

Stock-Bond Correlations

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Stock-bond correlation has recently turned from positive to negative. Exhibit 1 plots the annual return series for equities and bonds. Three periods of decoupling stand out—near 1930, near 1960, and near 2000. Exhibit 2 shows the history of 12-month trailing stock-bond correlations since 1926. Clearly, the relation between the two main asset classes has not been particularly stable. The correlation has tended to be positive but has occasionally dipped below zero for extended periods. The three episodes of negative correlations—1929–1932, 1956–1965, and 1998–2001—coincide with the decoupling of stock and bond performance in Exhibit 1.¹

Should we expect stock-bond correlation to be mildly positive, as in the last 40 years, or mildly negative as it has been for the last four years? The answer is important for long-term asset allocation decisions since correlations across asset classes are one key input in portfolio optimization and asset-liability management exercises as well as for hybrid derivatives valuation. Moreover, negative correlation makes government bonds excellent hedges against major systematic risks—recession, deflation, equity weakness, and other financial market crises—and this attractive feature may justify an exceptionally low bond risk premium, that is, higher government bond valuations.

To assess the sustainability of the correlation reversal, we explore factors that cause

positive or negative comovements across stocks and bonds. Specifically, we examine stock and bond market sensitivity to the business cycle, inflation, volatility, and monetary policy conditions. Economic growth and volatility shocks tend to push stock and bond prices in opposite directions, and thus cause decoupling. The inflation level is also important, because common variation in discount rates makes stocks and bonds positively correlated at high inflation levels. When inflation is low, discount rates are more stable, and growth uncertainty dominates, making stock-bond correlation lower.

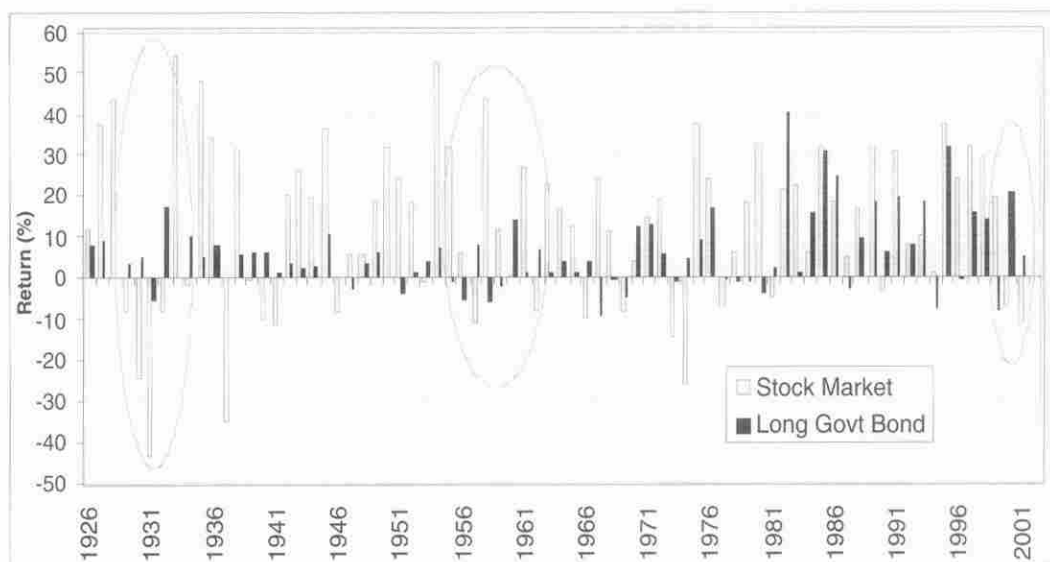
I. FACTORS THAT CAUSE POSITIVE OR NEGATIVE CORRELATION

We conjecture that an immediate reason for the changing correlation sign is the changing direction of causality between stock and bond markets. Correlation does not necessarily imply causality. Yet many investors feel strongly that the causality from bond prices to stock prices is positive (say, falling bond yields tend to also reduce equity discount rates), while the causality from stock to bond prices is negative (say, equity weakness can prompt monetary policy easing and a bond market rally). Empirical lead-lag patterns are consistent with this intuition.

Exhibit 3 shows that a previous month's bond market strength is positively related to next month's stock market strength, while past

EXHIBIT 1

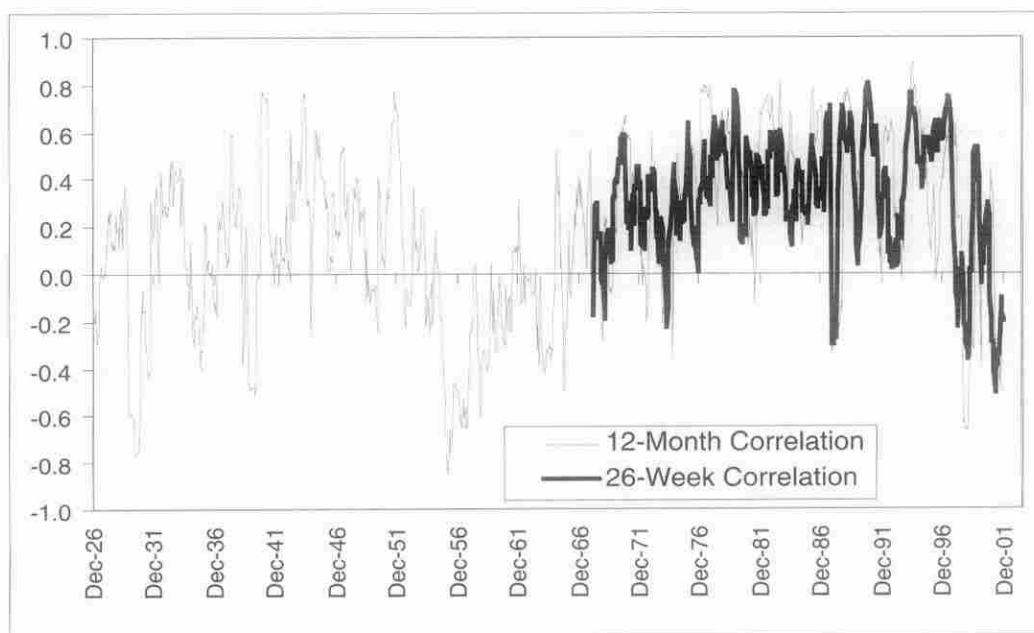
Annual Returns of U.S. Equities and Bonds—1926-2001



Sources: Ibbotson Associates and Schroder Salomon Smith Barney.

