From Bonds to Dividend Strips: Decomposing the Equity Premia Term Structure

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Abstract

We construct a Stochastic Discount Factor that jointly prices nominal and real bonds as well as various equity portfolios from 1972 to 2022. Combining it with yield dynamics across these markets, we estimate term structures of risk premia for real bonds, nominal bonds, and equities. We then decompose equity risk premia into term, inflation, and cash flow risk premia components—where cash flow risk premia denote expected returns of dividend strips in excess of maturity-matched nominal bond strips. Term and inflation risk premia rise with maturity, while cash flow risk premia are hump-shaped and relatively low at long maturities. Moreover, short-maturity equity risk premia variation over time is mainly driven by cash flow risk premia, whereas long-maturity equity risk premia variation is dominated by term and inflation risk premia. These findings imply that credible explanations for the equity excess volatility puzzle must operate through bond risk premia dynamics.

JEL Classification: C58; E32; E43; E44; G11; G12.

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Introduction

Discounting cash flows at different horizons lies at the heart of financial economics, with important applications in both corporate finance (e.g., evaluating real investment projects with varying durations) and asset pricing (e.g., assessing the risk premia of assets with different cash flow maturities). Reflecting its central role, a long-standing literature on the term structure of interest rates dates back to the 19th century. More recently, research has focused on the term structures of risk premia in equities and other risky asset classes, recognizing that most cash flows are not fixed in nominal or real terms (see Binsbergen and Koijen (2017) for a review). In parallel, recent work emphasizes the role of bond returns in shaping equity return properties (e.g., Binsbergen (2025)). However, it remains unclear what features of the equity risk premia term structure are driven by bond risk premia components versus those arising purely from cash flow risk premia.

In this paper, we address this gap in the literature by decomposing the term structure of equity risk premia into three components: term risk premia, inflation risk premia, and cash flow risk premia (defined as the expected returns of dividend strips in excess of maturity-matched nominal bond strips). The first two components determine bond risk premia, while the third arises purely from cash flow risk (since dividends are uncertain in both nominal and real terms). We find that, on average, term and inflation risk premia are low at short maturities but high at long maturities. In contrast, cash flow risk premia are low (or even negative) at short and long maturities, peaking at intermediate maturities. Furthermore, while time variation in short-maturity equity risk premia is almost entirely driven by cash flow risk premia, variation in long-maturity equity risk premia is largely due to term and inflation risk premia. This last finding is particularly important, as it suggests that the risk premia on aggregate equity and bond portfolios (both of which have long cash flow duration) are primarily driven by common factors related to term and inflation risk premia despite the fundamentally different nature of equity and bond cash flows. Moreover, it implies the excess volatility puzzle in equities (Shiller (1981)) is inherently linked to bond risk premia variation.

We start from a preliminary analysis that demonstrates our key findings using data on nominal bond yields and dividend strip yields from prior work (Liu and Wu (2021) and Giglio, Kelly, and Kozak (2024)). Specifically, we construct realized annual returns on bond and dividend strips ($R_b^{(h)}$ and $R_e^{(h)}$) from realized 1- to 30-year yields as well as dividend growth. We then estimate expected returns on bond and dividend strips by regressing 1-year ahead returns on multiple bond and dividend strip yields simultaneously. Using the regression fitted values, we obtain bond risk premia from $\mathbb{E}_t[R_b^{(h)} - R_b^{(1)}]$ and cash flow risk premia from $\mathbb{E}_t[R_e^{(h)} - R_b^{(h)}]$. We then highlight our two key findings: (i) on average, bond risk premia increase with maturity while cash flow risk premia are hump-shaped, being relatively low at long maturities and (ii) time variation in short-maturity equity risk premia is almost entirely driven by cash flow risk premia whereas bond risk premia play a large role in long-maturity equity risk premia variation. The first finding can be thought of as a term structure extension of the main result in Binsbergen (2025) that the average return on the equity market in excess of a duration-matched bond portfolio is very low. The second finding is entirely novel, and highlights that much of the equity premium variation over time (responsible for the excess volatility puzzle) is linked to bond risk premia variation.

While our preliminary analysis showcases our main results using a very simple approach, it faces (at least) three important limitations. First, it is restricted to the sample period in Giglio, Kelly, and Kozak (2024), with bond yields being substantially lower at the end of the sample (November 2020) in comparison to the beginning (January 1974). This downward trend in the sample could potentially imply that average bond returns over the sample are higher than expected ex-ante and that our expected return proxies partially fit unexpected returns. Second, bond yields and equity yields are measured from separate sources (with different underlying methodologies). This internal inconsistency could partially drive our results (e.g., it could lead to arbitrage opportunities between bond and dividend strips that generate the type of effects we observe). And third, it cannot disentangle the inflation and term risk premia components of bond risk premia.

