The Stock-Bond Return Relation, the Term Structure’s Slope, and Asset-Class Risk Dynamics

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Abstract

We study whether asset-class risk dynamics can help explain the predominantly negative stock-bond return relation and movements in the term structure’s slope over 1997–2011. Using option-derived implied volatilities to measure risk, we find i) the negative stock-bond return relation largely disappears when controlling for risk movements, at both monthly and weekly horizons; ii) the partial relation between equity-risk changes and 10-year T-bond excess returns (term-slope movements) is reliably positive (negative); and iii) a stronger link between equity risk and stock returns implies a more negative stock-bond return correlation. Our results suggest a flight-to-quality influence between equity-risk dynamics and longer-term Treasury pricing.

I. Introduction

We study the role of asset-class risk dynamics for understanding the stock-bond return relation and movements in the term structure’s slope over the 1997–2011 period. We believe that our empirical investigation into bond-market dynamics offers the first joint evaluation of equity and bond risk in this setting, where risk is measured by the implied volatility from equity-index options and 10-year T-note futures options. Our primary aim is to address two related questions.

First, do asset-class risk changes have an important role in understanding the puzzling negative stock-bond return correlation that dominates the 1997–2011

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period? Figure 1 in Baele, Bekaert, and Inghelbrecht (BBI) (2010, p. 2376) depicts the shift in the stock-bond correlation from sizably positive to predominantly negative in the latter part of 1997. Since this period also had low and stable inflation (certainly as compared to the 1970s and 1980s), the negative stock-bond return correlation is puzzling from a traditional fundamental perspective such as that of Campbell and Ammer (1993).1

Second, over this same period, are equity-risk movements tied to T-bond prices and the term risk premia in a manner that suggests flight-to-quality pricing effects? Specifically, we examine the partial relation between equity-risk movements and both i) T-bond excess returns and ii) movements in the term structure’s slope. By “partial relation,” we refer to the estimated relation in a multivariate setting that controls for changes in T-bond risk and other variables suggested by the literature. Our empirical investigation focuses on the monthly horizon but also includes a brief robustness look at the weekly horizon.

In our investigation, we regard the change in the term structure’s slope (term slope, hereinafter) as being informative about the change in the Treasury term risk premia. To evaluate the change in the term slope, we focus on the change in the term structure’s second principal component, derived from the entire 10-year term structure of yields. We find similar results when defining the term slope as the difference between the 10-year and 6-month Treasury yields. Thus, our study symmetrically analyzes equity-risk linkages to both the “realized excess T-bond return” and the “change in the forward-looking term risk premia.”

The recent literature motivates and frames our study. BBI (2010) use a linear factor model to assess whether the changing stock-bond return correlation might be explained as a combination of changing factor exposures and changing factor volatilities. Their findings indicate that fundamental factors fail to generate the negative stock-bond return correlation that dominates since roughly 1997. BBI (2010) and Connolly, Stivers, and Sun (CSS) (2005) find that a higher equity implied volatility tends to be associated with a lower subsequent stock-bond return correlation.

Bekaert, Engstrom, and Xing (BEX) (2009) explore time-varying uncertainty and risk aversion in a joint stock-bond asset pricing model, where uncertainty refers to the conditional volatility of fundamentals (e.g., dividend growth). The BEX model features a classic flight-to-quality effect, where increased uncertainty is associated with increases in bond prices due to an increased precautionary savings effect. Relatedly, Campbell, Sunderam, and Viceira (2013) study the changing risk of government bonds and suggest that sometimes bonds may serve as a hedge against equity risk, such as during the 2008–2009 economic crisis.

David and Veronesi (2013) study the 1958–2008 period and investigate a model where investor learning bears on the relation between return volatilities and fundamentals. Their findings suggest that our 1997–2011 period is likely to have

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1Fundamental analysis in Campbell and Ammer (1993) and Fama and French (1989) suggests that movements in the short-term risk-free rate and common movements in expected returns are likely to contribute toward a positive stock-bond return correlation. This leaves variation in expected inflation as the principal contributor toward a negative stock-bond return correlation. The puzzle, of course, is that the post-1996 period (with low and stable inflation) has a predominantly negative stock-bond return correlation.
been perceived as a low-inflation-risk environment, which also suggests relatively lower long-term T-bond risk as compared to that during earlier higher-inflation-risk times (such as the 1970s and 1980s). If so, in our view, it seems plausible that flight-to-quality pricing influences on longer-term Treasuries may have become relatively more important over 1997–2011.

Collectively, we believe this literature suggests that equity-risk dynamics and flight-to-quality pricing influences may be important for understanding bond-market dynamics over our sample period. In addition to the predominantly negative stock-bond return correlation, the 1997–2011 period is also interesting because it has several episodes of high and volatile equity risk, making it well suited for a flight-to-quality investigation. Our goal is not to resolve the existing theoretical challenge, but rather to present new related empirical evidence that has both practical and theoretical implications.

Our empirical investigation contributes four primary findings that link the bond-market to equity-risk dynamics over the 1997–2011 period. First, the negative stock-bond return relation largely disappears when controlling for the asset-class risk changes (in a partial sense). Second, while controlling for bond-risk changes, the partial relation between equity-risk changes and 10-year T-bond excess returns (term-slope changes) is highly reliably positive (negative), which is suggestive of cross-market pricing influences. Third, in an extended model with additional explanatory factors for asset returns that are suggested in Campbell and Ammer (1993), equity-risk changes are highly reliably related to both stock and bond excess returns but in the opposite direction. This finding reinforces the important role of equity risk in understanding the observed negative stock-bond return relation. Fourth, consistent with changing equity-risk perceptions having both an own-market and cross-market pricing influence, we find that months with a more negative correlation between equity-risk changes and stock returns are associated with a more negative stock-bond return correlation, both for the concurrent month and the subsequent month.

Our empirical findings suggest that equity-risk movements are associated with a flight-to-quality style influence on the returns and risk premia of longer-term Treasuries. We also find that the partial relation between bond-risk changes and 10-year T-bond excess returns (term-slope changes) is negative (positive). This fits with the intuition that financial asset values (risk premia) tend to decrease (increase) with rising own-asset risk.

Of course, equity-, bond-, and derivative-market prices are all endogenously determined, reflecting more fundamental economic factors. By “influence,” we do not mean a strict structural causality in the sense of White and Lu (2010). Rather, our evidence suggests practical linkages between asset returns and implied-volatility “asset-class risk changes,” linkages that may bear on areas such as term structure modeling and portfolio management.

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2For example, over this period, equity risk was relatively high and volatile during the 1997 Asian real estate crisis, the 1998 Russian foreign-debt-default crisis, the 2001 terrorism crisis, the 2003 Iraqi war, and the 2008–2009 economic crisis.

3For our return analysis, we analyze approximate “monthly horizons” of rolling 22-trading-day returns of stock-index futures and 10-year T-note futures returns. Note that we use the more general term “bonds,” rather than distinguishing between T-notes and T-bonds.
This paper is organized as follows: Section II discusses additional related literature, and Section III presents our data and explains our sample choice. In Section IV, we present our results that relate asset-class excess returns to risk dynamics. Section V presents our results that relate movement in the term slope to risk dynamics, and Section VI concludes.

II. Additional Related Literature

The literature on return comovement also motivates our study. Kodres and Pritsker (2002) propose a rational model where investors respond to shocks in one market by optimally readjusting their positions in other markets. Cross-market rebalancing transmits the shocks, so a shock in one asset market that appears to be largely asset specific may have a material influence on the pricing of other financial assets. Relatedly, Fleming, Kirby, and Ostdiek (1998) highlight cross-market hedging as a source of linkages between the financial markets of different asset classes. In their analysis, even when expected short-term interest rates and expected inflation are unchanged, bond markets may be importantly affected by information events that alter expected stock returns, which may lead to cross-market volatility linkages. In a similar vein, Underwood (2009) examines order flow in a high-frequency analysis of the stock and bond spot market. He finds evidence that cross-market hedging is an important source of linkages across the two markets during periods of elevated equity volatility.

Other studies have tried to distinguish between cross-market pricing influences attributed to flight to quality versus flight to liquidity (see, e.g., Beber, Brandt, and Kavajecz (2008)). Goyenko and Ukhov (2009) find that positive shocks to stock illiquidity decrease bond illiquidity, which is consistent with flight-to-quality or flight-to-liquidity episodes. Distinguishing between flight-to-quality and flight-to-liquidity effects is not a goal in our study. Rather, we use the term “flight to quality” as a general term that may encompass both pricing effects.

Goyenko, Subrahmanyam, and Ukhov (2011) show that there is a tremendous change in the liquidity of Treasury securities beginning in the late 1990s. Figures 1 and 2 in their paper show that the degree of illiquidity (measured by bid-ask spreads) falls sharply in 1999 and then shows almost no variation over time. To the extent that illiquidity risk is priced, there should be only minimal illiquidity T-bond risk in the later period, relative to earlier periods. If so, this also suggests relatively low T-bond risk over our 1997–2011 period, which would be consistent with T-bonds’ assuming the role of a flight-to-quality financial asset in recent times. The presence of rational time variation in bond-risk premia is supported by evidence in Ludvigson and Ng (2009). They find a link between macroeconomic fundamentals and bond-risk premia.

