Bond-Stock Comovements*

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Abstract

This paper documents that during the late 20th Century, nominal government bonds and stocks tended to comove positively, whereas during the first quarter of the 21st Century they have tended to comove negatively. A similar sign switch is observable for real government bonds and breakeven inflation rates. Recent macroeconomic events have caused short-lived changes in these comovements, and periods with high risk premia tend to be periods in which bond-stock comovements are large in absolute value. The paper surveys theoretical models of these phenomena.

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1 Introduction and Empirical Facts

Government bonds are one of the fundamental building blocks of the financial system, the financing of the public sector, and investors' portfolios. It is therefore important to understand whether they are risky—comoving positively with risky assets such as stocks—or safe—comoving negatively with stocks and hedging risks from the stock market. Since most government bonds are nominal, paying out in local currency units such as US dollars, British pounds, or Euros, the prices of these bonds are sensitive to inflation expectations. Government bond risks can therefore be attributed to inflation, real factors, or a combination. This paper documents the key patterns in advanced economy government bond risks, decomposed into their real and inflation components, and reviews the literature on the drivers of changing risks in government bonds.

1.1 The Sign Switch at the Millennium

A key fact about bond-stock comovement is that it changed sign from positive to negative around the turn of the millennium (Campbell et al., 2009; Baele et al., 2010; Viceira, 2012; Campbell et al., 2017; Song, 2017). Figure 1 illustrates this fact using data from the US, the UK, and Europe. We measure the comovement between government bond returns and local stock returns with the beta (regression coefficient) of daily nominal government bond returns on daily local stock returns over the past three years.[1] When the nominal bond-stock beta is positive, bonds and stocks tend to rise and fall together, and bonds are risky like stocks. Conversely, a negative bond-stock beta indicates that bonds tend to rise when the stock market falls, and bonds hence pay out in states of the world that investors value most.

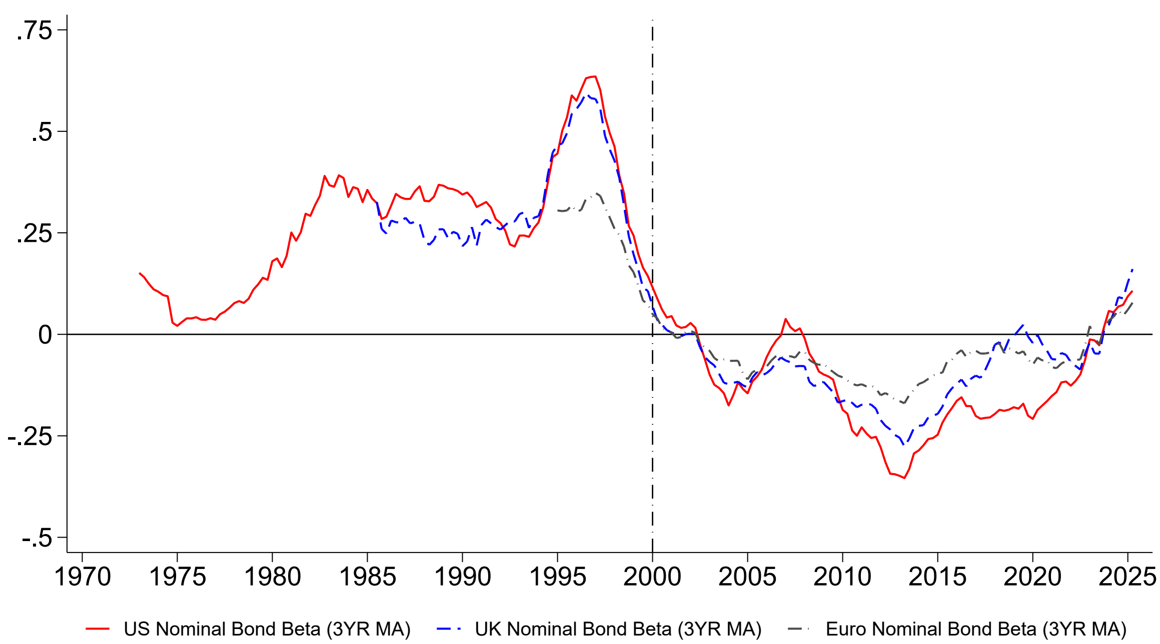
The bond-stock beta is not the only way to measure comovement. Alternatives include the covariance and the correlation between government bonds and stocks; but these alternatives always have the same sign as the beta since they can be written as the beta times a positive scale factor (the variance of stock returns for the covariance, and the ratio of the standard deviation of stock returns to the standard deviation of bond returns for the correlation). Thus, the evidence for a sign switch in the beta around the year 2000 is also evidence that the covariance and correlation changed signs at this time. In this paper, we use the bond-stock beta as a convenient summary statistic for comovement and mention the

[1] Denoting the daily log nominal government bond return in country c's local currency by $r_t^{c,nom}$ and the daily local-currency stock return in country c by $r_t^{c,stock}$, the nominal bond-stock beta is estimated as the regression coefficient β^{nom} from $r_t^{c,nom} = \alpha^{nom} + \beta^{nom} r_t^{c,stock} + \varepsilon_t$. We estimate (1) using a backward-looking rolling window of 90 days. For Figure 1 we keep the last observation of each quarter and report a moving average over the past twelve quarters. We do not adjust local-currency returns for the local-currency riskless interest rate because the adjustment is negligible at the daily frequency.

other measures only when they behave differently in the data or in theoretical models.

While Figure 1 shows that the bond-stock beta switched sign some years before the global financial crisis of 2008-2009, the crisis illustrates the hedging value of bonds in the 21st Century environment. The stock market fell in 2008, but at the same time government bonds rallied. The increase in the value of bonds cushioned a traditional 60-40 stock-bond portfolio from the dramatic stock market movements during the crisis. In this sense, government bonds were a "safe haven" for investors. However, Figure 1 makes clear that government bonds are not always a safe haven. In the late 20th Century, government bonds moved with, not against, the stock market.

Figure 1. Fifty Years of Bond-Stock Comovements This figure shows rolling regression coefficients of daily log 10-year nominal government bond returns onto daily stock returns for the US, the UK, and the Eurozone. Bond-stock betas are estimated using the past 90 days at each quarter-end. We then smooth these quarter-end bond-stock betas over a 12-quarter backward-looking window, requiring at least 6 quarters of observations. US stock returns correspond to the S&P 500, UK stock returns correspond to the FTSE 100, and European stock returns correspond to the STOXX Europe 600. Log bond returns are computed from changes in yields. Nominal 10-year zero-coupon yields from Gürkaynak et al. (2007) start in 1971.Q3, zero-coupon yields from the Bank of England start in 1984.Q1, and zero-coupon yields from the ECB start in 2004.Q3. European bond-stock betas are computed using daily 10-year German Treasury yields from Global Financial Data from 1993.Q3 through 2004.Q4. Because GFD yields are coupon bonds, we estimate the returns using the approximate duration for par bonds as in Campbell et al. (1997). The turn of the millennium is indicated with a vertical dashed line. The last quarter of observations is 2025.Q2.



In the most recent period 2023-2025, Figure 1 shows an increase in global bond-stock betas to positive levels, although it is too early to say whether this presages a return to the persistently positive bond-stock betas seen in the last century.[2] After the pandemic of 2020, many developed countries experienced high inflation in 2021 at levels not seen for four decades. While this recent inflationary experience bears some resemblance to the macroeconomic environment of the inflationary 1970s and 1980s, there are also notable differences. These differences are visible in the decomposition of bond-stock betas into real and inflation components, to which we turn next.

1.1.1 Real and Inflation Components

A simple way to better understand the economic drivers of bond-stock comovements is to decompose them into real and inflation components. Figure 2 shows separate betas for the real and inflation components of nominal bond returns, using inflation swap data when available, and breakeven inflation rates otherwise. The real bond-stock betas shown in Panel A and the inflation-driven bond-stock betas shown in Panel B of Figure 2 add up to the nominal bond-stock betas already shown in Figure 1.

The blue dashed line in Figure 2, Panel A, shows that UK real bond-stock betas were positive before 2000. In addition, Panel B shows that the inflation component of UK bond-stock betas (i.e., the difference between nominal and real bond-stock betas) was also strongly positive during this period, contributing to the overall high nominal bond risks visible in Figure 1 before 2000.[3] Unfortunately, the US did not have inflation-indexed bonds or inflation swaps, which are needed for this decomposition, until much more recently. However, given the similarities between the US, the UK, and the Eurozone in Figure 1, we view data from UK inflation-indexed bonds during the 1980s as informative more broadly.

