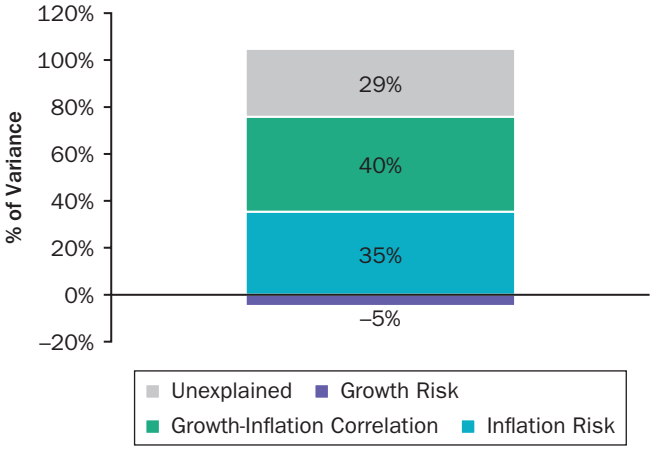
**Visually Testing the Model: Forecast and Realized US Stock–Bond Correlation, Rolling 10-Year, December 1, 1936–September 30, 2022**




**NOTES:** US stocks are the S&P 500. US bonds are nominal 10-Year US Treasuries. For the regressions, the series being analyzed is the rolling 10-year stock–bond correlation. Growth (IP) is the 12-month change in industrial production. Inflation (CPI) is the 12-month change in the CPI. Growth risk is the rolling 10-year volatility of Growth. Inflation risk is the rolling 10-year volatility of Inflation. Growth–inflation correlation is the rolling 10-year correlation between growth and inflation. The fitted correlation uses the regression betas/alpha from Exhibit 5.

## EXHIBIT 7

**Variance Decomposition of the Stock–Bond Correlation, December 1, 1936–September 30, 2022**




**NOTES:** US Stocks are the S&P 500. US Bonds are nominal 10-Year US Treasuries. For the regression, the LHS variable is the rolling 120-month stock–bond correlation. Growth is the 12-month change in industrial production. Inflation is the 12-month change in the CPI. Growth Risk is the rolling 10-year volatility of growth. Inflation Risk is the rolling 10-year volatility of inflation. Growth–Inflation Correlation is the rolling 10-year correlation between growth and inflation.

expectations and demand-pull inflation shocks.[11] Although not shown here, we find similar and consistent patterns in the growth–inflation correlation in international data.