Our focus on aggregate equity volatility follows directly from Ang, Hodrick, Xing, and Zhang (2006) (among others). Premised on the logic that aggregate equity volatility risk may be a priced factor, Ang et al. demonstrate empirically that stocks with a high beta with respect to innovations in aggregate volatility, measured by changes in the Chicago Board Options Exchange’s (CBOE) Volatility Index (VIX), have lower expected returns. This work suggests the question of...
whether time-varying aggregate equity volatility may also have a role in explaining bond-market dynamics.

III. Data Description and Sample Selection

In this section, we first discuss the measures of our main dependent variables (i.e., bond returns, stock returns, and changes in the term slope) and then discuss the measures of our primary explanatory variables (i.e., equity risk and bond risk). We then report summary statistics for these measures and discuss other sample selection issues.

Our main empirical investigation primarily uses the daily returns on Standard & Poor’s (S&P) 500 and 10-year T-note futures contracts. We compute the returns using the continuous futures series provided by Datastream. We use futures returns, rather than spot returns, as these asset-class futures contracts are very widely traded and mitigate potential microstructure-related measurement concerns that are inherent in spot portfolio returns. We investigate the 10-year Treasury horizon because this horizon has become a widely used longer-term Treasury standard over our sample period and the 10-year T-note futures contract has the largest trading volume among the longer-term Treasury futures contracts over our 1997–2011 period. Furthermore, the realized returns on futures contracts are naturally interpreted as excess returns, which fits with our empirical goals. Secondarily, we also analyze spot stock returns and bond returns, using returns from the Center for Research in Security Prices (CRSP) value-weighted stock index and returns implied by daily movements in the 10-year Treasury constant maturity (TCM) series.

Our empirical work focuses on rolling monthly periods (defined as rolling 22-trading-day periods) to match the monthly horizon common in finance studies and to mitigate some of the noise that may be evident in a daily return analysis. In addition, a monthly horizon matches i) the volatility forecast horizon implied by the CBOE’s VIX and ii) the frequency of Consumer Price Index (CPI)/Producer Price Index (PPI) news shocks, which we use as inflation news shocks in our later analysis. Finally, we believe that using rolling 22-trading-day observations should also better measure return dynamics, as compared to relying only on calendar-month observations (see Richardson and Smith (1991)).

Our analysis connects equity-risk dynamics to movements in the term slope as measured by movement in the term structure’s second principal component. Previous research has shown that the term structure’s first three principal components are closely related to its level, slope, and curvature, respectively. The advantages of this slope measure are that it uses information from yields over the entire maturity structure and, by construction, it is orthogonal to the yield level

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4 Ahn, Boudoukh, Richardson, and Whitelaw (2002) elaborate on this point and find that daily stock-index futures returns do not display the positive autocorrelation that is evident in daily spot portfolio returns.

5 See, for example, Diebold, Piazzesi, and Rudebusch (2005). They find that the first two principal components account for almost all (99%) of the variation in the yields, a finding that is also evident in our sample. Our principal component analysis uses the daily yields of the TCM series at the 6-month, 1-year, 2-year, 3-year, 5-year, 7-year, and 10-year horizons.
(i.e., the first principal component). We also note that comparable analysis for a simpler term-slope variable, defined as the difference between the 10-year and 6-month TCM series yields, leads to similar results. Over our 1997–2011 sample period, the correlation between the rolling 22-trading-day changes in the second principal component and in this simple term yield spread is 0.90. Then, in our interpretation, we consider that changes in the term slope should be informative about changes in the forward-looking Treasury term risk premia.6

Our primary measure of equity risk is the original VIX measure produced by the CBOE, now denoted as VXO by the CBOE.7 In this article, our exposition uses the term “VIX” to refer to the VXO. Constructed as a weighted average of the implied volatilities on eight different option series on the S&P 100 stock index, VIX is the implied volatility of a hypothetical at-the-money option with 30 calendar days (about 22 trading days) to expiration. Within the Black-Scholes option-pricing framework, VIX is a direct forecast of the future level of stock volatility. Furthermore, given the well-known bias in the Black-Scholes-type implied volatility of equity-index options, VIX may also reflect stochastic volatility (the volatility of volatility) (see, e.g., Coval and Shumway (2001)).

For the risk (expected volatility) of the 10-year T-notes, we use the implied volatility from options on 10-year T-note futures contracts provided on Bloomberg. We use the rolling implied volatility of the Bloomberg TY1 series. This series is similar in concept to the original VIX, in that it is a standardized implied volatility calculated by weighting the implied volatility from multiple near-term, near-at-the-money options and with a rolling time to expiration of about 1 month. Hereafter, we abbreviate this 10-year Treasury implied volatility as TIV. A day’s implied volatility is the trading day’s closing value, throughout, for both VIX and TIV.

Our use of these two implied-volatility risk measures (i.e., the VIX and TIV) rests on the assumption that these are good proxies for the forward-looking risk, or expected volatility, of each respective asset-class return series. We find that both TIV and VIX contain substantial and reliable information about the subsequent realized volatility for their respective daily futures returns, which supports our empirical application. Details are available from the authors in an unpublished Appendix.

Panel A of Table 1 reports the variance-covariance matrix for the time series of rolling 22-trading-day (monthly) values for the key variables. Panel B presents summary statistics for our implied-volatility risk measures and rolling 22-trading-day correlations between daily returns and daily changes in our risk measures. We note that the stock-bond return correlation tends to be negative, with a mean

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6While other factors may be involved in understanding the level of the term slope (such as future interest-rate expectations, according to the expectations theory for term structure), short-horizon changes in the term slope seem likely to substantially reflect changes in the term risk premia.

7We use the original CBOE’s VIX due to its familiarity and its well-known theoretical basis, and because it allows us to have two additional years of data for our comparative analysis. We conduct some comparative analysis over the 1988–1996 period (the new VIX is not available until 1990). Over 1990–2011, the period for which both VIX and VXO are available, the correlation between the levels of these two measures is 0.987, and the correlation between the rolling 22-trading-day changes in the new VIX and VXO is 0.974.
(median) correlation of $-0.202$ ($-0.270$) for the rolling 22-trading-day correlations. Furthermore, the rolling correlations between the stock returns and VIX changes are especially strong and negative, with a mean (median) correlation of $-0.805$ ($-0.842$).

Next, we provide a brief comparison to the 1988–1996 period for perspective and to highlight differences with our sample. The earlier 1988–1996 period is appreciably different, with a predominantly positive stock-bond return correlation and a weaker negative correlation between stock returns and VIX changes. Over 1988–1996, the rolling 22-trading-day stock-bond correlations have a mean (median) of 0.423 (0.451), and the rolling correlations between the stock returns and VIX changes have a mean (median) of $-0.581$ ($-0.648$). Furthermore, the VIX level is appreciably higher over 1997–2011 versus 1988–1996, with a mean (median) of 23.50 (22.55) over the later period versus 17.44 (16.62) over the earlier period.

Figure 1 displays the time series over 1988–2011 of the rolling 22-trading-day correlations between i) stock and bond daily returns and ii) daily stock returns and VIX changes. Figure 2 displays the time-series behavior of our risk measures, the VIX and TIV, also over 1988–2011. These figures also depict the prominent differences between our 1997–2011 period and the preceding 1988–1996 period.

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**Table 1**

**Summary Statistics**

Table 1 reports summary statistics for key variables in our study over the 1997–2011 sample period. Panel A reports the variance-covariance matrix for the following seven variables at the monthly frequency (a month refers to the 22-trading-day horizon, and the statistics are from rolling 22-trading-day periods): i) the implied spot return from 10-year T-note yield changes, ii) the CRSP value-weighted stock-index return, iii) the 10-year T-note futures return, iv) the S&P 500 futures return, v) the change in the ln(VIX), vi) the change in the ln(TIV), and vii) the change in the second principal component from the term structure. The off-diagonal elements report the correlations, and the diagonal elements report the standard deviation of the respective variable. In Panel B, VIX is the CBOE’s original VXO series, TIV is the implied volatility of 10-year T-note futures options, and the last three rows report on the rolling 22-trading-day correlations formed from daily returns (using the spot returns described for rows (1) and (2) in Panel A) and daily implied-volatility changes.