Our more elaborate analysis is designed to address these issues. In particular, we estimate a no arbitrage term structure model for bond and dividend strips jointly using data from January 1972 to December 2022, with bond yields being similar at the beginning and end of our sample period. The overall results from our no arbitrage model are qualitatively similar to the ones in our preliminary analysis, indicating that these findings are not due to a mismatch between the measurement of equity and bond yields or a downward trend in bond yields. Moreover, our term structure model includes inflation and real bond yield dynamics, allowing us to show that inflation and term risk premia are each responsible for about half of the bond risk premia effect on the equity risk premia.

Using our no arbitrage model, we also find that discount rate movements are responsible for a large fraction of the variation in equity yields (in line with the excess volatility puzzle of Shiller (1981)) and that discount rates are more important for long-maturity claims (as in Binsbergen et al. (2013) and Golez and Koudijs (2025)). Importantly, we show that the discount rate effect on long-maturity equity yields is driven by term and inflation risk premia, rather than cash flow risk premia. As such, credible explanations for the equity excess volatility puzzle must operate through bond risk premia dynamics.

Our no arbitrage term structure model is based on a Stochastic Discount Factor (SDF) constructed to price nominal and real bonds as well as a broad set of equity portfolios. We rely on the equity portfolios and no arbitrage framework of Giglio, Kelly, and Kozak (2024) (GKK), but modify it by adding state variables and factors designed to capture real and nominal bond term structure components. In our baseline specification, we include the level and slope of nominal and real bond yields as state variables (beyond the four dividend yields in GKK). Moreover, we include level and slope risk factors based on returns related to nominal and real bonds (beyond the returns on the overall equity market and equity principal components used in GKK). We specify the model dynamics following GKK and use a simple regression-based estimation method (adapted from Adrian, Crump, and Moench (2013)) to keep the model estimation as transparent as possible. While the model setup involves many empirical decisions, we provide an extensive set of robustness checks to demonstrate that our key findings remaining valid under alternative empirical specifications.

Contribution to the Literature

This paper directly contributes the equity term structure literature (see Binsbergen and Koijen (2017) for a review).[1] We add to this literature by building on the GKK framework in order to decompose the term structure of equity risk premia into components associated with inflation risk premia, term risk premia, and cash flow risk premia. We find that while time variation in the risk premia of short-term dividend strips is mostly driven by cash flow risk premia, time variation in the risk premia of long-term dividend strips is largely driven by inflation and term risk premia. Since equity indices are similar to long-term dividend strips, this finding has profound implications for how we should think about the drivers of time variation in the equity premium and of the corresponding excess volatility puzzle well documented in the literature (e.g., Shiller (1981)).

We also contribute to a recent literature that emphasizes bond-based determinants of equity returns (e.g., Binsbergen (2025), Binsbergen and Ma (2025), and Gormsen and Lazarus (2025), with the latter two being subsequent to our paper).[2] In particular, Binsbergen (2025) shows that the equity premium is close to zero or even negative over the past five decades when it is measured as average equity returns in excess of duration-matched Treasury bonds. This result demonstrates the importance of the bond risk premium component of the equity premium on average. Our analysis deepens this initial insight along three important dimensions. First, we extend the unconditional result in Binsbergen (2025) to the entire equity term structure, showing that the average risk premia of dividend strips are almost entirely driven by the cash flow risk premia component for short maturity contracts and by the bond

[1] While the equity term structure literature is too long to be properly summarized here, a set of representative papers are Lettau and Wachter (2007, 2011), Binsbergen, Brandt, and Koijen (2012), Binsbergen et al. (2013), Belo, Collin-Dufresne, and Goldstein (2015), Cejnek and Randl (2016, 2020), Li and Wang (2018), Miller (2019, 2020), Gormsen and Koijen (2020), Gonçalves (2021a,b, 2023), Gormsen (2021), Gormsen, Koijen, and Martin (2021), Bansal et al. (2021), Boguth et al. (2023), Cassella et al. (2023), Gormsen and Lazarus (2023), Giglio, Kelly, and Kozak (2024), Golez and Jackwerth (2024), Golez and Matthies (2025), and Golez and Koudijs (2025). See also Backus, Boyarchenko, and Chernov (2018) for a joint analysis of multiple risk premia term structures, including of dividend strips.