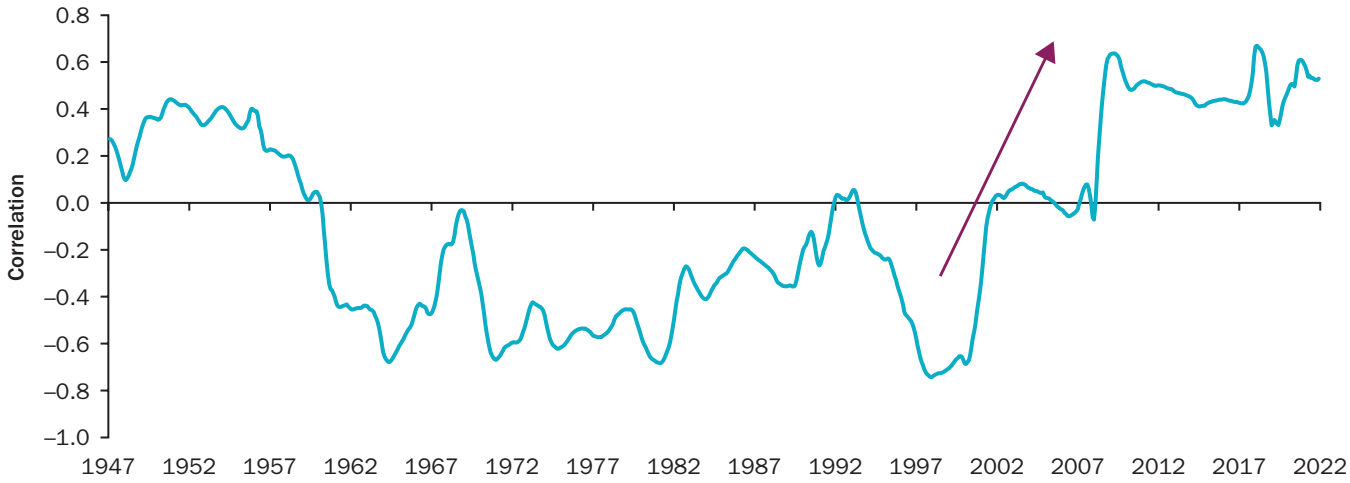
## INTERNATIONAL EVIDENCE

Thus far, we have focused on US data, but do our conclusions hold internationally? In Exhibit 9, we plot the same visual representation of our model as in Exhibit 6 but for Germany, Japan, France, the United Kingdom, and Italy. Here, we use returns for local equity and bond markets and local measures of industrial production and CPI over a slightly shorter history, beginning in 1960 (we include the United States over the same period for comparison). The results are remarkably consistent—especially strong for Germany where the model realizes an $R^2$ of 85%, but also good for Japan and the United Kingdom with

[11] Campbell, Pflueger, and Viceira (2020) discuss the change in sign of a related variable, the correlation between inflation and the output gap.

## EXHIBIT 8

**Growth–Inflation Rolling 10-Year Correlation, December 1, 1936–September 30, 2022**




**NOTES:** Growth is the 12-month change in industrial production. Inflation is the 12-month change in the CPI. Growth–inflation correlation is the rolling 10-year correlation between growth and inflation.

$R^2$s of 67% and 52%, respectively. The model is weaker for France, and weaker still for Italy where credit risk may be a significant driver of the SBC. Italian bonds have greater credit risk than the other bonds we study (which explains the higher average SBC) and also more time variation in credit risk (which explains the lower explanatory power of a model that ignores credit risk, which rose for Italy in the early 2010s).[12]

## LIMITATIONS OF THE MODEL

Growth and inflation news are important, but they are not the *only* common drivers of stock and bonds returns (as our simplified model assumes), so they are also unlikely to be the only drivers of the SBC. Here we list some other candidates.

A pure monetary policy shock would move stocks and bonds in the same direction via changes in discount rates. Monetary policy shocks are challenging to measure as it is difficult to disentangle the systematic response of monetary policy to economic activity and inflation from idiosyncratic policy decisions. Moreover, over longer time horizons—the focus of this article—monetary policy shocks are likely to wane in importance relative to the systematic component of policy.[13] Nevertheless, monetary policy shocks may be responsible for some of the higher-frequency variation in the SBC (for example, the positive spike during the 2013 "taper tantrum," visible in the short-term correlation line in Exhibit 1).

We previously mentioned the role of credit risk. A related driver is "flight to safety," which has tended to intensify the negative SBC so long as bonds are deemed a safe asset. Examples include the 1987 market crash and the Global Financial Crisis of 2008, and these episodes are also visible in the short-term correlation line in Exhibit 1.

[12] These analyses are based on local or currency-hedged returns. An investor with unhedged global equity and currency-hedged global bond allocations would also need to consider the impact of currency risk on stock–bond diversification.

[13] If you observe for a decade a persistently higher (or lower) fed funds rate than what you would expect given economic conditions and inflation, perhaps your policy reaction function is wrong.

## EXHIBIT 9

**International Evidence: Forecast and Realized Stock–Bond Correlation, International Data, Rolling 10-Year, January 1, 1960–June 30, 2022**


**NOTES:** Data end June 2022 due to less timely data for international industrial production and CPI on the FRED website. For the regressions, the series being analyzed is the rolling 10-year stock–bond correlation. Growth (IP) is the 12-month change in industrial production for each country. Inflation (CPI) is the 12-month change in the CPI for each country. Growth risk is the rolling 10-year volatility of growth. Inflation risk is the rolling 10-year volatility of Inflation. Growth–inflation correlation is the rolling 10-year correlation between growth and inflation. The fitted correlations use the same regression methodology as Exhibit 8 but use each country's stock and bond returns and CPI and industrial production measures.