**Panel A. Variance-Covariance Matrix for Monthly Returns and Monthly Changes**

<table>
<thead>
<tr>
<th>Variable</th>
<th>1. BD_RT</th>
<th>2. ST_RT</th>
<th>3. BD_FT_RT</th>
<th>4. ST_FT_RT</th>
<th>5. ΔVIX</th>
<th>6. ΔTIV</th>
<th>7. ΔPC2</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. BD_RT</td>
<td>2.38</td>
<td>-0.251</td>
<td>0.968</td>
<td>-0.188</td>
<td>0.278</td>
<td>-0.054</td>
<td>-0.782</td>
</tr>
<tr>
<td>2. ST_RT</td>
<td>5.51</td>
<td>-0.179</td>
<td>0.981</td>
<td>-0.732</td>
<td>-0.286</td>
<td>0.053</td>
<td></td>
</tr>
<tr>
<td>3. BD_FT_RT</td>
<td>1.87</td>
<td>-0.163</td>
<td>-0.724</td>
<td>-0.294</td>
<td>0.034</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4. ST_FT_RT</td>
<td>5.43</td>
<td>-0.724</td>
<td>-0.294</td>
<td>0.034</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5. ΔVIX</td>
<td>0.22</td>
<td>0.331</td>
<td>-0.156</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6. ΔTIV</td>
<td>0.16</td>
<td>0.228</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7. ΔPC2</td>
<td>0.15</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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</table>

**Panel B. Statistics for the Implied-Volatility and Rolling 22-Trading-Day Correlations**

<table>
<thead>
<tr>
<th>Variable</th>
<th>Mean</th>
<th>Median</th>
<th>10th</th>
<th>90th</th>
</tr>
</thead>
<tbody>
<tr>
<td>VIX</td>
<td>23.50</td>
<td>22.55</td>
<td>12.35</td>
<td>34.97</td>
</tr>
<tr>
<td>TIV</td>
<td>6.69</td>
<td>6.55</td>
<td>4.46</td>
<td>9.02</td>
</tr>
<tr>
<td>Corr_ST,BD</td>
<td>-0.202</td>
<td>-0.270</td>
<td>0.701</td>
<td>0.423</td>
</tr>
<tr>
<td>Corr_ST,ΔVIX</td>
<td>-0.805</td>
<td>-0.842</td>
<td>-0.929</td>
<td>-0.624</td>
</tr>
<tr>
<td>CorrBD,ΔTIV</td>
<td>-0.116</td>
<td>-0.153</td>
<td>0.593</td>
<td>0.411</td>
</tr>
</tbody>
</table>

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8The 1988–1996 period is chosen here because it has VIX availability but avoids possible distortions due to the extreme market crash on Oct. 19, 1987. The original VIX is available only back to 1986, by backfill from the CBOE.
FIGURE 1

“Stock-Bond Return” and “Stock Return-ΔVIX” Correlations

Figure 1 displays the time series of rolling 22-trading-day correlations for i) stock returns and 10-year T-note returns in Graph A and ii) stock returns and VIX changes in Graph B. The correlations are from the spot returns described in Table 1. The month t correlation is the correlation from daily returns over trading days t to t + 21. The sample period is 1988–2011.

Graph A. Rolling 22-Trading-Day Correlations between Stock and 10-Year T-Note Returns

Graph B. Rolling 22-Trading-Day Correlations between Stock Returns and VIX Changes
FIGURE 2
Implied Volatilities from Equity-Index and T-Note Futures Options

Figure 2 displays the time series for the equity-index and 10-year T-note futures implied volatility. The VIX is the CBOE’s original stock volatility index (VIX), now referred to as VXX by the CBOE. The TIV is the implied volatility from options on 10-year T-note futures contracts from Bloomberg. Graph A displays the VIX and TIV separately. Graph B reports on the VIX variability, where the value on day \( t \) represents the change in the \( \ln(\text{VIX}) \) over trading days \( t \) to \( t + 21 \). The sample period is 1988–2011.

Graph A. VIX and TIV Time Series

Graph B. VIX Variability, 22-Trading-Day Changes in \( \ln(\text{VIX}) \)
The apparent change around 1997 reinforces the findings in BBI (2010) and leads to our focus on the 1997–2011 period.9

One other important dimension of the 1997–2011 period is that inflation is relatively low and relatively stable, with CPI and PPI inflation averaging only 2.60% per annum and 2.38% per annum, respectively. Inflation over the 1970s and early 1980s was generally much higher. In this sense, changes in inflation risk over time could have a role in understanding the predominantly negative stock-bond return relation over 1997–2011, in that a decreased inflation risk could elevate the attractiveness of longer-term Treasury bonds as a flight-to-quality asset.10

We also evaluate the time series of inflation expectations as implied from Treasury Inflation-Protected Securities (TIPS) yields (our calculations follow the procedure in Gurkaynak, Sack, and Wright (2010)). Other than a sizable drop around the end of 2008, expected inflation appears to be quite stable with nearly 90% of the observations falling in the 1.75%–2.75% range. There are a number of periods where the stock-bond correlation is reliably negative and the inflation expectations fall in a narrow and modest band. This observation casts doubt on the notion that changing inflation expectations could be the primary driver of the negative stock-bond return correlation over our sample. However, as previously discussed, a low and stable inflation environment over our sample seems consistent with the notion that longer-term Treasuries may have served as a flight-to-quality financial asset.

IV. Asset-Class Returns and Risk Dynamics

We turn now to our main empirical analysis on the comovement between asset-class excess returns and asset-class risk changes. Section IV.A reports on the partial risk-return relations between the asset-class futures returns and the asset-class risk changes, in a simple setting without additional explanatory terms. Section IV.B reports on an extended return model that controls for other important factors, as suggested in Campbell and Ammer (1993), to see if the partial risk-return relations are influenced by the additional explanatory terms. In Section IV.C, we discuss an alternate approach that analyzes residuals from an augmented vector autoregression (VAR), in place of the raw variables. Since the VAR results are quite similar, we report the tabular results for our analysis only on the raw variables for brevity. Section IV.D presents additional robustness evidence. Finally, Section IV.E presents time-series evidence that the strength of the relation between stock returns and VIX changes is informative about both the concurrent and the subsequent stock-bond return correlation.

9Our remaining empirical work in this paper investigates the 1997–2011 period. In additional work, we have also performed estimations over 1988–1996 that are comparable to our equations (1) and (5) from Section IV. In stark contrast to our 1997–2011 results, our estimation over 1988–1996 finds no statistically reliable partial relation between the monthly VIX changes and the monthly 10-year T-bond futures return. In our view, this supports the notion that flight-to-quality pricing influences may have become relatively more important over our recent sample period.

10Findings in David and Veronesi (2013) suggest that investors were likely to perceive a decreased inflation risk over our sample period.
A. Asset-Class Returns and Risk Dynamics: An Initial Look

We begin by investigating the comovement between stock and 10-year T-note futures returns while controlling for movements in the risk of both asset classes. Table 2 reports estimates from five variations of the following equation system:

\[ r_{TN}^{10-Y} = \gamma_0 + \gamma_1 r_S^S + \gamma_2 \Delta \ln(VIX_{t-1,t+21}) + \gamma_3 \Delta \ln(TIV_{t-1,t+21}) + \varepsilon_{t,t+21}, \]

\[ \gamma_0 + \gamma_1 r_S^S + \gamma_2 \Delta \ln(VIX_{t-1,t+21}) + \gamma_3 \Delta \ln(TIV_{t-1,t+21}) + \varepsilon_{t,t+21}, \]

where \( r_{TN}^{10-Y} \) is the return for the 10-year T-note futures contract (S&P 500 futures contract) over trading days \( t \) to \( t+21 \); \( r_S^S \) is the return for the S&P 500 futures contract over trading days \( t \) to \( t+21 \); \( \Delta \ln(VIX_{t-1,t+21}) \) is the concurrent change in \( \ln(VIX) \) (\( \ln(TIV) \)), defined as the natural log (or natural log of \( TIV_{t-1} \)) minus the natural log of \( VIX_{t-1} \) (\( TIV_{t-1} \)); \( \varepsilon_{t,t+21} \) is the conditional variance of the residual \( \varepsilon_{t,t+21} \), \( \Delta \ln(TIV_{t-1,t+21}) \) is the concurrent change in \( \Delta \ln(TIV) \) (\( \Delta \ln(TIV_{t-1,t+21}) \)), \( \varepsilon_{t,t+21} \) is the conditional variance of the residual \( \varepsilon_{t,t+21} \), \( \alpha_0 \) is the conditional mean equation; \( TIV_1 \) is the squared closing implied volatility from the T-note futures options on day \( t-1 \), with units adjusted to the monthly horizon; and the \( \gamma \)'s and \( \alpha \)'s are coefficients to be estimated. Models (a)–(d) below report on OLS estimations of equation (i) above. Model (e) reports on the two-equation system, given by equations (i) and (ii) above, that is estimated simultaneously in a maximum likelihood system that assumes conditional normality. We report changes that are inclusive of 1 subperiods. For the coefficients, \( t \)-statistics are in parentheses, calculated with heteroskedastic and autocorrelation consistent standard errors. * and ** indicate significance at the 5% and 1% levels, respectively.