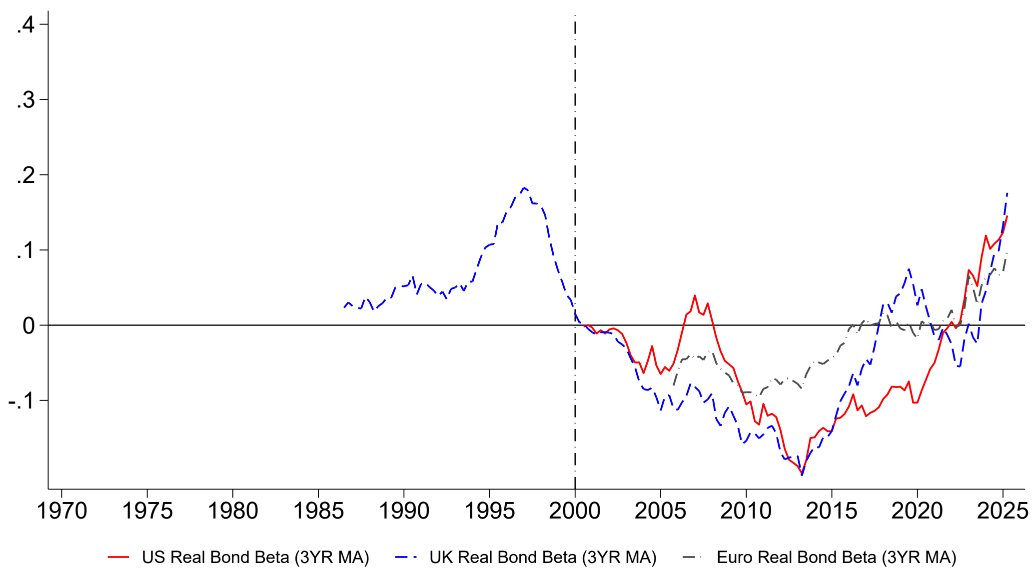
After 2000, Figure 2, Panel A shows that real bond-stock betas are negative in all three regions. Panel B shows that the inflation component of bond-stock betas was also negative, so both components contributed to the safety of nominal bonds after 2000. Naturally, correlations and covariances also have the same signs, given the positive scaling relationships between these measures of comovement.

[2] Gomez-Cram et al. (2024) documents the recent rise in government bond-stock correlations, while Pflueger (2025) points out that this rise occurred relatively late compared to the rise of inflation in 2021 and models the monetary policy drivers.

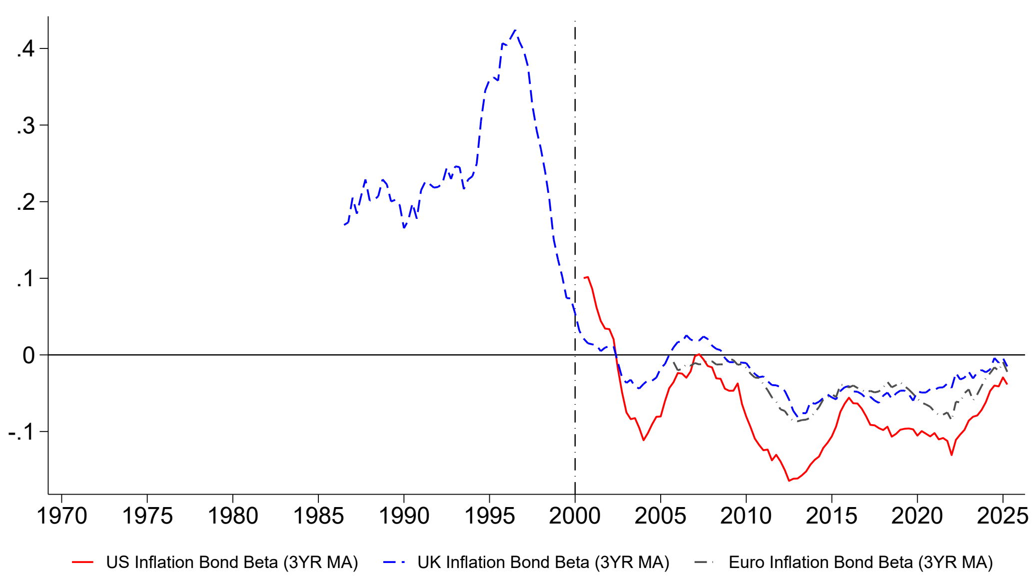
[3] An advantage of our focus on betas, rather than correlations, is that betas satisfy an adding up constraint, so the betas in Panels A and B of Figure 2 add up to the nominal beta in Figure 1. In recent years, where inflation swap data are available, we use inflation swap rates rather than breakeven inflation rates imputed from inflation-indexed government bond yields. Full details are given in the note to Figure 2. For simplicity, we refer to the "inflation component of bond-stock betas" whether we are using breakeven rates or inflation swap rates to measure them.

Figure 2. Real and Inflation Components of Bond-Stock Comovements. This figure shows rolling regression coefficients of the real and inflation components of daily government bond returns onto daily stock returns. The estimation window and stock return data are described in Figure 1. Zero-coupon 10-year government bond yields are decomposed into $y_t^{real,10} = y_t^{nom,10} - inflswap_t^{10}$, where $inflswap_t^{10}$ is the daily inflation swap rate from Bloomberg, whenever available. When inflation swap data is not available, we use 10-year zero-coupon breakeven inflation from Gürkaynak et al. (2010) (US) and from the Bank of England. Daily log real bond returns are then computed as $-10 \times \Delta y_t^{real,10}$ and daily log inflation bond returns are computed as $-10 \times \Delta inflswap_t^{10}$. Inflation swap data starts in 2005.Q1 for the US, 2004.Q4 for the UK, and 2004.Q4 for Europe. Breakeven inflation data starts in 1999.Q3 for the US, and 1985.Q3 for the UK The change of the millennium is indicated with a vertical dashed line. The last quarter of observations is 2025.Q2.

Panel A: Real Bond-Stock Betas



Panel B: Inflation Component of Bond-Stock Betas



Comparing the magnitudes of the betas shows that real bonds moved much less with stocks than nominal bonds did before 2000: the inflation component was the main driver of positive bond-stock covariance at this time. On the other hand, real bond-stock betas have contributed substantially to the increase in nominal bond-stock betas during the most recent period since 2023, whereas the inflation components of bond-stock betas show only small increases in this period.[4]

1.1.2 Evidence from Higher Frequency Variation

The smoothing of betas over 12 quarters in Figures 1 and 2 can obscure higher-frequency variation in bond-stock comovements that may be relevant for the interpretation of recent developments and that provides suggestive evidence for the fundamental drivers of bond-stock comovements. We illustrate this point in Figure 3 by plotting the inflation component of bond-stock bond betas over rolling 90-day windows, without smoothing, for a shorter sample period from January 1, 2021 through May 30, 2025.

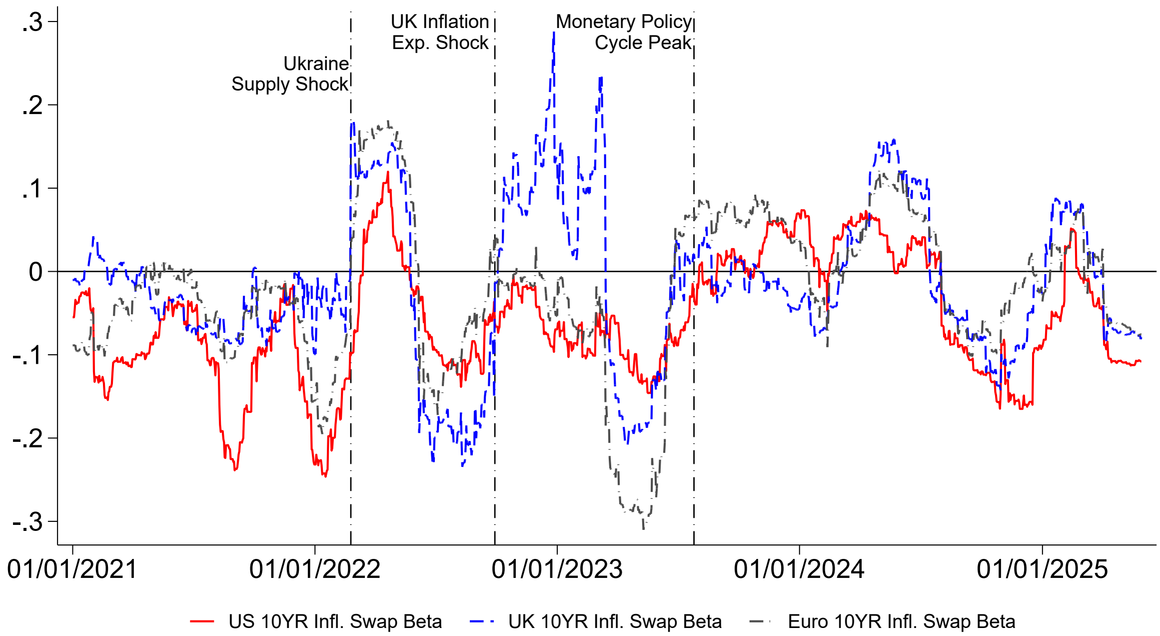
While Figure 3 is consistent with the overall post-pandemic negative inflation component in bond-stock betas in smoothed data, it shows more nuanced variation. By not smoothing, a turn towards a positive inflation component in bond-stock betas emerges in Figure 3 during the last quarter of 2023, coinciding with the peak of the most recent monetary policy hiking cycle.[5] Late 2023 was a period when the public was rapidly reassessing the Federal Reserve's response to inflation, following repeated 75-basis-point policy rate hikes to combat inflation (Bauer et al. (2025)). The increase in the inflation component of bond-stock betas around this time hence suggests that public perception of a strongly anti-inflationary monetary policy rule is a relevant factor for positive bond-stock comovements.