One phenomenon that has *not* driven the SBC is the secular downward trend in real rates and related richening of both stocks and bonds—the SBC remained negative even as both asset classes experienced this tailwind. It follows that a reversal in the trend—a return to rising yields and cheapening of both asset classes—would not necessarily produce a positive SBC, *unless* it were accompanied by (or a response to) a sustained rise in inflation uncertainty.

We have focused on long-term changes in the SBC regime by estimating our model on rolling 10-year variables. If we estimate the same model on shorter horizons (say, 5 years or 3 years), the signs of coefficients stay the same but the explanatory power weakens. This could be because other drivers become more important at shorter horizons, or it could be because our proxies are less accurate measures of the variables

at shorter horizons. Either way, shorter-term fluctuations in the SBC are likely to be harder to explain or predict using macroeconomic fundamentals.

Finally, we have examined only broad equity market returns. Some stocks are more correlated to bonds than others, and these cross-sectional patterns can also vary over time.[14] Panel A of Exhibit 10 shows bond correlations for 11 equity sectors. Some stable patterns are evident. Utilities and consumer staples—with their bond-like stable cash flows—tend to be more positively correlated to bonds than the overall market, whereas energy and industrials—the most inflation-resilient sectors—tend to be more negatively correlated. Other sector patterns are less stable: the financial sector was among the most positively correlated to bonds during the 70s and 80s, but in recent years it has been the most negatively correlated sector.

Turning to styles, we contrast cheap "value" and expensive "growth" stocks, based on book-to-price. During the late 2010s, growth stocks were more correlated than value stocks to bond returns, leading to a negative bond correlation for long–short value factors and prompting much theorizing by commentators. But Panel B of Exhibit 10 shows that over the long term, this has not been a strong or stable relationship. During the 1980s and 1990s, value stocks were more positively correlated to bonds, and in general the value–growth dispersion has been much narrower than for sectors, until the late 2010s. It is possible that during a period of unrealistic expectations for expensive stocks' long-term growth prospects, these stocks could trade as though they have longer cash flow duration, with more exposure to discount rates. But that discussion is unlikely to be relevant for asset allocation decisions and is beyond the scope of this article.[15]

While our model links the SBC to growth and inflation volatility and their correlation, it is silent on the fundamental macroeconomic forces driving growth and inflation variability and their comovement. Ultimately, growth and inflation are driven by fundamental shocks buffeting the economy—supply, demand, technology, and policy shocks, among others—and the systematic response of policymakers to economic developments. To truly understand variation in the SBC over the past century, and to form an opinion on how it may evolve going forward, we must consider how these forces influence growth and inflation outcomes.

Retrospectively, our model explains the shift in the late 1990s from a positive to negative SBC in terms of growth volatility rising relative to inflation volatility, and the growth–inflation correlation flipping from negative to positive. We would like to take one step further and understand what drove these changes.