<table>
<thead>
<tr>
<th>Period</th>
<th>Model</th>
<th>( \gamma_1 \times 100 )</th>
<th>( \gamma_2 )</th>
<th>( \gamma_3 )</th>
<th>( \alpha_1 )</th>
<th>( R^2 )</th>
</tr>
</thead>
<tbody>
<tr>
<td>1997-2011</td>
<td>(a)</td>
<td>-5.61 (-2.19)*</td>
<td>2.09 (3.87)**</td>
<td>-0.922 (-1.22)</td>
<td>0.71</td>
<td>2.7%</td>
</tr>
<tr>
<td></td>
<td>(b)</td>
<td></td>
<td>0.18 (0.06)</td>
<td>2.64 (4.53)**</td>
<td>-2.06 (-2.86)**</td>
<td>8.8%</td>
</tr>
<tr>
<td></td>
<td>(c)</td>
<td></td>
<td>-1.50 (-0.56)</td>
<td>2.33 (4.44)**</td>
<td>-1.42 (-2.36)**</td>
<td>n/a</td>
</tr>
<tr>
<td></td>
<td>(d)</td>
<td></td>
<td>0.18 (0.06)</td>
<td>2.64 (4.53)**</td>
<td>-2.06 (-2.86)**</td>
<td>8.8%</td>
</tr>
<tr>
<td></td>
<td>(e)</td>
<td></td>
<td>-1.50 (-0.56)</td>
<td>2.33 (4.44)**</td>
<td>-1.42 (-2.36)**</td>
<td>0.504 (3.54)**</td>
</tr>
<tr>
<td>1997-2004.06</td>
<td>(a)</td>
<td>-7.01 (-2.73)**</td>
<td>2.63 (4.39)**</td>
<td>-1.06 (-0.83)</td>
<td>0.09</td>
<td>4.1%</td>
</tr>
<tr>
<td></td>
<td>(b)</td>
<td></td>
<td>-1.43 (-0.42)</td>
<td>2.74 (3.04)**</td>
<td>-1.95 (-1.68)</td>
<td>10.0%</td>
</tr>
<tr>
<td></td>
<td>(c)</td>
<td></td>
<td>-1.42 (-0.49)</td>
<td>2.71 (3.46)**</td>
<td>-1.85 (-1.79)</td>
<td>0.071 (0.29)</td>
</tr>
<tr>
<td></td>
<td>(d)</td>
<td></td>
<td>-1.43 (-0.42)</td>
<td>2.74 (3.04)**</td>
<td>-1.95 (-1.68)</td>
<td>10.0%</td>
</tr>
<tr>
<td></td>
<td>(e)</td>
<td></td>
<td>-1.42 (-0.49)</td>
<td>2.71 (3.46)**</td>
<td>-1.85 (-1.79)</td>
<td>0.071 (0.29)</td>
</tr>
<tr>
<td>2004.07-2011</td>
<td>(a)</td>
<td>-4.25 (-1.02)</td>
<td>1.75 (2.24)*</td>
<td>-0.787 (-0.98)</td>
<td>0.50</td>
<td>1.6%</td>
</tr>
<tr>
<td></td>
<td>(b)</td>
<td></td>
<td>2.25 (0.51)</td>
<td>2.71 (3.67)**</td>
<td>-2.14 (-2.88)**</td>
<td>8.3%</td>
</tr>
<tr>
<td></td>
<td>(c)</td>
<td></td>
<td>-1.26 (-0.31)</td>
<td>2.29 (3.63)**</td>
<td>-1.58 (-2.05)</td>
<td>0.571 (3.36)**</td>
</tr>
</tbody>
</table>

where \( r_{TN}^{10-Y} \) is the return for the 10-year T-note futures contract over trading days \( t \) to \( t+21 \); \( r_S^S \) is the return for the S&P 500 futures contract over trading days \( t \) to \( t+21 \); \( \Delta \ln(VIX_{t-1,t+21}) \) is the concurrent change in \( \ln(VIX) \) (\( \ln(TIV) \)), defined as the natural log (or natural log of \( TIV_{t-1} \)) minus the natural log of \( VIX_{t-1} \) (\( TIV_{t-1} \)); \( \varepsilon_{t,t+21} \) is the conditional variance of the residual \( \varepsilon_{t,t+21} \), \( \Delta \ln(TIV_{t-1,t+21}) \) is the concurrent change in \( \Delta \ln(TIV) \) (\( \Delta \ln(TIV_{t-1,t+21}) \)), \( \varepsilon_{t,t+21} \) is the conditional variance of the residual \( \varepsilon_{t,t+21} \), \( \alpha_0 \) is the conditional mean equation; \( TIV_1 \) is the squared closing implied volatility from the T-note futures options on day \( t-1 \), with units adjusted to the monthly horizon; and the \( \gamma \)'s and \( \alpha \)'s are coefficients to be estimated. We report estimates over 1997–2011 and over inclusive 1/2 subperiods.

In our empirical work throughout the paper, we report \( t \)-statistics that are calculated with heteroskedastic and autocorrelation consistent standard errors.
For our monthly analysis, the number of lags for the autocorrelation structure is set to 22 since we use 22-trading-day overlapping variables. For robustness analysis presented later, we adjust the lag structure to match the weekly horizon data.

Models (a)–(d) of Table 2 report on four variations of an ordinary least squares (OLS) estimation of equation (1). The first three models in the table examine the simple relation of the bond-futures return with the stock-futures return, $\Delta VIX$, and $\Delta TIV$, respectively. The model (a) estimation depicts the simple negative stock-bond return relation over our sample period. The model (b) estimation indicates a strong positive simple relation between $\Delta VIX$ and the bond-futures returns. Note that the simple relation between bond returns and $\Delta VIX$ (depicted in model (b)) is comparatively stronger than the simple stock-bond return relation (depicted in model (a)). Finally, the model (c) estimation indicates that the simple relation between $\Delta TIV$ and the bond-futures return is statistically insignificant.

In model (d) of Table 2 with all three explanatory terms, we find that the partial relations for $\Delta VIX$ and $\Delta TIV$ not only retain their respective signs but also increase in magnitude, as compared to the simple relations. For the full sample period, the estimated $\gamma_2$ is 2.09 when estimated with $\Delta VIX$ only, whereas the estimated $\gamma_2$ is 2.64 (or about 25% higher) when the model includes the other two explanatory variables. We also note that the relation between the bond-futures return and $\Delta TIV$ is now reliably negative when controlling for the other terms. This indicates that when controlling for changes in equity risk, there is a reliable negative relation between the $\Delta TIV$ and T-note values: As expected, the bond values decrease as their own risk increases.

Since our study investigates comovement related to time-varying risk, it is appropriate to verify that our primary results hold when allowing for time-varying volatility. Model (e) of Table 2, the two-equation system given by equations (1) and (2), incorporates time-varying residual volatility. The system is estimated by maximum likelihood estimation assuming a conditional normal density. The estimated $\alpha_1$ is reliably positive, indicating that the lagged TIV contains reliable information for the subsequent volatility. The partial relation between the bond futures and $\Delta VIX$ ($\Delta TIV$) remains reliably positive (reliably negative).

Finally, when comparing model (a) of Table 2 to models (d) and (e), we stress the substantial difference between the simple and the partial stock-bond return relations. That is, when controlling for the risk changes, the partial relation between the bond-futures return and the stock-futures return falls substantially and becomes statistically insignificant in all cases for models (d) and (e). This contrasts with the negative simple relation in model (a).

Table 3 reports on a comparable investigation using stock-futures returns as the dependent variable. We report on five model variations of the following equation system:

\begin{align*}
\Delta r_{t,t+21}^S &= \gamma_0 + \gamma_1 r_{t,t+21}^{TN} + \gamma_2 \Delta \ln(VIX_{t-1,t+21}) \\
&\quad + \gamma_3 \Delta \ln(TIV_{t-1,t+21}) + \varepsilon_{t,t+21}, \\
\Delta \ln(v_t) &= \alpha_0 + \alpha_1 VIX_{t-1}^2,
\end{align*}

where $r_{t,t+21}^S$ is the stock-futures return, $r_{t,t+21}^{TN}$ is the bond-futures return, $VIX_{t-1,t+21}$ is the change in VIX, and $TIV_{t-1,t+21}$ is the change in TIV.
where the terms and estimation details are as provided for equations (1) and (2), and VIX replaces TIV in the conditional variance equation.

We find that the characteristics of the stock-bond return relation are consistent with the results from Table 2. The simple stock-bond return relation is significantly negative (model (a)) while the partial stock-bond return relation goes to near 0 (models (d) and (e)). In regard to the relation between equity values and ΔVIX, we find that both the simple relation and the partial relation are large and highly reliable. This finding confirms the well-known contemporaneous negative relation between ΔVIX and stock returns. Finally, the ΔTIV is not reliably related to the stock-futures return, in a partial sense (models (d) and (e)).

Next, we note that the partial negative relation between the stock-futures returns and ΔVIX is about six times larger (in magnitude) than the comparable positive relation between the bond-futures returns and ΔVIX (compare the estimated γ2’s in Tables 2 and 3). This seems intuitive. If the Table 2 results reflect flight-to-quality pricing influences (i.e., a cross-market effect), we would expect the effect of ΔVIX to be appreciably smaller in the cross (bond) market than what we see in the primary (equity) market.

To summarize, our results in this subsection suggest that the negative stock-bond return correlation over 1997–2011 is substantially tied to joint risk-price dynamics, at least over monthly horizons. The ΔVIX term has a highly reliable partial relation to both the stock and T-note returns, but with opposite signs.