The other marked dates in Figure 3 correspond to a classic supply shock (the invasion of Ukraine in February 2022) and an increase in inflation uncertainty around the UK mini-budget (September 2022). While the Ukraine shock arguably increased macroeconomic supply uncertainty and hence stagflation risks around the world, the UK mini-budget destabilized inflationary expectations primarily in the UK, making stagflation more likely there. Correspondingly, Figure 3 shows that the inflation component of bond-stock betas in all three regions rose around the Ukraine invasion, but only the UK inflation component rose around the UK shock.

[4] The real and inflation components of bond-stock betas are measured precisely, since betas are based on high-frequency data. The average standard errors for the moving averages of US nominal, real, and the inflation component of bond-stock betas are 0.06, 0.02, and 0.03. We compute Huber-White robust standard errors for the regression (1) for each 90-day window, and then take the 12-quarter moving average scaled by $\sqrt{12}$ to approximate the standard error of the moving average beta.

[5] The inflation component of US bond-stock betas briefly becomes statistically significantly positive at the 90% level during the last quarter of 2023.

Figure 3. Macroeconomic Events vs. Inflation Component of Bond-Stock Betas 2021-2025. This figure shows a daily series for the inflation return component of 10-year nominal bond-stock betas, estimated over a rolling backward-looking 90-day window as described in Figure 2. This figure shows the daily estimated beta without smoothing. The sample period is from January 1, 2021 through May 30, 2025.



These patterns around recent events suggest that two types of fundamentals matter for nominal bond-stock comovements: (a) uncertainty about supply-type shocks; and (b) a strongly anti-inflationary monetary policy rule. As we will see, economic models imply that these same factors combine to generate high-inflation recessions, thereby driving positive nominal bond-stock comovements through the inflation component of nominal bond returns.

1.2 Risk Premia and Bond-Stock Comovements

Risk premia are important drivers of bond and stock prices, and therefore they substantially influence bond-stock comovements. The influence of risk premia needs to be understood in conjunction with the macroeconomic environment. One other important pattern in the data is an interaction between high-frequency variation in bond risks and the lower-frequency sign change in bond risks. Relying primarily on the post-2000 period, Laarits (2020) among others has documented that when risk premia, as captured by various macroeconomic and financial indicators, are low, this increases the bond-stock beta. To the best of our knowledge, we newly document that the relationship between risk premia and bond-stock betas changed around 2000, just as the lower-frequency level of bond-stock comovements switched from positive to negative.

We use two empirical proxies for low risk premia. The macroeconomic indicator, US surplus consumption, is motivated by the model of Campbell and Cochrane (1999), while the financial indicator, the US price-dividend ratio, reflects the present value logic of Campbell and Shiller (1988) that stock prices should be high when risk premia, for whatever reason, are low.[6]

Table 1 shows that before 2000, when average bond-stock betas were positive, they tended to decrease when risk premia were low, as captured by high US surplus consumption or a high US price-dividend ratio, and increase when risk premia were high; after 2000, when average bond-stock betas were negative, they tended to increase when risk premia were low and decrease, becoming even more negative, when risk premia were high. In both cases, periods with high risk premia amplified the absolute value of bond-stock betas. The results are remarkably consistent across the real and inflation components of bond-stock betas, across the two proxies for risk premia, and for the US (Panel A) and the UK (Panel B).

It is clear from Table 1 that changes in risk aversion or background risk do not always have the same effect on bond and stock returns. They sometimes move bonds and stocks in the same direction (what Cieślak and Pang (2021) call a "common risk premium" shock) and sometimes move them in opposite directions (a "hedging premium" shock). Common risk premium shocks are typical of the pre-2000 period, when average bond-stock betas were positive, and hedging premium shocks are typical of the post-2000 period, when average bond-stock betas are negative. It is therefore important to understand how "flight to safety" affects bond markets in different environments, where we define flight to safety as a decline in stock prices due to an increase in investor risk aversion or investors' expectations of risk. A safe asset is one whose price increases—or at least does not decline—as a result of flight to safety. Even though we only consider bonds that are free of credit risk, we find that government bonds are not always safe in this sense, and that the safety of bonds depends on the sign of the bond-stock beta.

[6]The intuition of surplus consumption is that when investors evaluate consumption relative to a slowly-moving habit that depends on past consumption, a low level of consumption relative to habit raises the level and volatility of investor risk aversion. We follow the simplified empirical implementation described in Cochrane (2017).

Table 1. Bond-Stock Betas onto Measures of Risk Aversion by Subperiod. This table reports univariate predictive regressions of 12-quarter moving average bond-stock betas (real, nominal, and inflation components) onto lagged US real log surplus consumption and the US log price-dividend ratio. Panel A reports US bond-stock betas onto US measures of risk premia. Panel B reports UK bond-stock betas onto US measures of risk premia. Constants are suppressed. Newey-West t-statistics with bandwidth 13 in parentheses.

Panel A: US

	1969.Q4-1999.Q4			2000.Q1-2022.Q1		
	Nominal	Real	Inflation	Nominal	Real	Inflation
Surplus consumption	-3.96**			2.08*	1.29	0.79*
	(-2.15)			(1.67)	(1.48)	(1.79)
R^2	0.15			0.18	0.13	0.19
Price-dividend ratio	-0.36***			0.70***	0.48***	0.22**
	(-2.06)			(2.66)	(2.65)	(2.29)
R^2	0.12			0.30	0.27	0.22
Obs.	121			89	89	89

Panel B: UK

	1983.Q2-1999.Q4			2000.Q1-2022.Q1		
	Nominal	Real	Inflation	Nominal	Real	Inflation
Surplus consumption	-6.38**	-2.49***	-3.93*	1.16	0.53	0.62**
	(-2.36)	(-3.18)	(-1.86)	(1.32)	(0.72)	(2.03)
R^2	0.26	0.36	0.20	0.09	0.02	0.28
Price-dividend ratio	-0.65***	-0.11	-0.50***	0.37	0.24	0.13**
	(-2.93)	(-1.17)	(-3.36)	(1.50)	(1.07)	(2.30)
R^2	0.35	0.09	0.41	0.13	0.06	0.17
Obs.	67	67	67	89	89	89

2 Models of Bond-Stock Betas

We now survey the models that have been used to understand changing bond-stock comovements. We start as generally as possible by linking real bond risks to the dynamics of the real stochastic discount factor (SDF) and nominal bond risks to the dynamics of the real SDF and inflation. We then link these dynamics to the macroeconomy via consumption-based preferences. A central insight is that the covariance between consumption growth and inflation should be inversely related to the nominal bond-stock covariance and nominal bond risk premia. We show how time-varying risk aversion can amplify the comovement of bonds and stocks dictated by the comovement of their risk-neutral returns. Finally, we discuss how real and nominal bond-stock betas can be linked to fundamental driving forces of the economy, including monetary policy, supply shocks, and frictions that create spreads between the interest rates faced by households and the rates set in financial markets.

In section 2.1 we consider models of the SDF, deriving implications for real bonds in section 2.1.1 and nominal bonds in section 2.1.2. In section 2.2, we discuss consumption-based models, starting with a homoskedastic model with Epstein-Zin preferences in section 2.2.1 and then allowing additional shocks resulting from financial frictions to enter the Euler equation in section 2.2.2. We focus on factors that may alter risk premia in section 2.2.3.

While some useful insights can be gained by treating the inflation process in reduced-form, New Keynesian models with production and monetary policy allow us to examine the fundamental macroeconomic drivers of bond risks. We discuss these models in section 2.3, focusing first on the three equations that describe the dynamics of inflation, output, and the short-term nominal interest rate in section 2.3.1, then on implications for stock and bond prices in section 2.3.2, and finally asking what light these models can shed on recent bond-stock comovements in section 2.3.3.

2.1 Bonds and the SDF

We use upper-case letters to denote levels of variables, and lower-case letters for logs. A superscript \$ denotes a nominal bond, and a superscript P denotes a perpetuity that makes an equal payment in each period. We use a tilde to denote innovations, i.e., the difference between a $t+1$ realization and the conditional expectation at time t. We work with real returns throughout, even when we are considering nominal bonds.