EXHIBIT 2

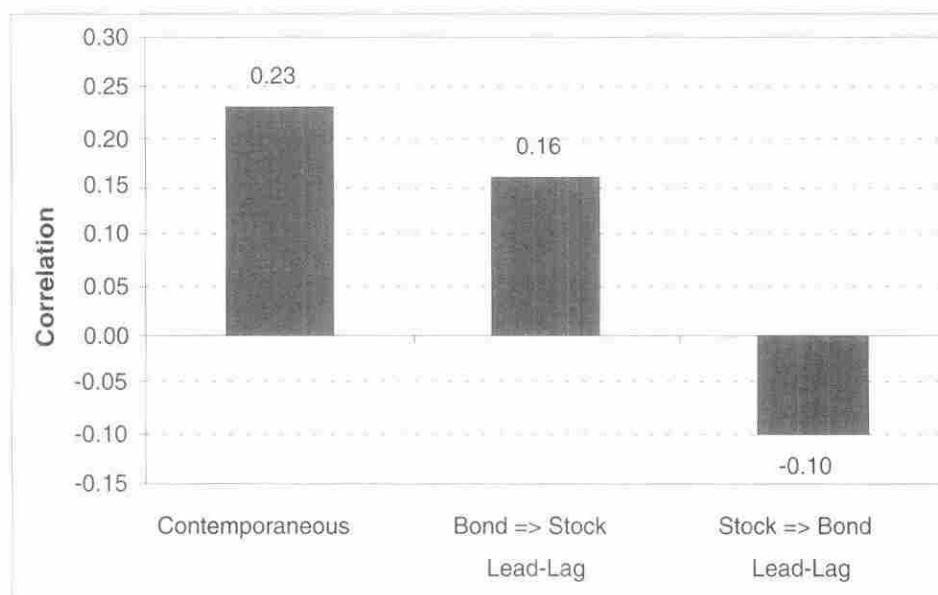
Historical U.S. Stock-Bond Correlations—1926-2001



Sources: Ibbotson Associates and Schroder Salomon Smith Barney.

EXHIBIT 3

Correlations Across Monthly Stock and Bond Returns—1952-2001



Sources: Ibbotson Associates and Schroder Salomon Smith Barney.

equity return is inversely correlated with subsequent bond return.²

To answer the natural follow-up question—whether stock-driven or bond-driven causality is likely to dominate in the future—we need to look at the underlying factors behind asset class movements. We try to characterize economic conditions under which stocks and bonds are more likely to move together or to decouple. Specifically, we study average stock and bond returns, valuations, and historical correlations in subsamples that represent different states of the world.³

In slicing the data, we focus on four key dimensions:

- Business cycle or growth outlook.
- Inflation environment.
- Volatility conditions.
- Monetary policy stance.

These four dimensions correspond to the key drivers of asset returns, and investors often consider scenarios associated with them. Systematic decoupling patterns (say, average stock and bond returns with opposite signs in a particular subsample) hint at the different sensitivities of asset classes to a key driver, and thus offer clues about the sources of negative correlation.

The dividend discount model framework reveals the

drivers of stock and bond prices, or returns, and gives us ideas as to which components are positively or negatively correlated across the asset classes. Both stock and bond prices (P_S and P_B) represent the present value of expected future cash flows, discounted by a rate that includes relevant risk premiums. While government bonds have fixed cash flows (coupon stream C and par value 100), stocks have uncertain cash flows—and the expected growth rate (G) of dividends (D) has a critical impact on equity valuations.

Stocks and bonds are both subject to discount rate uncertainty. Discount rates have both shared and contrary elements. The government bond yield (Y) reflects expectations of future short-term rates and the required bond risk premium, while the stock market discount rate also includes the required equity risk premium (ERP) as compensation for bearing additional risks.⁴

The stock and bond price equations are:

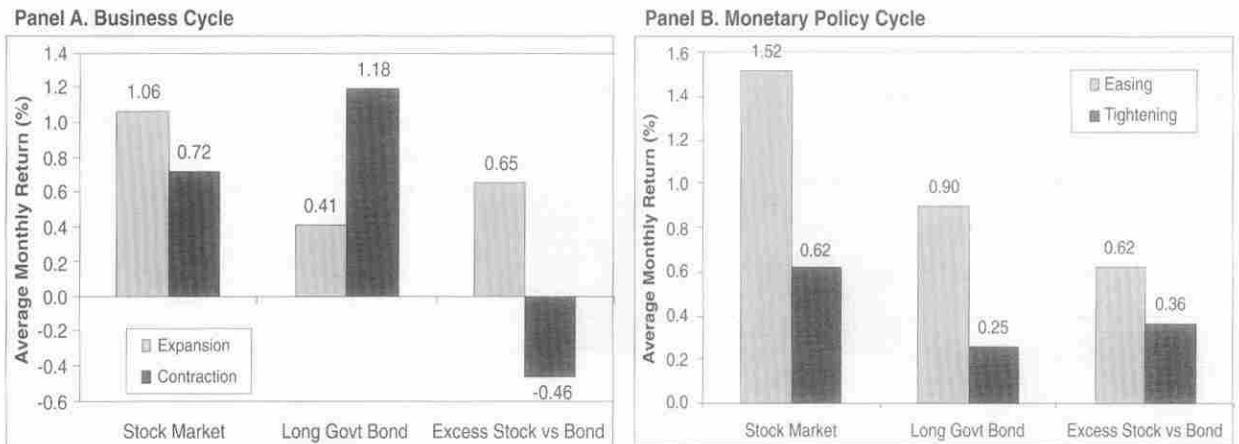
$$P_S = E\left[\sum_{t=1}^{\infty} \left(\frac{1+G}{1+Y_t+ERP_t}\right)^t D\right]$$

and

$$P_B = E\left[\sum_{t=1}^T \frac{C_t}{(1+Y_t)^t} + \frac{100}{(1+Y_T)^T}\right]$$

EXHIBIT 4

Average Stock and Bond Returns over Business Cycle and Monetary Policy Cycle—1952-2001



Business cycle based on NBER definitions; monetary policy cycle based on direction of latest Federal Reserve move.