### Table 3: S&P 500 Futures Returns and Asset-Class Risk Changes

<table>
<thead>
<tr>
<th>Period</th>
<th>Model</th>
<th>γ1 x 100</th>
<th>γ2</th>
<th>γ3</th>
<th>α1</th>
<th>R²</th>
</tr>
</thead>
<tbody>
<tr>
<td>1997–2011</td>
<td>(a)</td>
<td>−47.5 (−2.28)*</td>
<td></td>
<td></td>
<td></td>
<td>2.7%</td>
</tr>
<tr>
<td></td>
<td>(b)</td>
<td>−18.2 (−16.10)**</td>
<td></td>
<td></td>
<td></td>
<td>52.4%</td>
</tr>
<tr>
<td></td>
<td>(c)</td>
<td></td>
<td>−9.75 (−5.22)**</td>
<td></td>
<td></td>
<td>8.6%</td>
</tr>
<tr>
<td></td>
<td>(d)</td>
<td>0.78 (0.06)</td>
<td>−17.7 (−14.78)**</td>
<td></td>
<td></td>
<td>52.7%</td>
</tr>
<tr>
<td></td>
<td>(e)</td>
<td>−3.22 (−0.38)</td>
<td>−14.2 (−13.69)**</td>
<td>−1.24 (−1.46)</td>
<td>0.282 (7.09)**</td>
<td>n/a</td>
</tr>
<tr>
<td>1997–2004 06</td>
<td>(a)</td>
<td>−58.5 (−2.40)*</td>
<td></td>
<td></td>
<td></td>
<td>4.1%</td>
</tr>
<tr>
<td></td>
<td>(b)</td>
<td></td>
<td>−20.5 (−14.91)**</td>
<td></td>
<td></td>
<td>52.9%</td>
</tr>
<tr>
<td></td>
<td>(c)</td>
<td></td>
<td>−8.23 (−3.58)**</td>
<td></td>
<td></td>
<td>6.3%</td>
</tr>
<tr>
<td></td>
<td>(d)</td>
<td>−6.20 (−0.42)</td>
<td>−19.8 (−13.95)**</td>
<td>−2.67 (−1.94)</td>
<td></td>
<td>53.5%</td>
</tr>
<tr>
<td></td>
<td>(e)</td>
<td>−5.54 (−0.42)</td>
<td>−19.7 (−14.39)**</td>
<td>−2.67 (−2.00)</td>
<td>0.012 (0.28)</td>
<td>n/a</td>
</tr>
<tr>
<td>2004–2011</td>
<td>(a)</td>
<td>−36.5 (−1.10)</td>
<td></td>
<td></td>
<td></td>
<td>1.5%</td>
</tr>
<tr>
<td></td>
<td>(b)</td>
<td></td>
<td>−16.7 (−10.35)**</td>
<td></td>
<td></td>
<td>53.2%</td>
</tr>
<tr>
<td></td>
<td>(c)</td>
<td></td>
<td>−11.3 (−3.88)**</td>
<td></td>
<td></td>
<td>11.4%</td>
</tr>
<tr>
<td></td>
<td>(d)</td>
<td>9.83 (0.50)</td>
<td>−16.4 (−9.43)**</td>
<td>−1.49 (−0.84)</td>
<td></td>
<td>53.5%</td>
</tr>
<tr>
<td></td>
<td>(e)</td>
<td>−6.70 (−0.60)</td>
<td>−12.6 (−13.13)**</td>
<td>−0.72 (−0.70)</td>
<td>0.301 (4.67)**</td>
<td>n/a</td>
</tr>
</tbody>
</table>
This observation suggests a cross-asset-class “risk to return” valuation effect, where changes in equity-market risk bear on understanding changes in T-bond values.

B. Asset-Class Returns and Risk Dynamics: Extended Model

To probe further, we next evaluate whether the partial equity-risk relations from Section IV.A remain when controlling for additional important explanatory terms as suggested by Campbell and Ammer (1993). In their fundamental framework, movements in three factors affect comovement between stocks and bonds: the short rate (or risk-free interest rate), inflation, and the expected future risk premia. Accordingly, we add three new additional explanatory variables: i) the change in the risk-free rate, as proxied by the 6-month Treasury yield; ii) the inflation shock over the respective rolling 22-trading-day period, with two alternate measures (explained below); and iii) the change in the default yield spread, as measured by the difference between Moody’s Baa and Aaa bond yields. Following Jagannathan and Wang (1996), we include the default yield spread as a way to capture elements of time variation in risk premia.11

To measure inflation shocks, we implement two different approaches. First, we construct an “inflation shock” over a 22-trading-day period as the sum of the shocks in the CPI and PPI that occur over those 22 days. The shock in CPI or PPI is defined as the difference between the actual and the expected value. We obtain the expected value data from the Money Market Services (MMS) survey. Second, we compute inflation expectations as implied by TIPS yields following the procedure in Gurkaynak et al. (2010). Our inflation shock measure for a 22-trading-day period is the change in the TIPS-based inflation expectations from the beginning of the period to the end of the period. Because TIPS yields are not available over our entire sample and because the early TIPS market was considered to be illiquid, we evaluate the TIPS data only from 2004 onward.

As in Section IV.A, we focus initially on T-bond futures returns as a measure of excess-bond returns. We report estimates from three variations for the following model:

$$ r_{TN}^{T+21} = \gamma_0 + \gamma_1 r_{S}^{T+21} + \gamma_2 \Delta \ln(VIX_{T-1,T+21}) + \gamma_3 \Delta \ln(TIV_{T-1,T+21}) $$
$$ + \gamma_4 \Delta YD6M_{T-1,T+21} + \gamma_5 INF_{SH_{T-1,T+21}} $$
$$ + \gamma_6 \Delta DYS_{T-1,T+21} + \epsilon_{T,T+21} $$

where $\Delta YD6M_{T-1,T+21}$ is the change in the 6-month Treasury yield; $INF_{SH_{T-1,T+21}}$ is the inflation shock, either from PPI and CPI news shocks (for the estimation over 1997–2011) or from 10-year TIPS yields (for the estimation over 2004–2011); $\Delta DYS_{T-1,T+21}$ is the change in the yield spread between Moody’s Baa and Aaa bonds; where the changes for all terms are over the close of trading-days $T-1$ to $T+21$; and the other terms are as defined for equation (1). We report

11If the price of risk is constant (or nearly constant), then it would seem plausible that risk movements (as measured by VIX and TIV movements) would capture a good deal of the time-varying risk premia. However, we include the default yield spread as another variable that the literature has proposed as being tied to movements in the equity-risk premia.
estimates of equation (5) in Table 4, with separate estimates over 1997–2011 and 2004–2011 (corresponding to TIPS availability).

TABLE 4
Comovement between Risk Movements and Asset-Class Excess Returns: Extended Model

<table>
<thead>
<tr>
<th>Variable</th>
<th>1997–2011 Period, with the Inflation Shock Term from CPI/PPI News Shocks</th>
<th>2004–2011 Period, with the Inflation Term from TIPS Data</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>$\gamma_1 \times 100$ ($\gamma_2$ ($\gamma_3$ ($\gamma_4$ ($\gamma_5$ ($\gamma_6$ ($R^2$ (%)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>($\Delta$VIX) ($\Delta$TIV) ($\Delta$YDM) ($\Delta$INF_SH) ($\Delta$DYS)</td>
<td></td>
</tr>
<tr>
<td>1.</td>
<td>2.40 (0.98)</td>
<td>2.45 (4.20)**</td>
</tr>
<tr>
<td>2.</td>
<td>8.47 (2.47)**</td>
<td>2.55 (3.78)**</td>
</tr>
</tbody>
</table>

Panel A. Monthly 10-Year T-Bond Futures Returns as the Dependent Variable

Panel B. Monthly S&P 500 Futures Returns as the Dependent Variable

For our 1997–2011 and 2004–2011 estimation periods, we emphasize the following findings in Panel A of Table 4. First, $\Delta$VIX is highly reliably and positively related to the bond-futures return, with magnitudes little changed from the simpler model in Table 2. Furthermore, in contrast to the simple negative stock-bond return relation, the partial stock-bond relation depicted by the estimated $\gamma_1$ is either insignificantly positive (for the full sample in Panel A.1) or modestly positive (for the 2004–2011 period in Panel A.2). Finally, the $\Delta$TIV relation remains reliably negative, again consistent with the comparable Table 2 results.

Panel B of Table 4 reports on a comparable model as in equation (5), but with the stock-futures return as the dependent variable and the bond-futures return as the $\gamma_1$ explanatory term. We emphasize the following findings. First, the $\Delta$VIX relation remains hugely negative. Second, the partial stock-bond relation (i.e., the estimated $\gamma_1$) is either insignificantly positive (for the full sample in Panel B.1) or modestly positive (for the 2004–2011 period in Panel B.2); this contrasts with the simple negative stock-bond return relation. Third, the $\Delta$TIV term remains relatively unimportant for the stock-futures return.

We also believe it is informative to compare directly the estimates in Panel A of Table 4 (dependent variable: bond-futures returns) to estimates in Panel B...
(dependent variable: stock-futures returns). For both estimation periods, $\Delta VIX$ is the only explanatory term where the loadings are sizable and highly statistically significant for both dependent variables, but in the opposite direction. The estimated $\gamma_2$ on $\Delta VIX$ is $+2.45$ ($t$-statistic of 4.20) with the bond-futures returns as the dependent variable versus $-16.9$ ($t$-statistic of $-17.2$) with the stock-futures returns as the dependent variable. The $\gamma_2$ estimates over the 2004–2011 period are similar. In our view, this suggests that equity-risk dynamics are of first-order importance in understanding the negative stock-bond return correlation over 1997–2011.

C. Alternate VAR Approach

We have also estimated alternate versions of our models in Sections IV.A and IV.B that use the innovation or unpredictable component of each variable in place of the simple variable. By analyzing innovations that strip out the predictability from lagged variables, the results may be more directly interpreted as responses to unexpected shocks (e.g., flight to quality), rather than some movement that was predicted by past market conditions. To do this, we use an augmented VAR system to decompose monthly bond returns, stock returns, and $\Delta VIX$ and $\Delta TIV$ values into an expected and an innovation (or unexpected) component. In our augmented VAR, in addition to the lags of the system variables, we include i) lagged forward rates to take into account the predictability in bond returns that is noted in Cochrane and Piazzesi (2005), ii) the lagged levels of VIX and TIV to capture the risk environment, and iii) the lagged dividend yield and default yield spread to capture other predictability suggested by the literature. We retain the VAR residuals as innovations, and we then analyze the innovations.