2.1.1 Real Bonds and the SDF

The SDF framework is the most general approach to classical financial modeling. The existence of a positive SDF is guaranteed merely by the absence of arbitrage, without the need for more specific assumptions about market equilibrium. Risk premia on all assets are determined by their covariance with the SDF. Specifically, we have

$$\frac{\mathrm{E}_t\left[R_{i,t+1}-R_{f,t+1}\right]}{\sigma_t(R_{i,t+1}-R_{f,t+1})} = -\mathrm{Corr}_t(M_{t+1},R_{i,t+1}-R_{f,t+1})\frac{\sigma_t(M_{t+1})}{\mathrm{E}_t\left[M_{t+1}\right]}, \tag{1}$$

where $R_{i,t+1}$ is the real return on asset i from time t to time $t+1$ and M_{t+1} is the SDF at time $t+1$.

An asset with a high Sharpe ratio (the left-hand side of equation (1)) must have a large negative correlation with the SDF on the right-hand side of the equation. (The ratio of the volatility of the SDF to its mean also appears on the right-hand side, but is common to all assets.) Since stocks appear to have a high Sharpe ratio, they are likely to be highly negatively correlated with the SDF; indeed they are perfectly negatively correlated with it in the standard empirical implementation of the Sharpe-Lintner CAPM, which remains an important benchmark model in the asset pricing literature. Therefore the correlation of other asset returns with stocks is often treated (up to a sign change) as a proxy for the correlation of these assets with the SDF. We follow this approach in this section, although we acknowledge that it may fail if stock returns have an important unpriced component that is strongly correlated with the returns on other assets.

The SDF approach is particularly helpful for understanding real bonds, because the price at time t of a real bond of any maturity n just equals the conditional expectation of the cumulative SDF from time t to time $t+n$. Writing $P_{n,t+1}$ for the price of an n-period real bond at time $t+1$, we have

$$P_{n,t+1} = \mathrm{E}_{t+1}[M_{t+2}M_{t+3}...M_{t+n+1}] = \mathrm{E}_{t+1}[M_{t+1,t+n+1}]. \tag{2}$$

and

$$\widetilde{P}_{n,t+1} = P_{n,t+1} - \mathrm{E}_t P_{n,t+1} = (\mathrm{E}_{t+1}-\mathrm{E}_t)[M_{t+1,t+n+1}]. \tag{3}$$

Hence

$$\mathrm{Cov}_t(P_{n,t+1}, M_{t+1}) = \mathrm{Cov}_t((\mathrm{E}_{t+1}-\mathrm{E}_t)M_{t+1,t+n+1}, M_{t+1}). \tag{4}$$

The conditional covariance between the one-period-ahead price of an n-period bond and the SDF is the conditional covariance between the SDF and revisions of expectations of future values of the SDF. If the SDF is positively serially correlated, so that a positive innovation in the SDF today increases expectations of the SDF in the future, then real bonds are positively correlated with the SDF. This means that they are negatively correlated with stocks and are safe assets that hedge other risks; accordingly, they carry a negative risk premium. Conversely, if the SDF is negatively serially correlated, then real bonds are negatively correlated with the SDF and positively correlated with stocks: they are risky assets with a positive risk premium.[7]

2.1.2 Nominal Bonds, Inflation and the SDF

Nominal bonds further depend on inflation, and inflation dynamics hence affect their prices and risk premia. We consider a two-period nominal bond and for simplicity assume that the one-period log nominal bond yield equals the one-period log real yield plus the expected inflation rate.[8] Since the real payoff on a two-period nominal bond at time $t+1$ is the nominal price of a one-period nominal bond divided by inflation, the innovation in the real log return on a two-period nominal bond can be written as

$$\widetilde{r}^{\$}_{2,t+1} = -\left(\widetilde{r}_{1,t+2} + \widetilde{\pi}_{t+1} + (\mathrm{E}_{t+1} - \mathrm{E}_t)\pi_{t+2}\right). \tag{5}$$

Recall that $\widetilde{r}_{1,t+2}$ denotes the innovation to the log real risk-free rate that can be earned from time $t+1$ to $t+2$, i.e. the innovation from time t to $t+1$ in the real risk-free rate known at $t+1$, $\widetilde{\pi}_{t+1}$ is the innovation to log inflation from time t to $t+1$, and π_{t+2} is log inflation from time $t+1$ to $t+2$.

It follows that the covariance of the two-period nominal bond return with the log SDF is the sum of the covariances of these elements with the log SDF:

$$\mathrm{Cov}_t\left(m_{t+1}, r^{\$}_{2,t+1}\right) = -\mathrm{Cov}_t\left(m_{t+1}, r_{1,t+2} + \pi_{t+1} + E_{t+1}\pi_{t+2}\right). \tag{6}$$

In equation (6), the covariance between the log real SDF and the log real rate $r_{1,t+2}$ captures the real rate dynamics as in Section 2.1.1. But in addition to real rate dynamics, inflation dynamics also affect bond risks. If realized current or expected future inflation are posi-

[7] This logic is extended in the canonical work of Alvarez and Jermann (2005) to show that the expected return on a real bond with an arbitrarily long maturity is informative about the relative volatility (or more generally entropy) of the permanent and transitory components of the SDF.

[8] This simplification, sometimes known as the Fisher equation, amounts to abstracting away from the risk premium in the one-period nominal bond so as to simplify the analytical expression for the risk premium in long-term bonds.

tively correlated with the log real SDF, then nominal bond returns are negatively correlated with the SDF and—given the negative covariance between stock returns and the SDF—are positively correlated with stock returns.

The same logic describes the risk premium on a two-period nominal bond—or the expected return in excess of a one-period real bond adjusted for Jensen's inequality—since this equals the negative of the covariance of the two-period nominal bond return with the log SDF. We therefore have:

$$\mathrm{E}_t\left(r^{\$}_{2,t+1} - r_{1,t+1}\right) + \frac{1}{2}\mathrm{Var}_t r^{\$}_{2,t+1} = \mathrm{Cov}_t\left(m_{t+1}, r_{1,t+2} + \pi_{t+1} + E_{t+1}\pi_{t+2}\right). \tag{7}$$

Focusing on the inflation terms in equation (7), if realized current or expected future inflation are positively correlated with the log real SDF m_{t+1}, real payoffs on nominal bonds are low precisely when the SDF is high, leading investors to require a higher nominal bond risk premium. Conversely, when inflation and inflation expectations are negatively correlated with the log SDF, nominal bonds are hedges and investors are willing to hold them at a low or even negative risk premium.

Expression (7) shows that the sign of the bond risk premium is determined by the comovement of bond returns with the SDF. Due to their high Sharpe ratio stocks are plausibly highly negatively correlated with the SDF, and bond-stock comovements are a natural inverse proxy for the bond-SDF comovement that appears in (7). Using survey expectations to separate the expected risk premium component in bond excess returns from unexpected realizations in interest rates, Leombroni et al. (2026) show empirically that expected bond excess returns and bond-stock comovements are closely linked, both within the US across bond maturities, and across developed countries. Models of the term premium, through (7), hence have implications for bond-stock comovements and are informative for understanding the drivers of these comovements. For this reason, we include term premium models in our theoretical discussion, though always with a focus on their implications for comovements.

2.2 From the SDF to Consumption Growth

So far, we have considered a general SDF, for which it is sufficient to assume no arbitrage. In order to understand bond-stock comovements in relation to the macroeconomy, it is crucial to link the SDF to the Euler equation of a representative investor. Several approaches, including Epstein-Zin preferences, habits, and—as a special case—power utility, provide useful insights.

2.2.1 Epstein-Zin Preferences

Consumption-based asset pricing models derive both the SDF and stock returns from assumptions about the preferences of a representative investor and the dynamics of aggregate consumption. Consumption is treated as exogenous in these models, but the conclusions will be unchanged even if consumption is the endogenous result of production decisions, provided that the stochastic process for consumption is correctly modeled.