Sources: Ibbotson Associates, NBER, and Schroder Salomon Smith Barney.

These equations suggest that growth news is likely to cause a wedge between stock and bond performance. If G rises in cyclical expansions, stocks benefit but bonds do not—indeed they may be hurt by the impact of growth on yields.

Stocks and bonds have partly common discount rates. Inflation shocks are unambiguously negative for bonds as they raise expected future short rates and inflation-related bond risk premiums. Inflation could in theory have no impact on stocks, if rising inflation affects cash flow growth rates as much as discount rates. In practice, high inflation hurts equities because it has a detrimental effect on real earnings growth (partly related to anti-inflationary monetary policy responses) as well as inflation-related risk premiums or money illusion. Common up- and downtrends in real bond yields and earnings yields during inflationary and disinflationary phases appear to have made the stock-bond correlation high from the mid-1960s to the mid-1990s.⁵

Stock and bond discount rates can move in opposite directions due to differences in equity and bond risk premiums. Most obviously, flight to quality episodes often raise required equity risk premiums (reduce stock prices) and reduce bond risk premiums (raise government bond prices).

II. STOCK AND BOND BEHAVIOR IN DIFFERENT ECONOMIC CONDITIONS

The business and monetary policy cycle, the inflation level, and world conditions all have implications for stock and bond behavior.

Business and Monetary Policy Cycle

We first look at the behavior of the U.S. stock market (in terms of the S&P 500) and the bond market (20-year Treasury) over business and monetary policy cycles in the last half-century. Stocks tend to outperform bonds during business cycle expansions, and bonds tend to outperform stocks during contractions (see Exhibit 4, Panel A). Stocks have higher average returns in expansions than in recessions, while the reverse is true for bonds, reflecting the opposite sensitivities of these assets to growth. Monetary policy easing, however, boosts the performance of both asset classes (see Exhibit 4, Panel B).

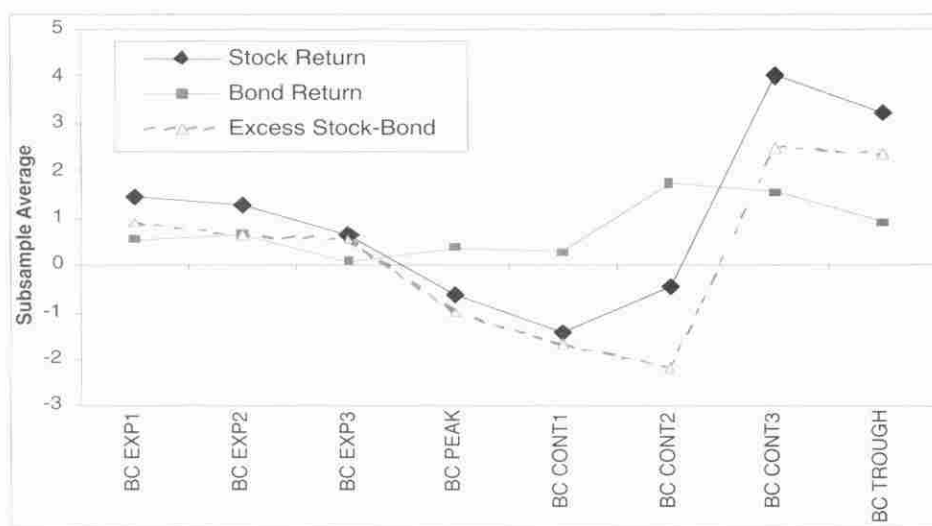
Exhibits 5 and 6 provide a more detailed picture of stock and bond behavior over the business cycle. We divide each expansion and contraction into first, second, and last thirds, and examine seven-month windows around business cycle peaks and troughs. Note that expansions tend to be longer than contractions, a fact concealed by the graphs.⁶

Exhibit 5 shows that:

- Both asset classes have higher average returns near cyclical troughs than near peaks, which is likely to reflect counter-cyclical monetary policy.
- Average equity returns are highest in the last third of the contraction, due to the forward-looking nature of financial markets. Late-recession and early-expansion growth is best for stock returns, as it coincides with improving valuations and is not yet threatened by rising inflation or monetary policy tightening.

EXHIBIT 5

Average Stock and Bond Returns over Business Cycle—1952-2001



Notes: BC Business cycle, EXP Expansion, CONT Contraction.
Sources: Ibbotson Associates, NBER, and Schroder Salomon Smith Barney.

- Bonds have highest returns in the middle of a contraction. They outperform stocks only when equity returns are negative around the business cycle peak and two-thirds into the contraction.
- Bonds lead stocks around cyclical turning points, consistent with the bond-stock lead-lag patterns noted earlier. One interpretation is that monetary policy tightening tends to end the pain for bonds, but starts it for equities. Decoupling performance is apparent in the opposite signs of average stock and bond returns from the peak to two-thirds through the contraction. Indeed, trailing stock-bond correlation is lowest near the peak and early contraction.

Exhibit 6 also shows that the monetary policy cycle leads the business cycle. Yield curve steepness, a monetary policy proxy, tends to be lowest near business cycle peaks and highest near business cycle troughs. Real earnings growth by contrast is coincident with but does not lead the business cycle. Real earnings growth is positive in all expansion subsamples and negative in all contraction subsamples, and it is highest in mid-expansion and lowest in mid-contraction.

Impact of Inflation Level

Exhibit 7 suggests that the inflation level is a key driver of stock-bond correlation. The time series graph and the scatterplot reveal a positive relation. We conjecture that:

- At high inflation levels, common discount rate changes dominate stock and bond volatility and induce positive correlation across asset classes.
- Amid low but positive inflation, discount rates are relatively stable, and growth uncertainty dominates stock and bond volatility, thus inducing lower correlation.
- Amid deflation, even discount rate correlation may be negative since deflation may cause higher equity risk premiums and lower bond risk premiums, making the stock-bond correlation negative.⁷

We next examine stock and bond returns at different inflation levels. Bond-inflation relations are simple and linear. High inflation hurts realized real bond returns and raises required bond risk premiums, while deflation boosts real bond returns and reduces required bond risk premiums.

We suspect equity-inflation relations are non-linear, though. Low-but-positive inflation levels appear optimal for real earnings growth and equity returns. Deflation or higher inflation typically are less stable than 1% to 4% inflation and imply reduced real earnings growth potential and possibly higher required equity risk premiums. Thus, while the disinflation of the 1980s-1990s boosted stock and bond returns, further disinflation from here or outright deflation would help only bonds, not stocks.