[2] A somewhat related set of papers studies the comovement between equities and bonds (e.g., Campbell and Ammer (1993), Baele, Bekaert, and Inghelbrecht (2010), David and Veronesi (2013), Campbell, Pflueger, and Viceira (2020), Kozak (2022), Laarits (2022), and Chernov, Lochstoer, and Song (2024)).

risk premia component for long maturity contracts. Second, we show that the time variation in the risk premia of long maturity dividend strips is in large part driven by time variation in the maturity-matched bond risk premia, which is not the case for short maturity dividend strips. And third, we decompose the bond risk premia component into inflation and term risk premia, shedding light on the underlying economic drivers of the average and time variation in the equity risk premia.

The rest of this paper is organized as follows. Section 1 provides a preliminary analysis that showcases our main results using data for bond and dividend strip yields from prior papers. Section 2 introduces our no arbitrage term structure model while Section 3 covers its empirical implementation and estimation. In turn, Section 4 validates our estimation by demonstrating that the model properly prices the test assets we use in the estimation and implies bond and dividend strip yields that closely match yield data from external sources. Then, Section 5 provides an empirical analysis of the term structure of equity risk premia and its components within our no arbitrage term structure model. Section 6 concludes. The Internet Appendix contains technical derivations, details about the model estimation and data sources and measurement, and supplementary empirical results.

1 Preliminary Results using Strips Data from Prior Studies

This section provides a preliminary analysis that demonstrates some of our main results using bond and equity strips data from prior papers. This analysis shows that our main results are not due to our particular no arbitrage model and empirical choices (albeit our model and empirical choices allow us to deal with some limitations of this preliminary analysis).

Hereafter, R reflects gross annual nominal returns and we suppress time subscripts inside statistical moments when convenient (e.g., $\mathbb{E}_t[R] \equiv \mathbb{E}_t[R_{t+1}]$). Moreover, to facilitate exposition, we use RP as an abbreviation for both risk premium and risk premia (with the usage being clear from the context).

We construct returns on h-year bond and dividend strips (with h from 1 to 30 years) using

$$R_{b,t}^{(h)} = \frac{P_{b,t}^{(h-1)}}{P_{b,t-1}^{(h)}} = \frac{e^{-(h-1)\cdot y_{b,t}^{(h-1)}}}{e^{-h\cdot y_{b,t-1}^{(h)}}} \tag{1}$$

and

$$R_{e,t}^{(h)} = \frac{P_{e,t}^{(h-1)}}{P_{e,t-1}^{(h)}} = \frac{D_t}{D_{t-1}} \cdot \frac{e^{-(h-1)\cdot y_{e,t}^{(h-1)}}}{e^{-h\cdot y_{e,t-1}^{(h)}}} \tag{2}$$

with $P_{b,t}^{(0)} = 1$ and $P_{e,t}^{(0)} = D_t$, where D_t is the nominal dividend on the equity index.

We obtain bond yields, $y_{b,t}^{(h)} = (1/h) \cdot log(P_{b,t}^{(h)})$, by combining the dataset in Liu and Wu (2021) with the 30-year nominal bond yield from the Federal Reserve. We obtain dividend strip yields (or simply equity yields), $y_{e,t}^{(h)} = (1/h) \cdot log(P_{e,t}^{(h)}/D_t)$, as well as dividend growth, D_t/D_{t-1}, directly from the Giglio, Kelly, and Kozak (2024) (GKK) dataset.[3] Since the GKK dataset covers from January of 1974 to November of 2020, our analysis in this section is restricted to this period. Further details about data collection and measurement are provided in Subsection 3.2 since we also use these yields in some parts of our general analysis.

Figure 1(a) plots, in a solid black line, the average realized RP for dividend strips with maturities from 1 to 30 years (i.e., $\mathbb{E}[R_e^{(h)} - R_b^{(1)}]$ estimates for $h = 1, 2..., 30$). The unconditional equity RP increase with dividend maturity. However, these average equity RP are partially driven by their bond RP component, as highlighted in Binsbergen (2025). Specifically, the h-year unconditional equity RP is given by[4]

$$\underbrace{\mathbb{E}[R_e^{(h)} - R_b^{(1)}]}_{\text{Equity RP}} = \underbrace{\mathbb{E}[R_b^{(h)} - R_b^{(1)}]}_{\text{Bond RP}} + \underbrace{\mathbb{E}[R_e^{(h)} - R_b^{(h)}]}_{\text{Cash Flow RP}}. \tag{3}$$

[3]The GKK dataset contains both $R_{e,t} = (P_{e,t} + D_t)/P_{e,t-1}$ and $y_{e,t} = log(1 + D_t/P_{e,t})$, allowing us to measure dividend growth from $D_t/D_{t-1} = R_{e,t} \cdot (1 - e^{-y_{e,t}})/(e^{y_{e,t-1}} \cdot (1 - e^{-y_{e,t-1}}))$, which follows directly from the $R_{e,t}$ definition.