A leading paradigm in consumption-based asset pricing assumes that a representative investor has Epstein-Zin preferences, with a constant time discount factor δ, a constant coefficient of relative risk aversion γ, and a constant elasticity of intertemporal substitution ψ. The special case of power utility corresponds to the restriction that $\gamma = 1/\psi$.[9]

This model is particularly tractable if one makes the further assumptions that aggregate consumption is conditionally log-normally distributed and homoskedastic. In this case, a standard Campbell and Shiller (1988) approximation to Epstein-Zin marginal utility shows that the innovation in the log SDF, written $\widetilde{m}_{t+1}$ where the lower-case m denotes the log of the SDF and the tilde denotes the innovation, is given by

$$\widetilde{m}_{t+1} = -\gamma\, \widetilde{c}_{t+1} - \left(\gamma - \frac{1}{\psi}\right) \widetilde{g}_{t+1}. \tag{8}$$

Here $\widetilde{c}_{t+1}$ is the innovation in consumption at time $t+1$, and $\widetilde{g}_{t+1}$ is the revision in expectations of future consumption growth:

$$\widetilde{g}_{t+1} = (\mathrm{E}_{t+1} - \mathrm{E}_t) \sum_{j=1}^{\infty} \rho^j \Delta c_{t+1+j}, \tag{9}$$

where $\rho < 1$ is the Campbell and Shiller (1988) parameter of log-linearization. With Epstein-Zin utility, marginal utility moves not only with current consumption innovations but also with revisions in long-run expected future consumption growth. Whenever $\gamma > 1/\psi$, an increase in expected future consumption growth lowers marginal utility.[10]

The same loglinear approach shows that a levered claim to consumption that pays a log dividend $d_{t+1} = \lambda c_{t+1}$ has a return innovation

$$\widetilde{r}_{\lambda,t+1} = \lambda \widetilde{c}_{t+1} + \left(\lambda - \frac{1}{\psi}\right) \widetilde{g}_{t+1}. \tag{10}$$

---

[9] The long-run risk model of Bansal and Yaron (2004) assumes Epstein-Zin preferences with $\psi > 1$, persistent shocks to consumption growth, and persistent shocks to the volatility of consumption growth. We discuss the first two ingredients in this subsection and the third in the next subsection.

[10] For a textbook exposition, see Campbell (2018), pages 180-181. The Campbell and Shiller (1988) log-linearization is treated on p.134.

Shocks to current consumption and expected future consumption growth have a direct cash-flow effect proportional to λ, and shocks to expected future consumption growth have an indirect discount-rate effect proportional to $-1/\psi$. If we interpret stocks as a levered consumption claim, then equations (8) and (10) show that stocks will have a strong negative correlation with the SDF and a correspondingly high Sharpe ratio provided that $(\gamma - 1/\psi)$ and $(\lambda - 1/\psi)$ have the same sign. This is plausible when γ and λ are both well above one and ψ is close to one.

A real perpetuity, paying one unit of real consumption in each period, can be regarded as the limiting case of a levered consumption claim where leverage goes to zero. Writing the return innovation on a real perpetuity as $\widetilde{r}^P_{t+1}$ and setting $\lambda = 0$ in equation (10), we have

$$\widetilde{r}^P_{t+1} = -\left(\frac{1}{\psi}\right)\widetilde{g}_{t+1}. \tag{11}$$

When $\lambda - 1/\psi$ is positive, equations (10) and (11) imply that real bonds and stocks will be negatively correlated with one another unless current shocks to real consumption $\widetilde{c}_{t+1}$ are negatively correlated with revisions in expected future consumption growth $\widetilde{g}_{t+1}$, that is, unless consumption growth is mean-reverting. The intuition is that upward revisions in expected consumption growth are good for stocks (through the expected cash-flow channel) and bad for real bonds (through the interest-rate channel), and so stocks and real bonds can only move together if a consumption boom today (which is good for stocks through the current cash-flow channel) is expected to be followed by slow future consumption growth (which is good for bonds through the interest-rate channel).[11]

Consistent with this, Chernov et al. (2025) presents evidence that the persistence of aggregate US consumption growth increased around the time that the comovement between real bonds and stocks changed from positive to negative. Using a discrete-state Markov switching model with three regimes—one with persistent consumption growth, one with mean-reverting consumption growth, and one "rare disaster" regime with extreme mean-reversion—the paper finds that the US economy shifted from the second regime to the first in the late 1990s.

This analysis can be extended to consider nominal bonds (Piazzesi and Schneider, 2006; David and Veronesi, 2013).[12] Write $\widetilde{\pi}_{t+1}$ for the innovation in inflation at time $t+1$, and define

$$\widetilde{b}_{t+1} = (\mathrm{E}_{t+1} - \mathrm{E}_t)\sum_{j=1}^{\infty} \rho^j \pi_{t+1+j}. \tag{12}$$

[11] Campbell (1986) presented an early version of this analysis assuming power utility and a univariate stochastic process for consumption growth.

[12] For a textbook exposition, see Campbell (2018), pages 256–257.

The use of the letter b in this notation refers to breakeven inflation, since in a homoskedastic model with constant risk premia, innovations in expected future inflation are equivalent to innovations in breakeven inflation. The constant ρ is the same log-linearization parameter as in equation (9).

The real return on a nominal perpetuity, $\widetilde{r}^{\$P}_{t+1}$, is given by

$$\widetilde{r}^{\$P}_{t+1} = \widetilde{r}^{P}_{t+1} - \widetilde{\pi}_{t+1} - \widetilde{b}_{t+1}. \tag{13}$$

Equation (13) shows that nominal bonds can be positively correlated with stocks if real bonds are positively correlated with stocks, or if shocks to current and expected future inflation are negatively correlated with shocks to current and expected future consumption growth: that is, if current and breakeven inflation are countercyclical.

Some long-run theories of price determination do suggest countercyclical inflation. For example, the fiscal theory of the price level (Cochrane (2001, 2023)) draws attention to the identity that the market value of the government debt must equal the discounted present value of the primary surpluses that service it. If primary surpluses increase with output (because tax revenues increase with output more strongly than government spending does), and if consumption also increases with output, then the market value of the debt will be positively correlated with current and expected future consumption. Given predominantly nominal government debt, this is likely to imply that shocks that increase expected future consumption lower the price level, or equivalently that inflation is countercyclical (see also Jiang et al. (2024)).

From a shorter-term perspective, inflation may be countercyclical if the economy experiences supply shocks (such as the oil shocks of the 1970s and early 1980s) that lower output and raise prices—especially if strongly anti-inflationary monetary policy drives the economy into recession in response to these shocks. Conversely, inflation may be procyclical if it is demand-driven. We explore this mechanism in greater detail in the next section. Empirically, Campbell et al. (2020) document that realized inflation shifted from countercyclical to procyclical around the turn of the millennium, consistent with the importance of inflation dynamics for bond risks.

2.2.2 Shocks to the Consumption Euler Equation

The model in the previous subsection implies an Euler equation that tightly links current and expected future consumption, on the one hand, and bond and stock prices, on the other hand. However, many models imply additional shocks in the Euler equation. In the simple power utility case, for example, we may have

$$c_t = E_t c_{t+1} - \psi r_{1,t+1} + v_{x,t}. \tag{14}$$

Expression (14) ignores terms that are constant in a homoskedastic model. Here, $r_{1,t+1}$ is the real interest rate (the real risk-free return known at time t), and $v_{x,t}$ represents a shock to the relationship between the real interest rate and expected consumption growth.[13] A positive realization of $v_{x,t}$—sometimes called a demand shock in macroeconomics—tends to drive up consumption while also driving up the real risk-free rate.

Several types of structural demand shocks have been proposed in the literature. In international economics, the US dollar is often assumed to have a special convenience yield, defined as any component of the Treasury bill yield that is not consistent with the risk of Treasury bills and the cross-sectional pricing of risk (Kekre and Lenel (2024); Jiang et al. (2024); Hébert et al. (2023)).[14] Movements in the convenience yield show up as variation in $v_{x,t}$ in equation (14). Alternatively, a demand shock can be microfounded as a shock to optimism or growth expectations, similar to expectations-based demand shocks in Beaudry and Portier (2006), Bordalo et al. (2024) and the "traditional financial forces" shock in Caballero and Simsek (2022a). Pflueger et al. (2020) use the cross-section of stocks to measure investors' tolerance for macroeconomic risk, and show that this measure moves with bond prices and the macroeconomy just like a shock in the Euler equation. An increased desire for safety acts like a negative realization of $v_{x,t}$; it is associated with a lower real risk-free rate, higher real bond prices, and declines in real economic activity.

Shocks to convenience yields, growth expectations, or risk tolerance on the right-hand side of (14) can act like a positive demand shock $v_{x,t}$ and tend to drive bond and stock prices in opposite directions, providing a potential explanation for the negative bond-stock comovement post-2000. The intuition is that a positive shock $v_{x,t}$ drives up consumption and hence the dividends on stocks. If the stock discount rate moves relatively less, or even declines due to a fall in the equity risk premium, stock valuations rise. At the same time, a positive $v_{x,t}$ raises the real interest rate and, through higher macroeconomic demand, inflation, generating negative real and nominal bond-stock comovements.[15]

Other types of structural demand shocks create a positive bond-stock correlation, and

[13] Duffee (2023) documents volatility in the relationship between macroeconomic forecasts and real interest rates, supporting the idea that a volatile wedge exists in equation (14).

[14] A growing literature has analyzed the drivers of convenience yields, including liquidity, financial regulation of intermediaries, and the demand for Treasury bills by foreign central banks (Krishnamurthy and Vissing-Jorgensen (2012); Du et al. (2018); He et al. (2022); Du et al. (2023)).