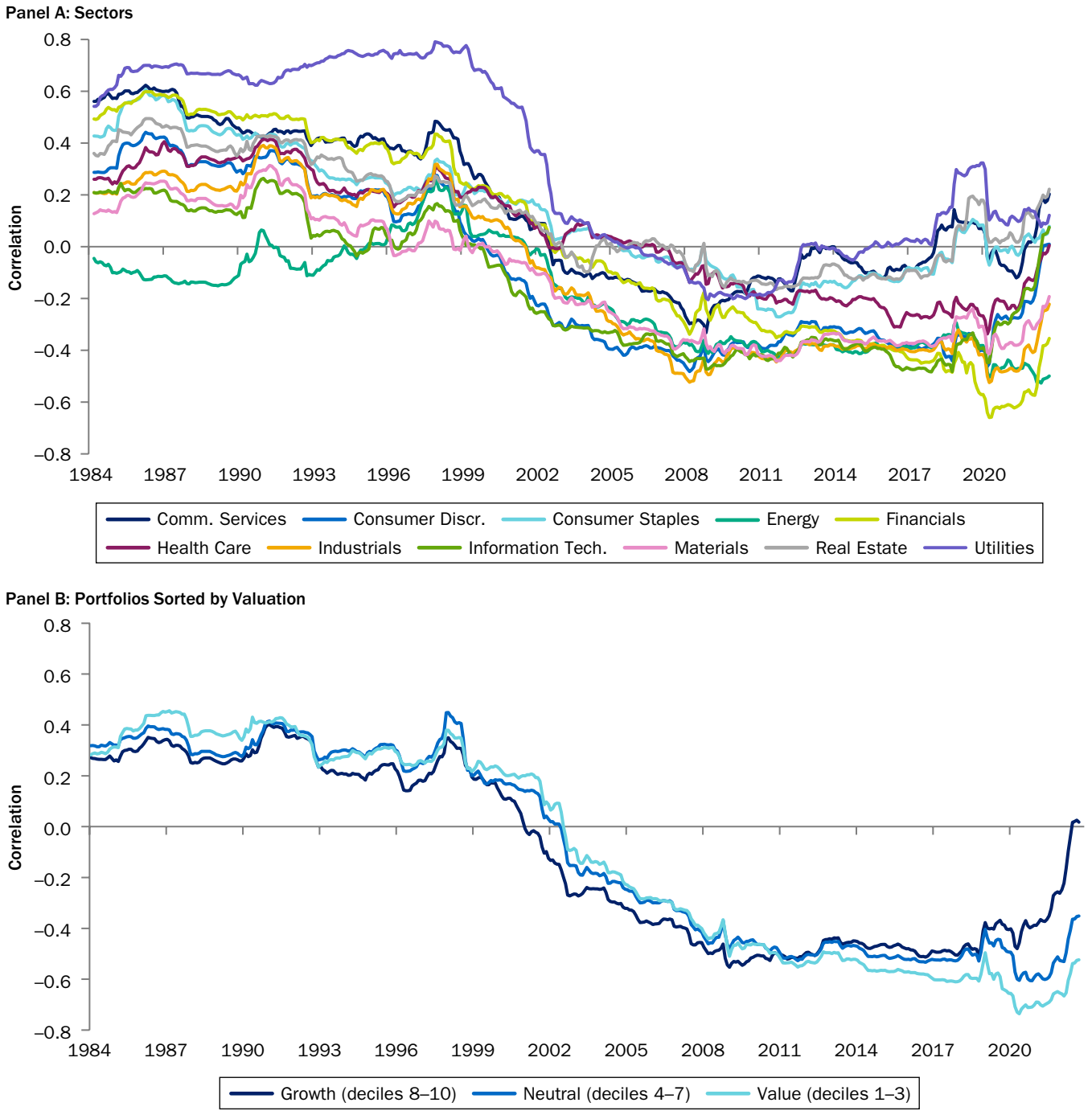
One argument is that the negative SBC is largely the result of "good luck." Namely, in the 25 years preceding the 2020s, demand shocks have been much more variable than supply shocks. Demand shocks contribute to a negative SBC by driving growth and inflation in the same direction (indeed, that is the definition of a demand shock), contributing to a positive growth–inflation correlation. The prevalence of demand shocks relative to supply shocks is likely also a contributor to inflation volatility being so subdued. Demand shocks are (relatively) easy for central banks to deal with. Because they drive inflation and growth (employment) in the same direction, central banks, which aim to stabilize inflation while maintaining full employment, do not face a trade-off. A negative demand shock that leads to weakness in the economy also causes inflation to decline. The proper monetary policy response is unambiguous. Supply shocks, in contrast, increase inflation without stimulating demand and, therefore, create a tradeoff for central banks, resulting in a negative growth–inflation correlation and, possibly, more variable inflation.