[4]Note that it is standard practice in the equity term structure literature to study returns on dividend futures (see the literature review in Binsbergen and Koijen (2017)). The return on a h-year dividend future is given by $R_{e,t}^{(h)}/R_{b,t}^{(h)}$, and thus it contains an adjustment for the h-year bond risk premium. However, the standard Euler condition in asset pricing models leads to implications for excess returns, not return ratios, so that the bond risk premia adjustment in the cash flow risk premia of Equation 3 (which follows Binsbergen (2025)) is more in line with how we think about risk premia in asset pricing (and accounts for an important Jensen's inequality term).

The blue dashed line of Figure 1(a) plots the bond RP, which capture RP related to inflation and real term risk. They start at 0% and strongly increase with maturity. The red dash-dotted line of Figure 1(a) plots the cash flow RP, which capture the pure cash flow component of the equity RP. In contrast to the equity RP, the cash flow RP are hump-shaped. They start low, increase over the early maturity years, and then decline in later maturity years. So, the increasing term structure of equity RP is driven by an increasing term structure of bond RP, not an increasing term structure of cash flow RP. This result is a term structure extension of the finding in Binsbergen (2025) that the realized equity premium over the last several decades has been (at most) only a little higher than the duration-matched bond risk premium realized over the same period.

While the average realized risk premia are interesting and important, the core novel result in our paper is on risk premia variation over time. To explore this aspect, we estimate regressions of $R^{(h)}_{e,t+1} - R^{(1)}_{b,t+1}$ as well as its two components ($R^{(h)}_{b,t+1} - R^{(1)}_{b,t+1}$ and $R^{(h)}_{e,t+1} - R^{(h)}_{b,t+1}$) for each dividend strip maturity h onto lagged bond and equity yields ($y^{(\tau)}_{b,t}$ and $y^{(\tau)}_{e,t}$) of many maturities jointly ($\tau = 1, 5, 10, 15, 20, 25, 30$). We treat the fitted values of these regressions as conditional expected returns. Then, for each dividend strip maturity h, we perform the equity premium variance decomposition

$$1 = \underbrace{\frac{\mathbb{C}ov\left(\mathbb{E}_t[R^{(h)}_e - R^{(1)}_b]\,,\,\mathbb{E}_t[R^{(h)}_b - R^{(1)}_b]\right)}{\mathbb{V}ar\left(\mathbb{E}_t[R^{(h)}_e - R^{(1)}_b]\right)}}_{\theta^{(h)}_{\text{Bond}} = \mathbb{V}ar\left(\mathbb{E}_t[R^{(h)}_e - R^{(1)}_b]\right) \text{ due to Bond RP}} + \underbrace{\frac{\mathbb{C}ov\left(\mathbb{E}_t[R^{(h)}_e - R^{(1)}_b]\,,\,\mathbb{E}_t[R^{(h)}_e - R^{(h)}_b]\right)}{\mathbb{V}ar\left(\mathbb{E}_t[R^{(h)}_e - R^{(1)}_b]\right)}}_{\theta^{(h)}_{\text{CashFlow}} = \mathbb{V}ar\left(\mathbb{E}_t[R^{(h)}_e - R^{(1)}_b]\right) \text{ due to Cash Flow RP}} \tag{4}$$

Figure 1(b) plots the term structure of these variance decompositions. The key finding is that the importance of the bond RP in explaining equity RP variation is much stronger for long maturity dividend strips than for short maturity dividend strips. For instance, while the bond RP explains 0% of the time variation in the RP of the 1-year dividend strip, it explains close to 40% of the variation in the RP of the 30-year dividend strip.[5]

[5] One may think that the increasing $\theta^{(h)}_{\text{Bond}}$ is obvious since $\theta^{(h)}_{\text{Bond}} = 0$ by construction. However, whether $\theta^{(h)}_{\text{Bond}}$ for $h > 1$ is positive or negative depends on the sign of the correlation between bond RP and equity RP. Moreover, as shown below in Equation 5, even if one thinks the correlation has to be positive (which is