Japan is a good out-of-sample experiment on the inflation sensitivity of stock-bond correlation, given the

EXHIBIT 6

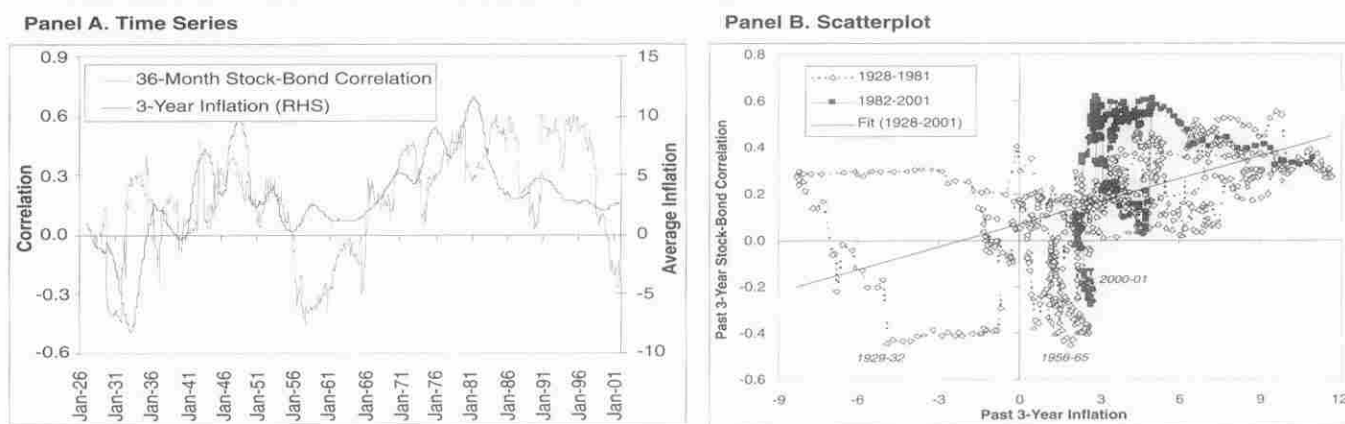
Subsample Averages of U.S. Stock and Bond Returns and Other Series Across Cycles—1952-2001

	Stock Return	Bond Return	Excess Stock-Bond	Earnings Yield	Bond Yield	Yield Ratio	Stock-Bond Correl.	Yield Curve	Δ Real Earn.	No of Obs
All	1.01	0.53	0.48	7.10	6.74	0.95	0.19	1.11	0.18	600
Business Cycle Expansion	1.06	0.41	0.65	6.79	6.62	0.98	0.19	1.13	0.38	505
Business Cycle Contraction	0.72	1.18	-0.46	8.75	7.41	0.85	0.20	1.05	-0.93	95
Business Cycle Exp 1	1.43	0.55	0.88	6.63	7.05	1.06	0.25	1.99	0.28	161
Business Cycle Exp 2	1.23	0.63	0.60	6.70	6.50	0.97	0.21	1.22	0.66	165
Business Cycle Exp 3	0.61	0.08	0.52	7.03	6.34	0.90	0.12	0.26	0.22	178
Business Cycle Peak	-0.66	0.37	-1.03	8.26	7.11	0.86	0.07	0.09	-0.54	63
Business Cycle Cont 1	-1.44	0.24	-1.68	8.46	7.50	0.89	0.09	0.42	-0.89	32
Business Cycle Cont 2	-0.47	1.72	-2.19	9.34	7.62	0.82	0.22	0.91	-1.35	33
Business Cycle Cont 3	4.01	1.53	2.48	8.26	7.05	0.85	0.29	1.82	-0.33	31
Business Cycle Trough	3.23	0.89	2.34	7.61	6.65	0.87	0.23	1.80	-1.41	59
Monetary Policy Easing	1.52	0.90	0.62	6.99	7.39	1.06	0.28	1.71	-0.43	261
Monetary Policy Tightening	0.62	0.25	0.36	7.18	6.25	0.87	0.13	0.65	0.64	339

Months in 1952-2001 are allocated to subsamples of business cycle expansions or contractions, as defined by NBER, or monetary policy easings or tightenings, based on the direction of the latest Fed move. Each business cycle is divided into first, second, and last thirds of expansion and contraction to examine seven-month windows around cyclical peaks and troughs. Stock return: S&P 500; bond return: yield of 20-year Treasury bond; trailing 12-month correlation, yield curve (five-year minus one-month rate), and monthly real earnings growth.

EXHIBIT 7

U.S. Stock-Bond Correlation Versus Inflation Level—1926-2001



Sources: Ibbotson Associates and Schroder Salomon Smith Barney.

country's deflationary experience of the 1990s. Exhibit 8, Panel A, shows that Japan's stock-bond correlation turned negative in 1992, much earlier than in the other G-3 markets. In Germany and the United States, stock-bond correlation turned negative only in 1998 and again in 2001, with global recession fears.⁸ But Exhibit 8, Panel B, reveals in all three countries, Japan, Germany, and the U.S., a

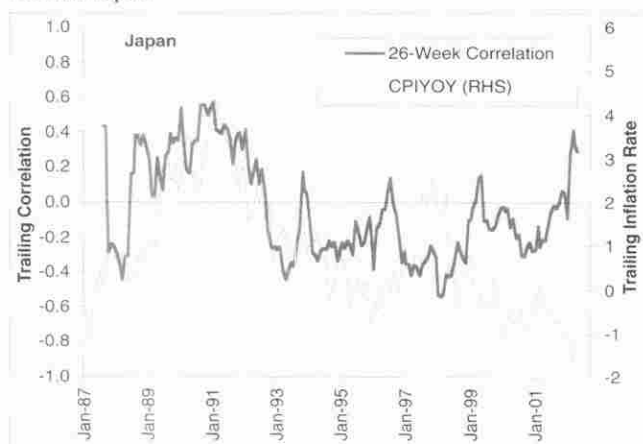
positive relation between correlation and inflation levels.