[14] See for example D E Shaw and Co. (2022).

[15] For more on the relationship between equity value and interest rates, see Maloney and Moskowitz (2021) and Asness (2022).

## EXHIBIT 10

### Rolling 10-Year Bond Correlations for US Equity Market Sectors, March 1, 1974–September 30, 2022




NOTES: Rolling 10-year series based on overlapping three-month returns at monthly frequency. Valuation portfolios are sorted on book-to-price, from the Ken French data library (https://mba.tuck.dartmouth.edu/pages/faculty/ken.french/data_library.html).

Another explanation for the negative SBC is "good policy." Central bankers since Volcker have emphasized low and stable inflation as a necessary backdrop for strong growth. Their resolute determination to hit their inflation objectives and their good communication have strongly anchored longer-term inflation expectations, resulting in very moderate levels of inflation uncertainty.[16]

So, is the prolonged negative SBC due to good luck (favorable macroeconomic shocks) or good policy (stable inflation expectations)? The safe answer is a likely a bit of both. But the dominance of demand shocks and absence of supply shocks in recent decades clearly contributed to a positive growth–inflation correlation and made central banks' objective of stabilizing inflation easier by aligning their two mandates. In an ambitious empirical study, Fernández-Villaverde, Guerrón-Quintana, and Rubio-Ramírez (2010) come down mostly in favor of good luck. While changes in the conduct of monetary policy mattered for the conquest of the Great Inflation during the Volcker Fed, they find inflation stayed low and stable over the subsequent decades due to favorable macroeconomic shocks.

Armed with the knowledge of how the SBC depends on economic primitives, we can ponder what the future holds. The global economy has recently experienced a series of supply shocks that have led to higher inflation and, through the response of central banks, are likely to lead to economic weakness. Consistent with our model, we have observed a rise in the SBC in 2022. If central banks are successful at curbing inflation (by putting the brakes on the economy) and maintain their inflation-fighting credibility, we may well see a return to the negative SBC that characterized recent decades. If, however, supply shocks are more prevalent moving forward or central bank credibility is called into question, perhaps due to a lack of resolve in bringing inflation down to target when economic conditions deteriorate, it is possible we will see a return to more historically (20th century) normal levels of positive SBC. Time will tell, and no doubt, how the current inflationary environment plays out will be an important determinant.

## HOW TO NAVIGATE A CHANGING SBC

Awareness is half the battle. Investors should communicate the importance and drivers of the SBC to their stakeholders and the implications of a possible change in regime. This process could include the following:

- putting together a dashboard to track realized SBC as well as indicators of inflation risk such as option-implied inflation volatility and economist forecast dispersion,[17]
- performing asset allocation scenario analysis where you shock the correlation matrix, and
- having a plan to respond to reduced diversification.

Alternative assets are likely to be an important tool for navigating a changing SBC. If the performance of stock and bond allocations becomes more correlated,

[16] Any doubts about central bank credibility that arose most recently in 2021–22 can be countered by noting that despite inflation printing well above central bank targets for over a year, both market and survey-based expectations of long-term inflation remain, at the time of writing in late 2022, incredibly well anchored.

[17] Czasonis, Kritzman, and Turkington (2021) propose specific quantitative forecasting methods for the SBC, based on fundamental variables.

## EXHIBIT 11

### Adding a Diversifier to Your Portfolio


**NOTES:** We assume a 0.3 Sharpe ratio for stocks, bonds, and alternatives. We assume 15% volatility for stocks, 4% volatility for bonds, and 10% volatility for alternatives, with alternatives zero-correlated to stocks and bonds. As we increase the SBC assumption, we hold everything else equal but solve for the alternatives capital weight that results in a portfolio with the same volatility as the 60/40 portfolio with SBC = –0.5, keeping the ratio of stocks to bonds fixed at 60:40. In Panel B, the solid line is expected excess return with alternatives, and the dotted line is without.

a "third allocation"—one that is diversifying to both traditional asset classes—may be able to make up the diversification deficit.