Since the predictability of monthly asset returns is quite modest, a priori we expect little difference between the analysis in the previous two sections and an analysis that relies on the unexpected component of the variables.12 Our analysis of the VAR residuals yields results that are quite similar to those in Tables 2–4 for the raw variables. For brevity, the comparable VAR results are available in an unpublished Appendix from the authors.

D. Additional Robustness Evidence

Our prior empirical analysis uses futures returns and focuses on a rolling monthly horizon. In this subsection, to probe robustness and pervasiveness, we show that our main results are also evident when analyzing monthly spot returns and when evaluating a shorter weekly horizon. We examine weekly returns to supplement our main analysis for three reasons. With rolling 5-trading-day

---

12Predictability with economic state variables and factors is generally more important for longer-horizon returns. BBI (2010) focus on the quarterly horizon because “This is the frequency at which data on the economic state variables used in the dynamic factor models are available. It may also be the highest frequency at which a fundamentals-based model is expected to have explanatory power” (pp. 2376–2377). Campbell and Ammer (1993), who perform a VAR analysis on monthly stock and bond returns, note that “Innovations were calculated from the first-order VAR system . . . naturally results are very similar if raw excess bond and stock returns are used” (p. 15).
weekly returns, we have many more independent observations (as compared to rolling monthly observations), so we may have greater statistical power. Furthermore, readers are likely to be naturally curious as to whether our results are robust to alternative return horizons, such as a week. Finally, with shorter-horizon returns, one would expect less predictability in an economic sense, so the issues of modeling predictability (i.e., whether or not to use a VAR approach) are mitigated.

Panels A and B of Table 5 repeat our prior evaluation in Tables 2 and 3, but with excess spot asset-class returns replacing the futures returns. The excess spot returns are calculated as the raw return minus a risk-free rate from 1-month T-bills, as provided in the French data library. Panels C and D repeat our prior evaluation in Tables 2 and 3, but with weekly futures returns replacing the monthly futures returns.

### TABLE 5

<table>
<thead>
<tr>
<th>Variable</th>
<th>Panel A</th>
<th>Panel B</th>
<th>Panel C</th>
<th>Panel D</th>
</tr>
</thead>
<tbody>
<tr>
<td>( \gamma_1 \times 100 )</td>
<td>( \gamma_2 )</td>
<td>( \gamma_3 )</td>
<td>( \alpha_1 )</td>
<td>( \Delta )</td>
</tr>
<tr>
<td>( rTN )</td>
<td>( \Delta VIX )</td>
<td>( \Delta TIV )</td>
<td>( \Delta VIX^2 )</td>
<td>( R^2 )</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Model</th>
<th>( \gamma_1 \times 100 )</th>
<th>( \gamma_2 )</th>
<th>( \gamma_3 )</th>
<th>( \alpha_1 )</th>
<th>( \Delta )</th>
</tr>
</thead>
<tbody>
<tr>
<td>(a)</td>
<td>10.8 (-3.92)**</td>
<td>n/a</td>
<td>2.43 (-2.94)**</td>
<td>0.754 (2.84)**</td>
<td>6.2%</td>
</tr>
<tr>
<td>(b)</td>
<td>-4.84 (-1.25)</td>
<td>2.78 (2.72)**</td>
<td>-1.74 (-2.16)*</td>
<td>n/a</td>
<td>10.6%</td>
</tr>
<tr>
<td>(c)</td>
<td>-4.87 (-1.49)</td>
<td>2.73 (3.44)**</td>
<td>-0.33 (-0.42)</td>
<td>0.269 (7.61)**</td>
<td>n/a</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Model</th>
<th>( \gamma_1 \times 100 )</th>
<th>( \gamma_2 )</th>
<th>( \gamma_3 )</th>
<th>( \alpha_1 )</th>
<th>( \Delta )</th>
</tr>
</thead>
<tbody>
<tr>
<td>(a)</td>
<td>-57.8 (-4.22)**</td>
<td>n/a</td>
<td>1.07 (-1.02)</td>
<td>n/a</td>
<td>6.2%</td>
</tr>
<tr>
<td>(b)</td>
<td>-12.9 (-1.37)</td>
<td>-18.4 (-15.45)**</td>
<td>-0.33 (-0.42)</td>
<td>0.269 (7.61)**</td>
<td>55.3%</td>
</tr>
<tr>
<td>(c)</td>
<td>-8.37 (-1.17)</td>
<td>-15.4 (-16.10)**</td>
<td>-0.33 (-0.42)</td>
<td>0.269 (7.61)**</td>
<td>n/a</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Model</th>
<th>( \gamma_1 \times 100 )</th>
<th>( \gamma_2 )</th>
<th>( \gamma_3 )</th>
<th>( \alpha_1 )</th>
<th>( \Delta )</th>
</tr>
</thead>
<tbody>
<tr>
<td>(a)</td>
<td>-7.44 (-5.59)**</td>
<td>n/a</td>
<td>1.51 (-6.41)**</td>
<td>n/a</td>
<td>5.6%</td>
</tr>
<tr>
<td>(b)</td>
<td>-3.47 (-1.78)</td>
<td>1.53 (4.83)**</td>
<td>-1.09 (-3.91)**</td>
<td>0.606 (8.46)**</td>
<td>10.8%</td>
</tr>
<tr>
<td>(c)</td>
<td>-2.89 (-1.83)</td>
<td>1.31 (5.23)**</td>
<td>-0.55 (-1.61)</td>
<td>0.259 (12.35)**</td>
<td>n/a</td>
</tr>
</tbody>
</table>

We find that all the key results in Tables 2 and 3 are also evident when evaluating monthly excess spot returns and weekly futures returns. In particular, we note two important regularities. First, for all four panels, when controlling for the two asset-class risks per models (b) and (c) in the table, the partial stock-bond return relation becomes appreciably smaller than the comparable simple relation...
per model (a). Second, in all four panels, the $\Delta VIX$ relations remain highly statistically significant.13

Finally, readers might also wonder whether our results are also evident when analyzing nonoverlapping data. Accordingly, we have repeated our monthly analysis using nonoverlapping observations and find qualitatively comparable results.

E. The Strength of the “Stock Return-$\Delta VIX$” Relation

Our previous results suggest that equity-risk variations tend to be associated with flight-to-quality influences on the prices of longer-term T-bonds over our 1997–2011 period. When combined with the well-known large negative relation between equity risk and equity values, such pricing influences could presumably induce a negative stock-bond return correlation. This suggests that periods when changing equity-risk perceptions are relatively more important in understanding equity returns are also likely to be periods with a more negative stock-bond return relation.

A simple and intuitive monthly measure that indicates the relative link between changing equity-risk perceptions and stock returns is the correlation over a month between daily stock returns and VIX changes (Corr$^{ST,\Delta VIX}_t$, measured by rolling 22-trading-day observations). In this subsection, we investigate whether the “stock-bond return” correlation (Corr$^{ST,BD}_t$) and the “stock return-$\Delta VIX$” correlation (Corr$^{ST,\Delta VIX}_t$) are reliably linked in a manner that suggests cross-market pricing influences.

We focus first on how the time series of Corr$^{ST, BD}_t$ comoves with the time series of Corr$^{ST, \Delta VIX}_t$ contemporaneously, by estimating four variations of the following model:

$$
Corr^{ST, BD}_{t,t+21} = \lambda_0 + \lambda_1 Corr^{ST,\Delta VIX}_{t,t+21} + \lambda_2 Corr^{BD, \Delta TIV}_{t,t+21} + \lambda_3 \ln(VIX)_{t-1} + \lambda_4 Corr^{ST, BD}_{t-22, t-1} + \epsilon_{t,t+21},
$$

where $Corr^{ST, BD}_{i,j}$ is the Fisher transformation of the sample correlation between the 22 daily stock and 10-year T-bond returns over trading days $i$ to $j$; $Corr^{ST, \Delta VIX}_{i,j}$ (Corr$^{BD, \Delta TIV}_{i,j}$) is the Fisher transformation of the sample correlation between the 22 daily stock returns and daily VIX changes (daily 10-year T-bond returns and daily TIV changes) over trading days $i$ to $j$; $\ln(VIX)_{t-1}$ is the natural log of VIX at close of day $t - 1$; $\epsilon_{t,t+21}$ is the residual; and the $\lambda$’s are estimated coefficients. Here, we use the CRSP value-weighted index return for the daily stock-market returns and we use the daily returns implied by changes in the 10-year TCM yield for the daily T-bond returns.

In equation (6), we are primarily interested in $\lambda_1$. Our earlier discussion suggests that the estimated $\lambda_1$’s are likely to be reliably positive. To control for

---

13Jubinski and Lipton (2012) provide supportive evidence at the daily change horizon. They analyze the relation between daily yield changes and daily VIX changes over Sept. 2002–Dec. 2008 (without the inclusion of a comparable TIV) and find evidence consistent with a flight-to-quality effect between equity-risk changes and yield changes.
other dimensions of risk that might influence the stock-bond return correlation and capture persistence in the stock-bond correlation, we also include three other explanatory variables. When T-bond values are strongly linked to bond-market risk changes, then own-market risk influences may be a more dominant effect for bond pricing, which could presumably obscure any cross-asset risk pricing influences. If so, then the estimated $\lambda_2$ (on $\text{Corr}^{BD, \Delta TIV}$) may be negative. Furthermore, we control for lagged VIX following CSS (2005), who document that a higher VIX is associated with a lower subsequent stock-bond return correlation. Finally, we include the lagged $\text{Corr}^{ST,BD}$ (the $\lambda_4$ term) to control for persistence in this correlation.