Li [2002] analyzes the macroeconomic factors that explain time variation in stock-bond correlations in G-7 markets. His main finding that uncertainty about expected inflation is the primary driver of trends in stock-bond correlations parallels our results, because his proxy for such inflation uncertainty is expected long-run inflation—

EXHIBIT 8

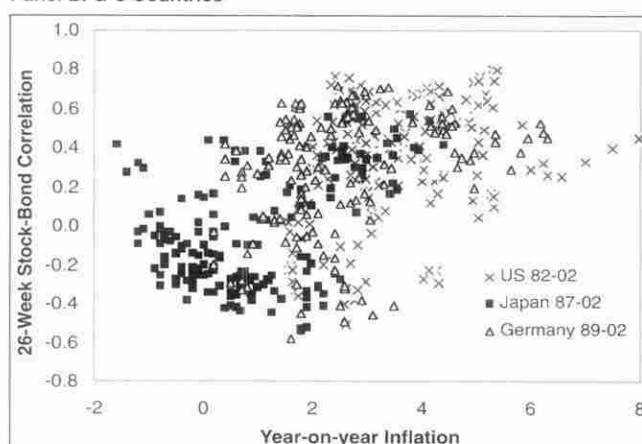
Stock-Bond Correlation versus Inflation Level

Panel A. Japan



Source: Schroder Salomon Smith Barney.

Panel B. G-3 Countries



motivated by the level-dependent nature of inflation uncertainty.

Different States of the World

Exhibits 9 and 10 review stock and bond performance (average of nominal monthly returns) and their difference and correlations since 1926 in subsamples that divide history into periods of:

- High or low real GDP growth.
- High or low inflation.
- High or low market volatility.
- Easy or tight monetary policy.

The growth and inflation variables are six-months ahead year-on-year series to partly capture the forward-looking nature of financial markets.⁹ In Exhibit 9, we use combination variables that reflect both the level (year-on-year series) and trend (year-on-year series versus 36-month average) aspects, as both seem relevant.¹⁰

Volatility is measured by trailing 12-month stock market volatility, and monetary policy stance is proxied by the spread between five-year and one-month rates. In the first three dimensions, we do not split data histories into two halves but instead use the lowest quartile as the cutoff point for growth and inflation and the highest quartile as the cutoff for volatility. Asymmetry is warranted since we want to isolate in one subsample scenarios that investors see as stagnation, deflation, and instability.

The main findings in Exhibit 9 are that:

- Stronger growth helps stocks and hurts government bonds, while higher market volatility, such as flight to quality episodes, hurts stocks and helps bonds. Thus, growth and volatility shocks are natural triggers for decoupling asset class performance and negative correlation (see Panel C).
- Monetary policy and inflation, however, affect stocks and bonds in the same way (easing and disinflation help both assets), and thus are less likely to cause negative stock-bond correlation.
- Meanwhile, yield curve and inflation regimes are better able to distinguish stock and bond valuations than growth and volatility regimes (see Exhibit 10). For example, equities are relatively rich—a high yield ratio—amid high or stable inflation and a steep yield curve.

Another way to analyze stock and bond sensitivities to various factors involves using high-frequency data (daily or within-day) to examine stock and bond price sensitivity to macroeconomic or policy announcements or to volatility spikes. Such studies appear to give much the same results as our low-frequency data.

Of course, the four dimensions in Exhibit 9 are interrelated, and it may be interesting to further divide data into smaller subsamples.¹¹ Exhibit 11 shows stock and bond performance, differences, and correlations in four quadrants of inflation and growth states—inflationary expansion, inflationary recession, deflationary expansion, and deflationary recession.¹²

Economic expansion combined with low inflation

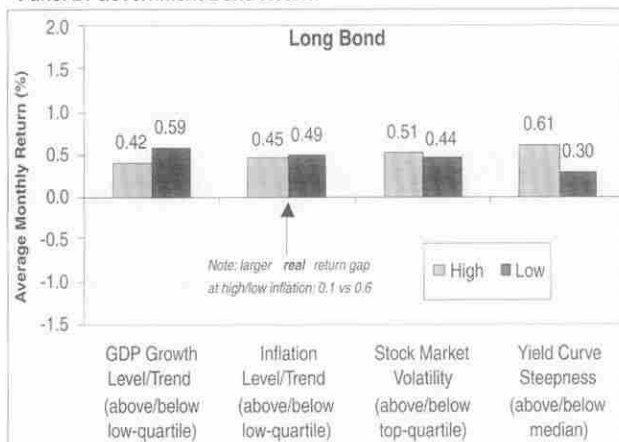
EXHIBIT 9

U.S. Stock and Bond Average Returns and Correlation Comparison Across Different Environments—1926-2001

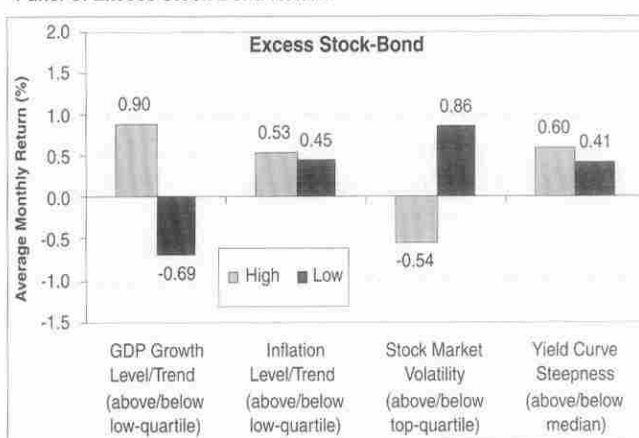
Panel A. Stock Market Return



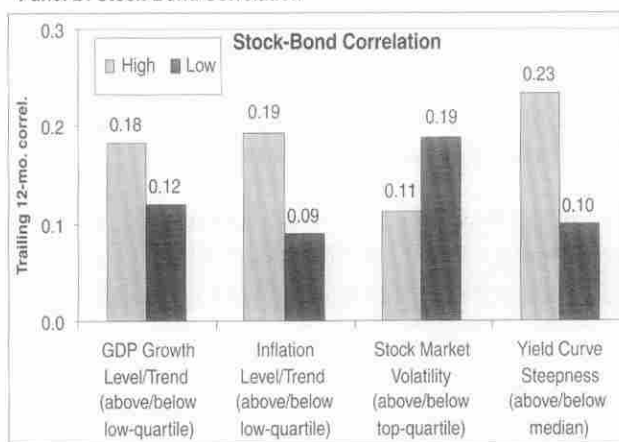
Panel B. Government Bond Return



Panel C. Excess Stock-Bond Return



Panel D. Stock-Bond Correlation



Sources: Ibbotson Associates and Schroder Salomon Smith Barney.

is the most bullish environment for equities, while deflationary recession is the most bearish environment. Decoupling asset class performance is most likely in this last scenario when stocks underperform bonds, and stock-bond correlation is at its lowest. Stocks also underperform bonds in the second state, but note that this state includes periods of moderate inflation (2%–5%); during stagflation like that of 1980–1981, stocks outperform bonds.