Recall Exhibit 2, Panel B, which showed how much the stock weight in a stock–bond portfolio would have to be reduced to maintain portfolio risk as the SBC increased and the associated reduction in expected return. What if we could instead reallocate to an alternative diversifier and maintain both portfolio risk and return? In Exhibit 11, Panel A, we show the allocation to a hypothetical alternative diversifier (assumed to be uncorrelated to stocks and bonds) required to maintain portfolio risk as the SBC increases. In Panel B, we see that, unlike simply reallocating to bonds, reallocating to such a diversifier could help to maintain both portfolio risk and return.

What real-world investments could fit the bill of our hypothetical diversifier in Exhibit 11? Some alternatives are better suited to this challenge than others.

- *Illiquid alternatives,* like private equity and private credit, may provide some cushion against short-term volatility due to their lack of mark-to-market pricing, but their diversification potential is limited because they inherit the same underlying economic exposures as their public market equivalents.
- *Commodities* have been lowly correlated to both stocks and bonds, on average, and have delivered stronger diversification during periods of inflation uncertainty. This is intuitive because while both stocks and bonds exhibit negative sensitivity to inflation news, commodities exhibit strong positive sensitivity. Ooi, Maloney, and Brixton (2022) highlight the benefits of a diversified allocation, showing that a broad basket of commodities has delivered inflation protection as strong as any individual commodity sector.

- *Long–short equity* and *multi-asset alternative risk premia* strategies use financial tools like shorting and leverage to deliver returns less correlated to stocks and bonds. Some are constructed to be market neutral, and these most closely reflect the assumptions of our hypothetical diversifier in Exhibit 11. The performance of these strategies is largely unrelated to the macro environment, making them good strategic diversifiers.
- Dynamic strategies like *Trend* and *Macro* take directional views at any point in time, but are lowly correlated to markets over the long term. Brixton, Maloney, and Thapar (2021) show that these strategies have tended to thrive on macroeconomic volatility, for example, outperforming during both upside and downside inflation shocks.

## CONCLUSION AND OUTLOOK

In recent decades, stock–bond investors have benefited not only from falling yields and rising valuations but also from the strong diversification between their two main allocations. We have become accustomed to a negative correlation between stocks and bonds, but this was not the historical norm prior to the 2000s, with the average correlation positive in the 20th century. A sustained rise in SBC would have implications for portfolio risk and therefore also asset allocation and expected returns. It would add another headache to the challenges of low starting yields, equity risk concentration, and heightened macroeconomic risks in the 2020s.

We studied theoretical drivers of the SBC and presented a simple model relating it to growth uncertainty, inflation uncertainty, and the correlation between growth and inflation. An empirical test of this model confirmed that stocks and bonds have been stronger diversifiers when growth news dominates and weaker diversifiers when inflation news dominates. We tested this model internationally and found similar results across six developed markets.

Our practical recommendations included educating stakeholders, monitoring the SBC and its macro drivers, and—most importantly—rethinking portfolio diversifiers. We listed a menu of alternative diversifiers, which could help not only to manage risk and improve diversification but also to enhance portfolio returns in a challenging environment of high valuations, monetary policy tightening, and heightened macroeconomic risks.

### Outlook for the Stock–Bond Correlation

At the time of writing, October 2022, inflation levels have stabilized in some markets but inflation uncertainty remains higher than it has been for several decades. Conversely, long-term expectations remain reasonably well anchored. Central bank credibility has been questioned over the past year but remains broadly intact. The SBC has drifted higher but has remained mostly negative.[18] A sustained shift to a positive SBC regime would probably require a rise in longer-term inflation uncertainty accompanied by further supply-driven inflation shocks and/or monetary policy errors, and this scenario remains a tail risk for investors.

[18] The rolling 65-day correlation between US equity and Treasury returns turned positive during Q2 2021, returned to negative territory for most of H2 2021 and H1 2022, but was again slightly positive in Q3 2022.

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