Panel A of Table 6 reports estimates of the models. Model (a) shows that the simple relation between $\text{Corr}^{ST,BD}$ and $\text{Corr}^{ST, \Delta VIX}$ is sizable and highly reliably positive for the 1997–2011 period and inclusive 1/2 subperiods. In models (b)–(d), when we include the other three control variables, the partial relation (the estimated $\lambda_1$) remains strongly positive.

We also find that the estimated $\lambda_3$ on the lagged VIX level is negative and generally statistically significant over 1997–2011. This indicates that CSS’s (2005) finding that a higher VIX is associated with lower subsequent stock-bond return correlation holds reliably over the 1997–2011 sample period. Next, the estimated $\lambda_2$ on $\text{Corr}^{BD, \Delta TIV}$ is negative, which is consistent with our earlier conjecture. Finally, we note that the estimated $\lambda_4$ on the lagged “stock-bond return” correlation is reliably positive, indicating substantial persistence in the correlation.

Graph A of Figure 1 and the $\lambda_4$ estimates from Panel A of Table 6 indicate persistence in the market conditions associated with the time-varying stock-bond return correlations. Given this persistence, we also estimate an alternative model that investigates the intertemporal relation between $\text{Corr}^{ST,BD}$ and the lagged $\text{Corr}^{ST, \Delta VIX}$. We estimate three variations of the following model:

$$
\text{Corr}^{ST,BD}_{t,t+21} = \lambda_0 + \lambda_1 \text{Corr}^{ST, \Delta VIX}_{t-22,t-1} + \lambda_2 \text{Corr}^{BD, \Delta TIV}_{t-22,t-1} + \lambda_3 \ln(\text{VIX})_{t-1} + \epsilon_{t,t+21},
$$

where all the terms are as defined for equation (6). A reliable intertemporal relation between $\text{Corr}^{ST,BD}$ and the lagged $\text{Corr}^{ST, \Delta VIX}$ (i.e., if the estimated $\lambda_1$ is positive and significant) would provide further evidence linking the two correlations and would imply that our earlier findings are not an artifact of an omitted contemporaneous factor or market condition.14

Panel B of Table 6 reports the estimation results for equation (7). Model (a) shows that the simple intertemporal relation between $\text{Corr}^{ST,BD}$ and $\text{Corr}^{ST, \Delta VIX}$ is sizable and highly reliably positive for the 1997–2011 period and inclusive 1/2 subperiods. When adding the other two explanatory terms (models (b) and (c)),

---

14For this intertemporal model, we do not include the lagged dependent variable because it largely subsumes the information from the other explanatory terms. In our view, this seems intuitive; the lagged variable that best describes the market conditions associated with a particular stock-bond return correlation is probably the lagged stock-bond return correlation.
The partial relation (the estimated $\lambda_1$) remains positive for the 1997–2011 period and inclusive $\frac{1}{2}$ subperiods, though it loses statistical significance for the individual subperiods.

The positive intertemporal relation over 1997–2011 (Panel B of Table 6) reinforces our contemporaneous findings (Panel A). Collectively, these results suggest an economic tie between the $\text{Corr}_{ST,BD}$ and $\text{Corr}_{ST,\Delta VIX}$ over our sample period. This observation seems consistent with the implications from results in Tables 2–5; the stock-bond return relation seems substantially tied to the importance of time-varying equity risk on equity values.
The Term Structure’s Slope and Asset-Class Risk

If equity-risk influences long-term bond returns, it is natural to ask whether the term premia are also affected. In this section, we study the comovement between monthly changes in the term-slope and asset-class risk dynamics. As mentioned earlier, we regard changes in the term slope as a measure of changes in the Treasury term risk premia.

Given the practical importance of the term slope, we feel this investigation is interesting in its own right. However, we also believe this additional investigation naturally follows from our earlier empirical findings. Over 1997–2011, the results reported in Section IV indicate that, ceteris paribus, the own-asset risk changes are negatively related to the own-asset realized excess returns and the equity-risk changes are positively related to the T-bond realized excess returns. These findings indicate a reliable comovement between longer-term bond yields and the risk changes, while not checking for comparable movements in short-term yields. Additionally, T-bill yields are generally regarded as being relatively more tied to Federal Reserve actions (see Piazzesi (2005)), as compared to long-term Treasury yields that are more tied to other market forces. Thus, it is a natural and interesting empirical question as to whether the term slope also comoves with risk changes over this period. In other words, do short-horizon yields move similarly, more, or less with equity-risk movements, as compared to long-horizon yields?15

How does our term-slope investigation fit with our earlier findings? One potential explanation for our Section IV findings is that, ceteris paribus, over our 1997–2011 period, i) increases in own-asset risk were associated with an increase in the own-asset risk premia and ii) equity-risk increases had a secondary cross-market negative influence on the Treasury term risk premia. If so, since changes in an asset’s risk premium should be negatively related to the concurrent asset return, the risk dynamics should have been tied to the returns in the manner that we found in Section IV.

Such risk-price dynamics also suggest that equity-risk movements might be tied to term-slope movements, with movement in the term slope interpreted as movements in the term risk premia (at least partially). Presumably, longer-term T-bond yields might have benefited more than T-bill yields from flight-to-quality influences over this recent low-inflation-risk environment since i) longer-term bonds were likely to provide greater diversification benefits in a stock-bond portfolio (because of the greater sensitivity of long-term bond prices to interest-rate changes) and ii) longer-term bonds tend to have a substantial yield premium over

15Our earlier findings do not necessarily indicate a similar comovement for the term slope. To quantify with a simple example, consider a 10-year zero-coupon bond and 3-month zero-coupon bond with initial yields of 5% and 3.5%, respectively. Next, assume that 1 month passes and the yield curve has experienced a parallel move downward, so the yield on these two bonds has shifted to 4.75% and 3.25%, respectively. Here, over the 1 month, the longer-term bond (now a 9-year, 11-month bond) would have appreciated with a positive holding-period return of 2.81% and the short-term bond (now a 2-month bond) would have appreciated with a positive holding-period return of 0.33%. Hence, the realized excess return for the long-term bond would have been substantially positive at about 2.48% while the term slope did not change at all over the month.
 Movements in the Term Structure’s Slope and Asset-Class Risk

Table 7 reports how monthly changes in the Treasury term structure’s slope are related to the monthly changes in implied volatility for both the equity-index (VIX) and T-note futures (TIV). Models (a)–(e) report on five variations of the following two-equation system:

\[
\begin{align*}
\Delta PC_{t-1,t+21} & = \gamma_0 + \gamma_1 \tilde{r}_{t+21}^S + \gamma_2 \Delta \ln(VIX_{t-1,t+21}) + \gamma_3 \Delta \ln(TIV_{t-1,t+21}) + \varepsilon_{t-1,t+21}, \\
\gamma & = \alpha_0 + \alpha_1 TIV_{t-1}^2,
\end{align*}
\]

where \(\Delta PC_{t-1,t+21}\) is the change in the value of the second principal component from the Treasury term structure over the close of trading days \(t - 1\) to \(t + 21\); \(\Delta \ln(VIX_{t-1,t+21})\) is the concurrent change in \(\ln(VIX)\); \(\Delta \ln(TIV_{t-1,t+21})\) is the concurrent change in \(\ln(TIV)\); \(\varepsilon_{t-1,t+21}\) is the squared implied volatility from the T-note futures options on day \(t - 1\), with units adjusted to the monthly horizon; and the \(\gamma\)'s and \(\alpha\)'s are coefficients to be estimated. Models (a)–(d) report on OLS estimations of equation (i) above. Model (e) reports on the two-equation system, given by equations (i) and (ii) above, that is estimated simultaneously in a maximum likelihood system that assumes conditional normality. For the coefficients, \(t\) statistics are in parentheses, calculated with heteroskedastic and autocorrelation consistent standard errors. * and ** indicate significance at the 5% and 1% levels, respectively.

<table>
<thead>
<tr>
<th>Period</th>
<th>Model</th>
<th>(\gamma_1 \times 10^3)</th>
<th>(\gamma_2 \times 10^{-3})</th>
<th>(\gamma_3 \times 10^{-3})</th>
<th>(\alpha_1 \times 10^3)</th>
<th>(R^2)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1997–2011</td>
<td>(a)</td>
<td>0.369 (1.10)</td>
<td>-2.29 (−2.77)**</td>
<td>2.82 (3.03)**</td>
<td>0.7%</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(b)</td>
<td></td>
<td>-4.18 (−4.99)**</td>
<td>4.19 (4.45)**</td>
<td>4.0%</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(c)</td>
<td>-0.466 (−1.38)</td>
<td>-3.60 (−4.24)**</td>
<td>3.30 (3.14)**</td>
<td>11.7%</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(d)</td>
<td>-0.242 (−0.72)</td>
<td>-3.60 (−4.24)**</td>
<td>3.30 (3.14)**</td>
<td>0.894 (3.28)**</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(e)</td>
<td>0.410 (1.22)</td>
<td>-2.42 (−2.87)**</td>
<td>2.77 (1.92)</td>
<td>n/a</td>
<td></td>
</tr>
<tr>
<td>1997–2004.06</td>
<td>(a)</td>
<td></td>
<td>-3.75 (−3.17)**</td>
<td>3.61 (2.59)**</td>
<td>0.9%</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(b)</td>
<td>-0.281 (−0.62)</td>
<td>-3.78 (−3.00)**</td>
<td>3.67 (2.26)*</td>
<td>−0.065 (−0.09)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(c)</td>
<td>0.047 (0.15)</td>
<td>-2.20 (−1.77)</td>
<td>2.80 (2.43)*</td>
<td>4.3%</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(d)</td>
<td>-0.649 (−1.23)</td>
<td>-4.62 (−4.23)**</td>
<td>4.87 (3.98)**</td>
<td>14.0%</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(e)</td>
<td>-0.103 (−0.19)</td>
<td>-3.65 (−3.56)**</td>
<td>4.02 (3.29)**</td>
<td>1.01 (3.50)**</td>
<td></td>
</tr>
</tbody>
</table>