The last panels in Exhibits 9 and 11 show the average trailing stock-bond correlation in different subsamples. Stock-bond correlation tends to be lowest when inflation and growth are low—deflationary recession—and when equities are weak and volatile—flight to quality episodes. Stock-bond correlation also tends to be low near the business cycle peak and during monetary policy tightening. Since 1968 we have had access to weekly data, and unpublished analysis shows that the results are sim-

ilar for 26-week trailing stock-bond correlation over this sample.

Other research provides similar evidence. Stivers and Sun [2002] show that stock-bond correlation is lower when the implied volatility from equity index options is higher. Gulko [2002] shows that stocks and Treasuries tend to decouple during equity market crashes, while in normal conditions, the asset classes are positively related.

III. MARKET IMPLICATIONS

We have argued that stock-bond correlations are more likely to be negative when inflation is low, growth slow, equities weak/vulnerable, and volatility high; when growth and safe haven uncertainties overwhelm discount rate and inflation uncertainties; and when equity-driven causality dominates. In the future, we expect low correlations as

EXHIBIT 10

Subsample Averages in High versus Low Growth, Inflation, Volatility, and Steepness Regimes—1926-2001

	Stock Return	Bond Return	Excess Stock-Bond	Earnings Yield	Bond Yield	Yield Ratio	Stock-Bond Correl.	Monthly Inflation	No. of Obs
All	0.96	0.46	0.51	7.42	5.37	0.72	0.17	0.26	912
Gdpyoy High	1.37	0.42	0.95	7.16	5.35	0.75	0.18	0.26	683
Gdpyoy Low	-0.25	0.57	-0.83	8.19	5.43	0.66	0.15	0.27	229
Cpiyoy High	0.93	0.50	0.43	7.45	6.09	0.82	0.23	0.39	683
Cpiyoy Low	1.07	0.33	0.74	7.33	3.21	0.44	-0.02	-0.12	229
Gdpmomentum High	1.22	0.44	0.78	7.30	5.63	0.77	0.19	0.28	683
Gdpmomentum Low	0.19	0.51	-0.33	7.79	4.60	0.59	0.11	0.21	229
Cpimomentum High	1.12	0.38	0.74	6.96	5.43	0.78	0.17	0.33	686
Cpimomentum Low	0.48	0.70	-0.22	8.82	5.17	0.59	0.17	0.07	226
Gdpcombination High	1.32	0.42	0.90	7.21	5.46	0.76	0.18	0.27	682
Gdpcombination Low	-0.10	0.59	-0.69	8.06	5.08	0.63	0.12	0.23	229
Cpicombination High	0.97	0.45	0.53	7.26	5.91	0.81	0.19	0.38	683
Cpicombination Low	0.93	0.49	0.45	7.92	3.75	0.47	0.09	-0.09	229
Stockvolatility High	-0.03	0.51	-0.54	6.64	4.95	0.74	0.11	0.15	233
Stockvolatility Low	1.30	0.44	0.86	7.69	5.51	0.72	0.19	0.30	679
Steepness High	1.20	0.61	0.60	6.63	5.97	0.90	0.23	0.19	465
Steepness Low	0.71	0.30	0.41	8.25	4.74	0.58	0.10	0.34	447

1926-2001 is used to include more observations of deflationary recessions such as the 1930s. Subsamples based on both level data (year-on-year (yoy) series) and trend data (YOY series versus 36-month average), as well as on their combination. Volatility is 12-month trailing stock market volatility, and curve steepness is five-year rate minus one-month rate. Cutoff values are low-quartile for growth and inflation and top-quartile for volatility. The cutoff values for the subsamples are 0.8%, 1.3%, -2.7%, -1.3%, -0.52%, 0.35%, 13.4% (vol), 100bp. The table shows nominal returns in the first few columns but provides approximate monthly inflation for readers who want to convert nominal asset returns to real returns.

long as inflation remains low—and negative correlations if deflation materializes or if equity weakness persists.

Stock-bond correlations are important for government bond valuations. We argue that negative stock-bond correlation gives bonds great hedging characteristics. The attractive feature of a negative beta can systematically reduce required bond risk premiums and even justify negative premiums (lower expected returns than cash). Government bonds perform well and smooth portfolio performance just when that is most needed: when most risky assets are losing money in crises and recessions.¹³

Indeed Exhibit 12 shows that the estimated Treasury bond risk premium turned negative in the Fall of 1998 and again in 2001 just when the negative stock-bond correlation warranted it. Positive correlation makes government bonds much less attractive. During the stagflations induced by 1973 and 1979-1980 oil price shocks, bonds hardly served as good recession hedges or as insurance against equity market weakness.