[15] An interesting avenue for future research is to understand to what extent demand shocks to the Euler equation can serve as the fundamental for the changes in consumption dynamics documented by Chernov et al. (2025).

are therefore unable to explain the post-2000 evidence of negative bond-stock comovements. One example is a "patience shock" or a decline in the rate of time preference. A pure discounting shock affects the discount rates applied to equity dividends as well as the levels of those dividends. Stocks and long-term real bonds are both long-term claims whose values tend to increase when the rate of time preference declines. Gormsen and Lazarus (2025) argue that these channels are relevant to explain longer-term upward drifts in stock and bond prices. Volatile pure discounting shocks tend to imply positive comovement between real long-term bonds and stocks, consistent with late 20th Century but inconsistent with early 21st Century data.[16] Cieślak et al. (2024) estimate a New Keynesian asset pricing model with two different types of demand shocks and show that convenience yield shocks can jointly explain inflation comovements and negative bond-stock betas during the 2000s, while pure discount rate shocks at least on their own cannot.

A behavioral model that has a similar effect to a pure discount rate shock is the model of inflation illusion proposed by Modigliani and Cohn (1979) and further explored by Campbell and Vuolteenaho (2004). In that model, equity investors discount real equity dividends at nominal interest rates. This implies that a rise in inflation, which drives up nominal bond yields, also increases equity discount rates and leads to positive comovement between stocks and nominal bonds. Inflation illusion is a rare example of a behavioral mechanism potentially affecting bond-stock comovements; in general, this topic has been little studied in the behavioral finance literature.

2.2.3 Amplification Through Changing Risk Premia

So far, we have seen that consumption dynamics and Euler equation shocks matter for real bond-stock comovements, while inflation dynamics matter for nominal bond-stock comovements. However, bond and stock prices vary not only due to expectations about their real cash flows and about real interest rates, but also due to time-varying risk premia. We now show that this seemingly separate source of bond-stock comovements is closely linked to the real cash flow and real interest rate risks of bonds through an endogenous flight to safety mechanism, explaining the empirical evidence in Table 1.

The effect of flight to safety can be understood most simply by considering comparative statics with respect to investor risk aversion, γ, in the special case with power utility. The

[16] Albuquerque et al. (2016) show with Epstein-Zin preferences, discount rate shocks imply positive comovements between real bond returns and stock returns and generate an upward-sloping term structure, different from growth shocks in a typical long-run risk model.

expression for the two-period nominal bond risk premium (7) simplifies in this case to:

$$\mathrm{E}_t\left(r^{\$}_{2,t+1} - r_{1,t+1}\right) + \frac{1}{2}\mathrm{Var}_t r^{\$}_{2,t+1} \;\; = \;\; -\gamma \times \mathrm{Cov}_t\left(c_{t+1}, r_{1,t+2} + \pi_{t+1} + E_{t+1}\pi_{t+2}\right). \quad (15)$$

The risk premium formula (15) is instructive, because it implies that the effect of risk aversion on the bond risk premium is fundamentally determined by how interest rates and inflation comove with the business cycle. The three terms on the right-hand side of (15) can be mapped into the decomposition of the bond-stock covariance into real and inflation components. The real rate $r_{1,t+2}$ on the right-hand side enters through the real rate-consumption covariance, while π_{t+1} and $E_{t+1}\pi_{t+2}$ enter through the covariances of realized and expected inflation with consumption. More sophisticated models model risk aversion or the volatilities of shocks as stochastic processes, but the basic insights can be gained by considering permanent changes in these parameters.

To understand how time-varying risk aversion amplifies bond-stock comovements, consider first the case where the right-hand side of (15) is negative. This could be due to inflation or real rates falling when consumption is low, or both. In this case, investors are willing to hold bonds at a negative risk premium, which becomes more negative as risk aversion γ increases. At the same time, an increase in risk aversion raises the stock risk premium, which is characterized by an expression similar to (15) with a positive consumption covariance on the right-hand side.[17] As risk aversion increases, bond risk premia decline further while stock risk premia increase, resembling a flight to safety that benefits the prices of safe bonds but lowers the value of the stock market.

By contrast, when the right-hand side of (15) is positive, nominal bonds' real cash flows are risky, nominal bond risk premia are positive, and risk premia of nominal bonds and stocks comove positively. In that case, an increase in risk aversion raises risk premia on both bonds and stocks simultaneously, driving down their prices together. Flight to safety no longer benefits bonds; instead, investors flee from both stocks and bonds towards short-term safe assets. Overall, bonds may either benefit or suffer from flight to safety, depending on whether the underlying real cash flows and real interest rate dynamics make bonds safe (as in the early 21st century) or risky (as in the late 20th century).

Volatile risk aversion unambiguously amplifies the covariance between bonds and stocks—increasing its absolute value by moving it away from zero—as shown by Campbell et al. (2020). The implications for the bond-stock beta are not as clear-cut as for the covariance, since the variance of stock returns—which divides the covariance in the formula for beta—

[17] As we do elsewhere in this article, we treat stocks as an asset highly correlated with consumption. Empirically, this correlation has been found to be lower than predicted by theory at a quarterly horizon (Campbell (2000)), though it is higher at longer horizons (Parker (2003), Parker and Julliard (2005)).

also increases. In the quantification of Campbell et al. (2020), these opposing effects roughly cancel each other. However, one could imagine alternative specifications where volatile risk aversion amplifies the covariance between bonds and stocks more than the variance of stock returns—perhaps because other factors unrelated to risk aversion elevate the variance of stock returns in a persistent fashion—and hence increases the absolute value of the bond-stock beta as well as the bond-stock covariance. The endogenous effects of flight to safety hence provide a natural lens through which to view the empirical evidence in Table 1.

So far, we have not taken a stance on the drivers of investor risk aversion, γ. Time-varying risk aversion can be microfounded in several different ways. It might be a property of investor preferences, as in the habit formation models of Campbell and Cochrane (1999) and Campbell et al. (2020), but it could also arise from changes in intermediaries' risk-bearing capacity as in models where the demands of end investors are accommodated by leveraged intermediaries (e.g. He and Krishnamurthy (2013), Vayanos and Vila (2021)). With a few exceptions, such as He et al. (2022), there is relatively little research linking bond-stock comovements to intermediaries, perhaps because government bonds and stocks are often held directly by households (Haddad and Muir (2021)). However, Parker et al. (2023) and Fang and Goldstein (2025) point out that the growth of automatically rebalancing target date funds, increasingly used by households as vehicles for their bond and stock holdings, may alter the dynamics of stock and bond prices. This is a topic that deserves further research.

While the discussion above refers to time-varying risk aversion, a similar mechanism operates if risk aversion is constant but volatilities are time-varying (e.g. Bekaert et al. (2009), Bansal and Shaliastovich (2013), Jurado et al. (2015)). Quantifying the relative contributions of time-variation in risk aversion and in volatilities is another fruitful research topic.

The lesson of this analysis is that whether bonds benefit from flight to safety depends on the fundamental macroeconomic environment, with implications for the comovement between bond and stock risk premia. Baele et al. (2010), Kozak (2022), and Laarits (2020) emphasize flight to safety as a driver of negative bond-stock comovements, and Cieślak and Pang (2021) and Antolín-Díaz (2024) provide evidence that bond-benefiting flight to safety has become more important since the turn of the millennium. Overall, the empirical finding that bonds have tended to benefit more from flight to safety after the millennium is endogenous to the sign of bond-stock betas and hence to the macroeconomic environment.

2.3 Models with Production and Monetary Policy

While a consumption-based model can explain bond-stock comovements from consumption and inflation dynamics, a deeper question concerns the drivers of these dynamics. New Keynesian models with monetary policy, price- or wage-setting frictions, and endogenous production can help answer questions such as: How do supply and demand shocks affect bond-stock comovements? How do changes in the perceived monetary policy rule affect bond-stock comovements? Were the negative bond-stock comovements after the millennium the result of "good luck", "good policy", or a combination?

2.3.1 The Basic New Keynesian Model

The basic New Keynesian model provides a simple way to understand the fundamental drivers of consumption and inflation comovements, and hence bond-stock comovements. To keep things simple, we go straight to the three log-linearized equations describing output, inflation, and interest rate dynamics in a small-scale New Keynesian model (presented up to constants):[18]

$$\textbf{Euler Equation:} \quad x_t = (1-\rho^x)E_t x_{t+1} + \rho^x x_{t-1} - \psi r_{1,t+1} + v_{x,t}, \tag{16}$$

$$\textbf{Phillips Curve:} \quad \pi_t = \kappa x_t + (1-\rho^\pi)\, E_t\pi_{t+1} + \rho^\pi \pi_{t-1} + v_{\pi,t}, \tag{17}$$

$$\textbf{Monetary Policy Rule:} \quad i_t = \rho^i i_{t-1} + (1-\rho^i)\,(\gamma^x x_t + \gamma^\pi \pi_t) + v_{i,t}, \tag{18}$$

The real risk-free rate, $r_{1,t+1}$, and the nominal policy rate, i_t, are linked via the Fisher equation

$$i_t = r_{1,t+1} + E_t\pi_{t+1}, \tag{19}$$

which is the Euler equation for the nominal one-period bond, abstracting away from the risk premium on the short-term nominal bond.