16 Over 1997–2011, the 10-year TCM yield was greater than the 6-month TCM yield about 86% of the time.
where \( \Delta PC_{2-t-1,t+21} \) is the change in the term structure’s second principal component over trading days \( t - 1 \) to \( t + 21 \) and other terms and estimation details are as provided for equations (1) and (2). For the conditional variance equation, we note that TIV is not the implied volatility of the raw dependent variable, but rather is the implied volatility of the 10-year T-note futures return (or, roughly, the volatility of the 10-year yield). Since it seems plausible that the long-term yield volatility would be informative about the volatility of the term slope, we include TIV here to allow for time-varying volatility.

Estimates of the first three models in Table 7 show the simple relation of \( \Delta PC_2 \) with the stock-futures return, \( \Delta VIX \), and \( \Delta TIV \), respectively. The model (a) estimation indicates that the stock-futures return is not reliably related to the change in the term slope in a simple sense. The model (b) estimation indicates a reliable simple negative relation between \( \Delta VIX \) and \( \Delta PC_2 \). Finally, the model (c) estimation indicates that \( \Delta TIV \) is reliably positively related to \( \Delta PC_2 \), which suggests (quite plausibly) that the term slope increases with bond risk.

Focusing next on the partial relation between the risk changes and the term-slope changes, we find that both the magnitude and statistical reliability of the negative “\( \Delta VIX-\Delta PC_2 \)” relation are appreciably higher when controlling for \( \Delta TIV \). In all three sample periods, the estimated \( \gamma_2 \) in models (d) and (e) of Table 7 has a magnitude that is about 1.5 to 2 times that estimated in model (b). In regards to the “\( \Delta TIV-\Delta PC_2 \)” relation, here too, we see gains in the magnitude of the coefficient when we control also for the other asset-class risk. In other words, when controlling for both asset-class risk changes, the estimated coefficients on both \( \Delta VIX \) and \( \Delta TIV \) not only retain their respective signs but also increase in magnitude and statistical reliability. Finally, when allowing for time-varying volatility (model (e)), we find that the partial risk relations remain similar (the estimated \( \gamma_2 \) and \( \gamma_3 \)) and that the lagged TIV does contain reliable volatility information.

Similar to the extended analysis in Section IV.B for the futures returns, we also estimate an extended version of equation (8) that includes changes in the 6-month Treasury yield, changes in inflation expectations, and changes in the default yield spread as additional explanatory terms. Table 8 reports the results. The inclusion of these additional terms has almost no effect on our key partial risk relations of interest, the estimated \( \gamma_2 \) on the \( \Delta VIX \) term remains negative and highly statistically significant and the estimated \( \gamma_3 \) on the \( \Delta TIV \) term remains positive and highly statistically significant.17

To summarize, our results here indicate that equity-risk movements have a strong negative partial relation to movements in the term slope over 1997–2011. The partial relation for the equity-risk changes is appreciably stronger than the comparable simple relation. These findings suggest an apparent cross-market influence between equity-risk movements and changes in the term risk premia.

17Concerning robustness, we find qualitatively similar results when evaluating a term slope in equation (8) that is defined as the difference between the 10-year and 6-month TCM yields. Furthermore, the partial relation between \( \Delta VIX \) and the term-slope change remains reliably negative when using a comparable VAR approach to that explained in Section IV.C. Results are available from the authors.
TABLE 8  
Term Structure’s Slope and Asset-Class Risk: Extended Model

Table 8 reports on the partial relation between monthly risk changes and movements in the term slope while controlling for changes in inflation expectations, short-term interest rates, and the default yield spread. We estimate the following model:

\[
\Delta PC_{t-1,t+21} = \gamma_0 + \gamma_1 r_{S,t+21} + \gamma_2 \Delta \ln(VIX_{t-1,t+21}) + \gamma_3 \Delta \ln(TIV_{t-1,t+21}) + \gamma_4 \Delta YD6M_{t-1,t+21} + \gamma_5 \Delta DYSt_{t-1,t+21} + \epsilon_{t+21},
\]

where \(\Delta PC_{t-1,t+21}\) is the change in the value of the second principal component from the Treasury term structure over the close of trading days \(t-1\) to \(t+21\) and the other terms are as defined in Table 4. We report on two estimation periods. For the inflation shocks, we use the PPI and CPI news shocks for a 1997–2011 estimation (Panel A), and we use the change in implied inflation from 10-year TIPS yields for a 2004–2011 estimation (Panel B). For the estimated coefficients, \(t\)-statistics are in parentheses, calculated with heteroskedastic and autocorrelation consistent standard errors. * and ** indicate significance at the 5% and 1% levels, respectively.

### Panel A. 1997–2011 Period, with the Inflation Shock Term from CPI/PPI News Shocks

<table>
<thead>
<tr>
<th>(\gamma_1 \times 100)</th>
<th>(\gamma_2 \times 10)</th>
<th>(\gamma_3 \times 10)</th>
<th>(\gamma_4 \times 10)</th>
<th>(\gamma_5)</th>
<th>(\gamma_6)</th>
<th>(R^2)</th>
</tr>
</thead>
<tbody>
<tr>
<td>-0.613 (−1.72)</td>
<td>-4.14 (−4.96)**</td>
<td>4.33 (4.61)**</td>
<td>0.006 (0.01)</td>
<td>0.042 (1.48)</td>
<td>-0.324 (−1.79)</td>
<td>14.5</td>
</tr>
</tbody>
</table>

### Panel B. 2004–2011 Period, with the Inflation Term from TIPS Data

<table>
<thead>
<tr>
<th>(\gamma_1 \times 100)</th>
<th>(\gamma_2 \times 10)</th>
<th>(\gamma_3 \times 10)</th>
<th>(\gamma_4 \times 10)</th>
<th>(\gamma_5)</th>
<th>(\gamma_6)</th>
<th>(R^2)</th>
</tr>
</thead>
<tbody>
<tr>
<td>-1.61 (−2.77)**</td>
<td>-4.52 (−4.50)**</td>
<td>4.34 (4.52)**</td>
<td>-0.647 (−1.01)</td>
<td>0.640 (7.19)**</td>
<td>-0.125 (−0.84)</td>
<td>41.4</td>
</tr>
</tbody>
</table>

VI. Conclusions

We study how the stock-bond return relation and movements in the term slope are related to asset-class risk dynamics over the 1997–2011 period. At the center of our study is the predominantly negative stock-bond return correlation that prevails over this period; others in the literature have noted this negative correlation is puzzling from an economic fundamentals perspective, given the period’s low and stable inflation. We investigate equity risk and bond risk jointly, as measured by the implied volatility from equity-index options and 10-year T-note futures options, and we focus on the monthly horizon.

We have four key findings that relate asset-class risk dynamics to the stock-bond return correlation (and bond-market dynamics more broadly). First, the negative stock-bond return relation largely disappears when controlling for asset-class risk changes (in a partial sense), at both the monthly and weekly horizon. Put another way, at these horizons, the puzzle of the negative stock-bond return correlation appears to be largely about joint risk-return pricing dynamics.

Second, the relation between monthly equity-risk changes and 10-year T-bond excess returns (movements in the term slope) is reliably positive (reliably negative). These equity-risk relations strengthen when controlling for bond-risk changes. There is no comparable reliable partial relation between bond-risk changes and excess equity returns. The important volatility linkage is from equity volatility to bonds.

Third, in an extended model that includes other fundamental factors to help explain monthly asset returns, \(\Delta VIX\) is the only variable that is highly reliably related to both stock and bond returns, but with opposite signs. This finding reinforces the apparent importance of changing equity risk for understanding the negative stock-bond return correlation.

Finally, the connection between stock returns and changing equity-risk perceptions is important in understanding time variation in the stock-bond return...
correlation. We find that months with a more negative correlation between $\Delta VIX$ and stock returns are associated with a more negative stock-bond return correlation over both the same month and the subsequent month.

We believe that our findings show that equity-risk changes are central to an understanding of the stock-bond return correlation, even after controlling for fundamental factors suggested in Campbell and Ammer (1993). In this sense, our findings are consistent with the conclusions in BBI (2010), regarding the inability of fundamental models to subsume the tie between equity risk and the stock-bond return relation. For the 1997–2011 period, at least, we believe the evidence favors the view that the economic forces that drive equity-risk changes are largely the same forces that drive the negative stock-bond return correlation.

We have shown that equity-risk dynamics are linked both to movements in realized bond excess returns and in forward-looking term risk premia. The nature of these linkages is consistent with the intuitive notion of flight-to-quality pricing influences. Our evidence seems likely to bear on future research in areas such as term structure and portfolio management.

References