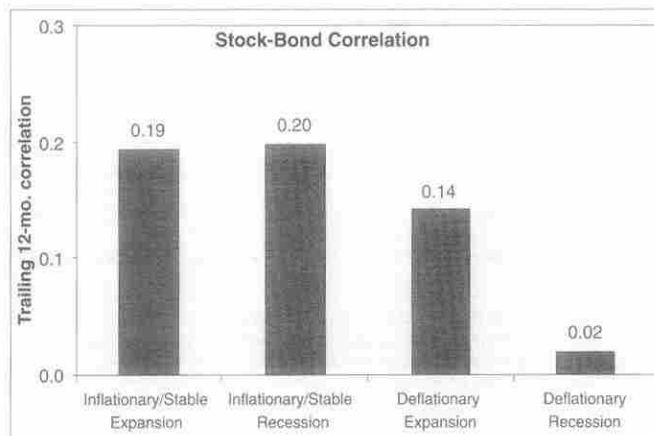
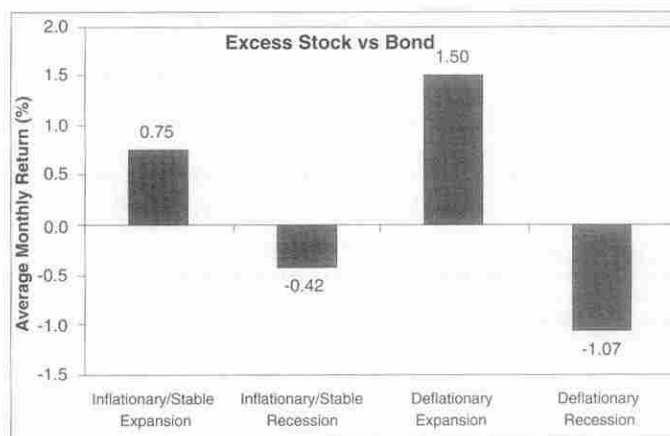
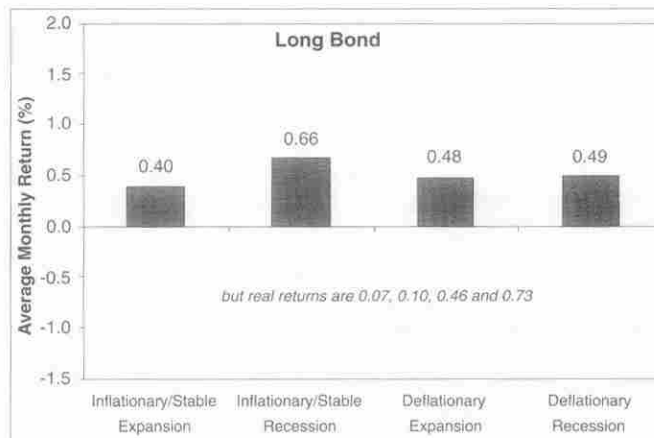
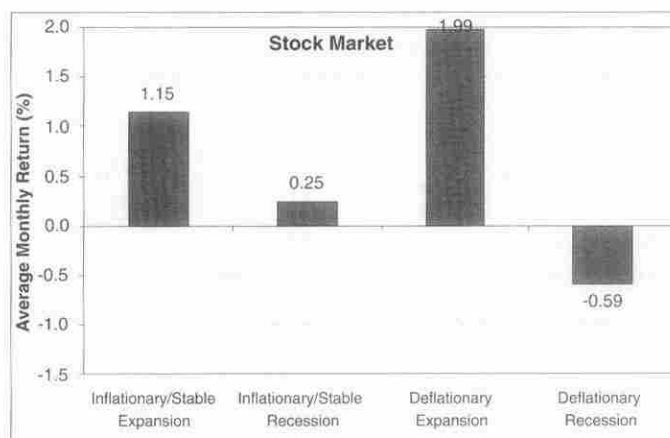
Our analysis of the survey-based bond risk premium—the difference between ten-year Treasury yield and survey-based expected average short (Treasury bill) rate over the next decade—indicates that the behavior of this series is well explained by three factors:¹⁴

- Long-run inflation expectations (reflecting level-dependent inflation uncertainty).
- Monetary policy stance (dummy variable, perhaps reflecting wealth-dependent risk aversion, sentiment, or market volatility).
- Trailing stock-bond correlation (reflecting government bond hedging features).

The first two factors may have a broadly similar impact on required stock and bond return premiums—the disinflation trend has reduced them in the 1980s-1990s while each Fed tightening period has coincided with a spike in premiums (see Exhibit 12). The last factor

EXHIBIT 11

U.S. Stock and Bond Average Returns and Correlation— Comparison Across Different States of the World—1926-2001



Sources: Ibbotson Associates and Schroder Salomon Smith Barney.

measures the decoupling tendencies. For example, flight to quality periods are associated with negative stock-bond correlations, falling bond risk premiums, and rising equity risk premiums. Empirically, negative correlation appears to justify 50-basis point lower government bond yields. This safe haven premium may keep government bonds expensive compared to historical standards, as long as stock-bond correlation remains negative.

Stock-bond correlation is also important for asset allocation decisions. Most portfolio optimization exercises still assume a positive correlation near +0.3—an invalid assumption in recent years, and likely in the foreseeable future.

The impact of negative correlation in 2001-2002 was especially painful for institutions that were overweighted in equities on the asset side and long duration on the liability side. The double whammy of poor equity returns and

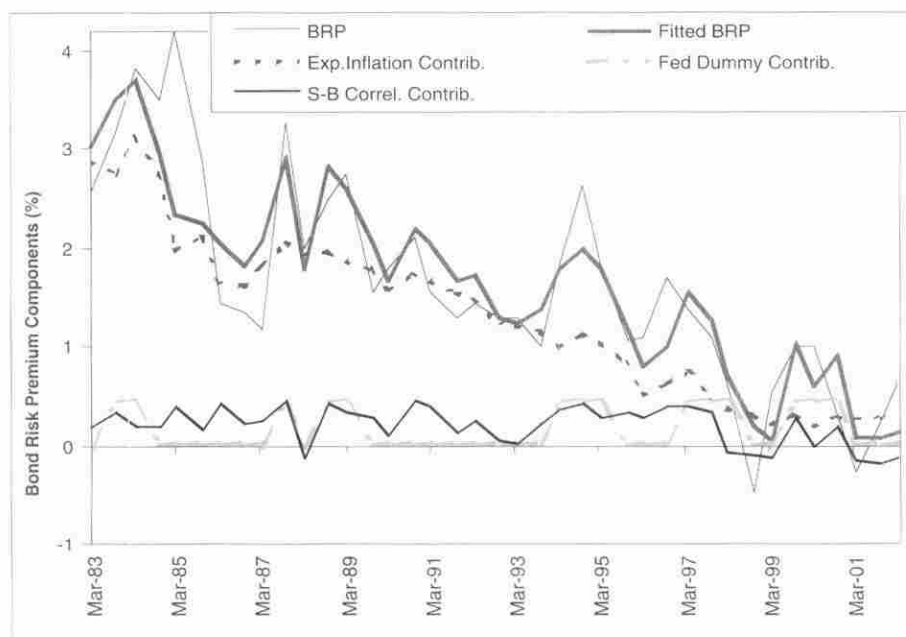
falling bond yields hurt on both sides of the balance sheet. Few institutions have yet reversed the sign of their correlation estimates. Such an adjustment, together with a reduced expected equity-bond premium and renewed appreciation of equity market risk, is likely to boost institutional demand for bonds in the foreseeable future.