Here, x_t denotes the output gap, or log real output relative to a flexible price benchmark. It is the main indicator of whether the economy is in an expansion or a recession. Since consumption and output tend to move together over the business cycle, we assume for simplicity that innovations to x_t are perfectly correlated with real consumption innovations.

The Euler equation (16) is a generalized version of the first-order condition for the one-period real risk-free bond (14). However, consumption and output in this broader model are endogenous rather than exogenous. The endogenous output response to the interest rate

[18] Full microfoundations can be found in textbooks such as Galí (2015) and Woodford (2003a), and the review article Clarida et al. (1999).

captures the power of monetary policy, whereby higher interest rates increase the incentive to save and reduce macroeconomic demand, thereby driving down output and consumption. The backward-looking term on the right-hand side of (16) can generate an empirically plausible delay in the output response to a monetary policy shock (Fuhrer, 1997). This term can arise from external consumption habits (Fuhrer, 2000) or sticky information (Mankiw and Reis, 2002; Auclert et al., 2020). As in section 2.2.2, the demand shock $v_{x,t}$ increases consumption and output at a given risk-free rate, such as a shock to the demand for safe assets or a change in credit market frictions.

The Phillips curve (17) follows from firms' optimal price-setting and production decisions when opportunities to revise prices are infrequent (Calvo (1983)). The backward-looking term may represent dependence of inflation expectations on past realized inflation, or price indexation to past inflation. The supply (or so-called cost-push) shock $v_{\pi,t}$ captures any disturbance to the relationship between the output gap and marginal costs of production. It is often viewed as an oil-price shock, though increases in wage bargaining power, changing price markups charged by firms, or shocks to long-term inflation expectations driven by fiscal considerations may act similarly.

In most small-scale New Keynesian models, monetary policy is described as an interest rate rule in the tradition of Taylor (1993), whereby the nominal policy rate increases in the output gap x_t and inflation π_t, with coefficients γ^x and γ^π. Much theoretical and empirical research has documented the relevance of interest-rate smoothing and policy gradualism that generate inertia captured by the coefficient ρ^i (e.g. Woodford (2003b), Bernanke (2004), Taylor and Williams (2010), Stein and Sunderam (2018)). Together, the output weight γ^x, inflation weight γ^π, and policy inertia ρ^i describe the systematic component of monetary policy. The monetary policy shock $v_{i,t}$ represents unexpected transitory deviations from this systematic monetary policy.[19]

Demand, supply, and monetary policy shocks differ sharply in their implications for the inflation-output gap comovement, which we have already seen is an important determinant of nominal bond-stock comovements. For simplicity we describe the effects of positive shocks, but negative shocks have opposite effects and comovements result from the volatilities of shocks rather than realizations in one direction or another.

A positive demand shock $v_{x,t}$ drives up the output gap and the real interest rate through the Euler equation and is therefore expansionary. It also drives up inflation through the Phillips Curve (since the output gap appears on the right hand side of this equation), and

[19] Potential microfoundations for such shocks can be disagreements about underlying demand conditions (Caballero and Simsek (2022b); Nakamura and Steinsson (2018)) or gaps between the actual and perceived monetary policy reaction function (Bauer and Swanson (2023); Bauer et al. (2024)).

the nominal interest rate through the monetary policy rule (since both the output gap and inflation appear on the right hand side of this equation). This lowers real and nominal bond prices at the same time that high output increases stock prices, pushing towards a negative bond-stock comovement.

By contrast, a positive supply shock $v_{\pi,t}$ can move inflation and the output gap in opposite directions, especially if monetary policy raises interest rates strongly to counteract inflation. The intuition is that the output gap tends to fall more when monetary policy raises the policy rate strongly in response to an inflationary supply shock (Bernanke et al. (1997)). Supply shocks hence have the potential to generate a positive bond-stock comovement.

Finally, a positive monetary policy shock $v_{i,t}$, which raises the nominal interest rate, tends to lower both inflation and the output gap and is therefore contractionary. Like a demand shock, this tends to induce a positive inflation-output gap comovement. However, different from a contractionary demand shock in the Euler equation, a contractionary monetary policy shock raises the real short-term interest rate and drives down real bond prices, pushing towards a positive real bond-stock comovement while also pushing towards a negative nominal bond-stock comovement.

The simplicity of the basic New Keynesian framework means that it can be expanded to consider other potential drivers. Cochrane (2018) and Schmitt-Grohé and Uribe (2022) have shown that in the New Keynesian model, a permanent increase in the nominal interest rate tends to raise inflation while also inducing an economic expansion, i.e, a positive inflation-output gap comovement. This could be captured formally by including a random walk component in the intercept of the monetary policy rule, resembling permanent shifts to the central bank inflation target. Investigating the implications for stocks and bonds from these types of permanent shifts would be a useful extension of this research, since long-term bond yields are likely informative about the expected persistence of shifts to the monetary policy rule.

It is important to remember that the state variables on the left-hand side of the New Keynesian equations do not directly respond to the exogenous shocks, as state variables and expectations are jointly endogenously determined. The joint determination of all three variables can lead to multiple equilibria, potentially influenced by sunspots (Cochrane (2011)), particularly when the inflation coefficient γ^{π} is less than one and nominal rates rise less than one-for-one with inflation (Clarida et al. (2000)). These unresolved issues are broadly present for New Keynesian models and are not specific to models with asset prices. We therefore describe merely the properties of a minimum state variable solution when the monetary policy inflation coefficient is greater than one. Since asset prices are informative about expectations, one question for future research is whether bond-stock comovements can be informative for equilibrium selection.

In summary, the basic New Keynesian model provides insights about which economic shocks or policy expectations generate procyclical or countercyclical movements in inflation and real interest rates. These are key building blocks for bond-stock comovements.

2.3.2 Implications for Asset Prices

We can use the insights from the basic New Keynesian model to understand bond-stock comovements. The high level and volatility of risk premia in bonds and stocks in the data represent a particular challenge for macroeconomic models seeking to quantitatively explain bond-stock comovements. A first generation of papers linking general equilibrium macroeconomic models with asset prices noted several modeling challenges (Rudebusch and Swanson (2008); Uhlig (2007); Jermann (1998)). Reflecting these challenges, many traditional macroeconomic models, such as those used by central banks, bracket out asset prices altogether or treat them in a reduced-form fashion (e.g. Smets and Wouters (2007)).

Over time, several approaches integrating asset prices into New Keynesian models have yielded promising results. Recall that the average term premium in New Keynesian asset pricing models is linked to bond-stock comovements through (7) and a close link between stock prices and the SDF. We therefore start with structural models of bond term premia and their lessons for bond-stock comovements. Rudebusch and Swanson (2012) consider a long-run risks model with Epstein-Zin preferences and technology shocks that act similarly to inflationary supply shocks to the Phillips Curve (17). Since an adverse technology shock tends to raise inflation and lowers output, their model implies that nominal bonds are risky with positive average nominal term premia. A sharper monetary policy focus on stabilizing long-run inflation can compress these positive term premia. However, since it is unlikely that policy can reverse the signs of *long-run* inflation and output responses to a technology shock, the signs of term premia and presumably bond-stock comovements typically do not switch in this long-run risk model.[20]

A different approach has combined habit formation preferences with the New Keynesian model, implying risk premia that vary with business cycle variables. This provides a channel by which monetary policy can affect asset prices even if its macroeconomic effects occur in the short to medium run rather than the long run. Pflueger and Rinaldi (2022) provide a proof-of-concept model, embedding the highly non-linear external habit preferences of Campbell et al. (2020) into a three-equation New Keynesian model. They show that this can jointly explain the large empirical stock market response to monetary policy surprises with a

[20]See also Kung (2015) and Swanson (2021) for other models explaining the average nominal term premium and other unconditional asset pricing moments in long-run risk models.

moderate and delayed output response (Bernanke and Kuttner (2005), Nagel and Xu (2025)). The amplification of asset price variation through risk premia also allows habit formation models to match the empirical evidence by Duffee (2018) that inflation expectations are much less volatile than long-term nominal bond yields, which tends to be a challenge for other consumption-based asset pricing models.[21]

Structural models of bond-stock comovements also differ regarding the economic channels that are allowed to vary, paralleling the "good policy" vs. "good luck" debate during the Great Moderation. "Good luck", in the form of reduced incidence of and concerns about supply shocks, provides a potential driver of the switch in bond-stock betas around the millennium. Campbell et al. (2020), Song (2017) and Bekaert et al. (2021) appeal to the intuition that supply shocks during the 1980s generated high-inflation recessions, driving down nominal Treasury bond prices along with stocks, making nominal Treasury bonds risky. On the other hand, demand shocks in equation (14) tend to raise inflation along with output and consumption, driving down Treasury bond prices as stocks rise, and making Treasury bonds valuable hedges. A change from macroeconomic supply to demand shocks then provides a potential explanation for why Treasury bonds turned from risky to safe around the millennium. However, these models assume exogenous inflation dynamics, and hence cannot speak to the role of monetary policy.[22]

"Good policy", specifically monetary policy, may also have contributed to the change in bond-stock comovements around the millennium. As the Fed moved away from the immediate inflation-fighting stance of the Volcker Fed towards a more gradual and balanced approach during the 1990s and early 2000s, the change in monetary policy likely affected bond-stock comovements. Consistent with this, Bauer et al. (2024) provide direct empirical evidence of the changing perceived cyclicality of policy rates. Bianchi et al. (2022) show that a secular increase in the weight on output in the monetary policy rule implies a downward drift in bond risks, although they study term premia and not bond-stock betas directly.[23]

[21] Other papers that have embedded habit preferences into a standard New Keynesian model include Uhlig (2007), Dew-Becker (2014), Rudebusch and Swanson (2008), and Bretscher et al. (2023). An alternative approach used in some papers is to assume an exogenous link between risk, uncertainty, or ambiguity, and the state of the economy (e.g. Bianchi et al. (2018), Gourio (2012), Kilic and Wachter (2018), and Gourio and Ngo (2020)), which, however, might be sensitive to changes in the policy framework. Miller et al. (2025) model exogenous inflationary disasters with endogenous production to explain trends in growth, equity valuations, and interest rates.

[22] Fang et al. (2025) and Kozak (2022) model changes in the nature of shocks in general equilibrium, but also keep monetary policy invariant. While Fang et al. (2025) focuses on the inflation component and oil price shocks, Kozak (2022) focuses on real bond-stock comovements and models different types of productive technologies.

[23] Gourio and Ngo (2020) and Li et al. (2022) consider alternative versions of this "good policy" explanation, emphasizing changes in the Phillips curve and in fiscal vs. monetary dominance, respectively. Du et al. (2020) explain cross-country variation in bond-stock betas with differences in monetary policy credibility.

The zero lower bound (ZLB) provides a concrete example of a change in the monetary policy rule during our sample. Using a structural model with Epstein-Zin preferences, Gourio and Ngo (2020) argue that the ZLB, which constrained interest rates from below after 2008, contributed to more negative bond-stock betas. Bok et al. (2025) do not consider bond-stock betas directly, but instead show that a particular type of shock emanating from uncertainty affects inflation differently at the ZLB. They argue that this is consistent with a more negative empirical comovement between the VIX and inflation expectations during the ZLB period, with potential implications for bond-stock betas. It is, however, important to keep in mind that changes in the monetary policy rule or conduct of monetary policy go well beyond the ZLB (see e.g. Clarida et al. (2000)), and the ZLB alone likely cannot explain why bond-stock betas turned negative already at the turn of the millennium as seen in Figure 1. Broader changes in the conduct of monetary policy around the millennium, potentially linked to the Fed's enhanced credibility, therefore likely also played a role.

2.3.3 Lessons from Recent Developments

The recent inflationary spike, with its resemblance to 1980s-style concerns about supply shocks but distinctly different monetary policy, provides an instructive out-of-sample period to validate the "good luck" vs. "good policy" explanations. Figure 1 shows that, different from the positive nominal bond-stock betas during the 1980s, nominal bond-stock betas remained negative during 2021 and 2022, even as inflation reached levels not seen in forty years. Moreover, Figure 2 shows that the real bond return component started to comove positively with stocks during this time, even as the inflation component continued to comove negatively with stocks. Only in the second half of 2023, after aggressive rate hikes, did the inflation component of bond-stock betas show a persistent turn into positive territory, as visible from the higher-frequency data in Figure 3.

Which structural interpretation explains recent developments in bond-stock betas, and how does this alter the interpretation of the earlier switch in bond-stock betas around the millennium? Pflueger (2025) shows that turning bonds into risky assets, as they were in the 1980s, requires both: (a) volatile supply shocks; and (b) an aggressive Federal Reserve response that prioritizes fighting inflation over supporting employment. Neither element alone is sufficient. She calibrates a three-equation New Keynesian model with habit formation preferences to match macroeconomic data and bond-stock betas during the 1980s vs. the 2000s, and uses this model to predict bond-stock betas at different counterfactual combinations of macroeconomic shocks and monetary policy.

The key insight can be illustrated by considering asset price responses to an inflationary supply shock, such as an oil price spike or supply chain disruption. If the Fed aggressively raises interest rates to fight inflation, a recession ensues and stocks suffer along with bonds, leading to positive nominal bond-stock betas. Conversely, when monetary policy responds by holding the nominal policy rate stable, the short-term real interest rate falls, boosting the economy and stock prices; but current and expected future inflation drive down the prices of nominal long-term bonds which leads to negative nominal bond-stock betas. Both volatile supply shocks and a strong anti-inflationary monetary policy response are therefore needed to explain the positive nominal bond-stock betas of the 1980s in Figure 1. Conversely, the negative bond-stock betas of the 2000s were helped by both less volatile supply shocks and a more gradual and output-focused monetary policy rule. Time-varying risk aversion in the model amplifies these patterns. When investors become more risk-averse, they simultaneously are willing to pay less for risky bonds and stocks (in the 1980s scenario) or they are willing to pay less for risky stocks while valuing safe bonds (in the 2000s scenario).

This joint view of macroeconomic shocks and monetary policy also naturally explains the otherwise surprising pattern in bond-stock betas during the recent inflationary surge. The model of Pflueger (2025) shows that if during 2021 and 2022 investors were concerned about volatile supply shocks similar to those experienced in the 1980s, but expected a "soft landing" due to a more measured Fed response, this explains the negative nominal bond-stock betas during this period shown in Figure 1. The simultaneous rise in real bond-stock betas during this period, as seen in Figure 2 Panel A, can also be explained. High inflation with a stable nominal rate implies that real rates must fall. Lower real rates correspond to higher real bond prices, and also stimulate the economy and stock prices through (16), so real bonds and stocks move together, even though nominal bonds and stocks move opposite each other.

Overall, while a turn from supply to demand shocks and towards a more gradual and output-focused monetary policy rule complemented each other around the turn of the millennium to generate negative nominal and real bond-stock betas, these forces worked against each other during 2021-2022, explaining why the inflation component of bond-stock betas remained negative even as real bond-stock betas increased during the recent inflationary spike.

Towards the last quarter of 2023, as the Fed had repeatedly hiked the policy rate by 75 bps, the US monetary policy rule came to be perceived as more similar to the inflation-fighting Fed of the 1980s (Bauer et al. (2025)). This New Keynesian asset pricing model hence implies that nominal bond-stock betas should have increased at the very end of our sample, as visible in Figure 1. It also implies that the inflation component of bond-stock betas should have turned positive as the Fed's response to inflation became clearly hawkish towards the peak of the most recent hiking cycle, consistent with Figure 3.

3 Conclusion

We have reviewed the theoretical and empirical progress made towards understanding the comovement of bonds and stocks. Approaches based on reduced-form dynamics for real consumption growth and inflation yield useful predictions, although ultimately consumption and inflation are endogenous outcomes of economic shocks and policy choices. Because nominal bonds tend to do poorly when inflation expectations rise, and stocks tend to move with the overall economy, a period that experiences high-inflation recessions should be expected to feature positive bond-stock comovement, as was indeed the case during much of the second half of the 20th century. Conversely, periods in which low-inflation recessions occur, such as the first two decades of the 21st century, should be expected to feature negative nominal bond-stock comovements. This explains the shift from positive bond-stock comovements before 2000 to negative bond-stock comovements after 2000.

We have emphasized that such changes in the fundamental risks of bonds are amplified by time-varying risk aversion or risk bearing capacity. We provide new evidence that negative bond-stock betas in the early 21st Century have been more negative when detrended consumption or stock prices suggest that risk aversion has been high; and that positive bond-stock betas in the late 20th Century were even more positive when these same indicators showed high risk aversion or low risk bearing capacity. This should be expected if an increase in investor risk aversion lowers the prices of risky assets, such as stocks or bonds before 2000, but raises the willingness to pay for safe assets, such as bonds during the post-2000 period.

The interplay between bonds' risk-neutral returns and time-varying risk premia has important implications when new macroeconomic forces shape the economy and inflation. For example, the re-emergence of supply shocks and other uncertainties may make nominal bonds more volatile and riskier for investors. While the increase in inflation uncertainty and the risk-neutral volatility of nominal bonds may be small, this increase may easily be amplified when investors become reluctant to hold risky assets, leading bonds to behave like risky assets during flight to safety episodes.

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