A postscript: Our prediction that stock-bond correlation will remain negative has more than held up since the time of our initial writing in June 2002. The 26-week rolling correlation of Treasury and S&P 500 returns has fallen from near -0.5 at mid-2002 to -0.7 at the end of 2002 and to a record-low -0.8 at the end of the first quarter of 2003, while the 12-month rolling correlation has approached -0.9.

The negative correlations are similarly high when we examine daily data or even within-day data. The negative relation is so pervasive that the new generation of

EXHIBIT 12

Survey-Based Bond Risk Premium, Fitted Value, and Components—1983-2002



Sources: Blue Chip Economic Indicators and Schroder Salomon Smith Barney.

market participants cannot even fathom that positive correlation was the standard only a few years ago.

ENDNOTES

This article is largely based on a research report written for Schroder Salomon Smith Barney by Antti Ilmanen in June 2002. Although the information in this report has been obtained from sources Schroder Salomon Smith Barney believes to be reliable, it does not guarantee its accuracy, and such information may be incomplete or condensed. All opinions and estimates included in this report constitute judgments as of the date of first publication and are subject to change without notice. This report is for information purposes only and is not intended as an offer or solicitation with respect to the purchase or sale of any security.

¹Since the 1960s, we have had access to higher-frequency data, and the patterns look broadly similar. For the most part, our historical sample covers either 1926–2001 to include the 1930s deflationary recession, or 1952–2001 to avoid the period of artificially low or pegged Treasury yields of the 1940s. Before the 1920s, market liquidity and data quality were poorer, and Treasuries were not always perceived as riskless, which would tend to raise correlations. Indeed stock-bond correlations ranged around 0.3–0.7 during the first quarter of the twentieth century—and around 0.0–0.4 during the deflationary last quarter of the nineteenth century.

The patterns would look virtually indistinguishable for

correlations between real asset returns or excess returns over the short rate instead of the nominal returns. The reason is that realized monthly returns are dominated by unexpected news; subtracting a small, relatively stable inflation or short rate component each month has little impact on correlations and covariances.

²We find similar Granger causality patterns in all G-5 markets during the 1978–2001 period. For example, the contemporaneous bond-to-stock and stock-to-bond lead-lag correlations are 0.12, 0.10, and –0.12 for Japan and 0.19, 0.05, and –0.17 for Germany.

³One could use various econometric techniques to formally estimate time-varying correlation coefficients. Academics have used linear regressions and non-linear GARCH-type models to estimate conditional correlations, but we are not aware of any studies that focus on stock-bond correlations.

⁴We ignore here distinctions between yield to maturity, par yield, and spot yield.

⁵See Ilmanen [2002, 2003] on the relation between inflation and expected stock returns. We focus on positive inflation rates but note below that deflation too may be bad for stocks while it is good for bonds. Also see Fama and French [1989] on common business cycle variation in stocks' and bonds' expected returns. Such variation may reflect a common risk premium in long-term assets or the impact of monetary policy—easy (tight) Fed policy tends help (hurt) both asset classes. Campbell and Ammer [1993] assess sources of covariation between stock and bond returns in post-war data, but some of their empirical results may reflect their restrictive assumptions and information set.

⁶Expansions cover the months from the business cycle trough to the peak, and contractions or recessions cover the months from the peak to the trough, as defined by the National Bureau of Economic Research (NBER). We assume that the last recession finished at the end of 2001.

While recessions are shorter than expansions, they carry more weight in investor minds than their frequency implies (95/600 months since 1952). Intuitively, the marginal utility of a dollar is higher in bad times.

⁷The last explanation is in the same spirit as Barsky's [1989] suggestion that the stock-bond correlation is state-dependent. He argues that the correlation is especially low when real rates fall while equity risk premiums rise.

⁸Stock-bond correlations were negative also in the aftermath of the 1987 stock market crash. Most recently, Japan's stock-bond correlation turned positive for specifically Japanese reasons. Equity market weakness in early 2002 forced banks to take profits in their bond holdings; later such pressures eased. German stock-bond correlation ranged around 0.2-0.6 between 1989 and 1997, dropping to -0.4-(+)0.3 between 1998 and 2001 and to below -0.5 in 2002.

⁹Our explanatory variables include information that is not available at the beginning of a month; thus, they are not purely predictive. It should be possible to develop a set of forward-looking growth and inflation variables as well as risk aversion indicators (say, stock volatility, recent equity performance, credit spreads) and monetary policy indicators (say, curve steepness, real short rate, short rate momentum). A useful stock-bond forecasting model could include these variables as well as basic value and momentum indicators.

¹⁰For example, high or rising inflation are bad news for bonds. Exhibit 10 also shows results for subsamples based on separate level and trend variables.

¹¹The four dimensions can be correlated with each other. Inflation can be pro- or counter-cyclical (demand-led inflation tends to be procyclical while supply shocks have tended to induce counter-cyclical inflation). Monetary policy can be pro- or counter-cyclical. Market volatility tends to be higher during recessions and during monetary policy tightening. It is also possible to use linear regressions or non-linear techniques to analyze the interactions.

¹²These states are again based on partly forward-looking growth and inflation; they capture the level and trend aspects of growth and inflation; and they are asymmetric (60% of months between 1926 and 2001 are in the inflationary expansion quadrant).

¹³Most of the systematic risk in the economy is in equities or assets positively correlated with equities. Another important risk source, idiosyncratic labor income risk (unemployment), is greatest in recessions. Government bonds hedge against tough times during equity meltdowns or recessions as well as in various financial market and global security crises.

¹⁴The regression equation of survey-based bond risk premium on three factors, using semiannual data between March

1983 and March 2002, has an explanatory power (R-squared) of 78%. The regression coefficients and the t-statistics are $-2.24 (-5.7) + 0.959 (8.8) \times \text{Consensus Forecast Long-Run Inflation} + 0.442 (2.4) \times \text{Fed Dummy} + 0.603 (2.0) \times \text{Stock-Bond Correlation}$. The fitted value and different factor contributions are plotted in Exhibit 12. The consensus forecasts of the next-decade average inflation rate and the short rate are based on the semiannual survey conducted by *Blue Chip Economic Indicators*. For further background, see Best, Byrne, and Ilmanen [1998] and Ilmanen [2000].

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