The analysis above measures dividend growth and equity yields in an internally consistent manner by taking both from the GKK dataset. However, the dividend measure used in GKK (which is common in the literature), assigns M&A paid in cash to price appreciation even though it induces a dividend (see Allen and Michaely (2003)). As we detail in Subsection 3.2, our main analysis instead follows some recent papers that measure aggregate dividends accounting for M&A paid in cash (e.g., Sabbatucci (2022), Gonçalves (2021a,b), Gonçalves (2023) and Chabi-Yo, Gonçalves, and Loudis (2025)). As such, Figures 1(c) and 1(d) replicate Figures 1(a) and 1(b) after replacing the GKK dividend growth (in Equation 2) with dividend growth calculated using our main dividend measure (under the simplistic assumption that the equity yields would still match those in GKK). The results are qualitatively similar, but quantitatively stronger. For instance, while the bond RP explains 0% of the time variation in the the RP of the 1-year dividend strip, it explains slightly more than 80% of the variation in the RP of the 30-year dividend strip.

Since the bond RP share of the equity RP variability can be written as

$$\theta^{(h)}_{\text{Bond}} \;=\; \mathbb{C}or\left(\mathbb{E}_t[R_e^{(h)} - R_b^{(1)}]\,,\,\mathbb{E}_t[R_b^{(h)} - R_b^{(1)}]\right) \cdot \frac{\sigma\left(\mathbb{E}_t[R_b^{(h)} - R_b^{(1)}]\right)}{\sigma\left(\mathbb{E}_t[R_e^{(h)} - R_b^{(1)}]\right)}, \tag{5}$$

and likewise for $\theta^{(h)}_{\text{CashFlow}}$, the increasing importance of $\theta^{(h)}_{\text{Bond}}$ can be due to bond RP volatility increasing more than cash flow RP volatility as the dividend strip maturity increases or due to the bond-equity RP correlation increasing as dividend strip maturity increases. Figure 2 shows that both channels are important in explaining the variance decomposition results in Figures 1(b) and 1(d). If either quantity was stuck at the low values observed for short-maturity dividend strips, then we would not see the strong increase in $\theta^{(h)}_{\text{Bond}}$ present in the data. The reason is that the multiplicative effect makes these two channels complementary (as opposed to substitutes). This finding rules out a trivial explanation for the increasing $\theta^{(h)}_{\text{Bond}}$ we observe: that it is entirely because bond RP volatility strongly increased with maturity. The results show that it is essential for our variance decomposition findings that the RP

not necessarily the case), whether $\theta^{(h)}_{\text{Bond}}$ increases with maturity beyond $h = 1$ depends on the joint dynamics of the bond and equity RP (i.e., the term structures of RP volatilities and equity-bond RP correlations).

on dividend and bonds strips comove much more strongly at long maturities than at short maturities. This aspect highlights that the common component of the equity and bond risk premia is an important driver of time variation in the overall equity premium (which mainly reflects the RP of long-maturity dividend claims).

Overall, the results in this section extend the insight in Binsbergen (2025) that the average equity premium is low when measured relative to a duration-matched bond portfolio (with this duration-adjusted equity premium being the analogue to our cash flow RP). Specifically, we show that cash flow RP are generally low, particularly for very short-term and very long-term dividend strips. Moreover, we show that the time variation in the RP of long maturity dividend strips is in large part driven by time variation in bond RP, which is not the case for short maturity dividend strips. This last result is entirely novel to our paper and has important implications for the excess volatility puzzle in equities. Therefore, it is the focus of our empirical analysis.

However, the analysis in this section has (at least) three important limitations. First, bond yields are substantially lower at the end of the sample (November 2020) in comparison to the beginning (January 1974). This downward trend in the sample could potentially imply that average bond returns over the sample are higher than ex-ante expected and that our expected return proxies partially fit unexpected returns. Second, bond yields and equity yields are measured from separate sources (with different underlying methodologies). This internal inconsistency could partially drive our results (e.g., it could lead to arbitrage opportunities between bond and dividend strips that generate the type of effects we observe). And third, we cannot disentangle the inflation and real term RP components of the bond RP without information on real bond strips.

The subsequent sections deal with these issues. In particular, we estimate a no arbitrage term structure model for bond and dividend strips jointly using data from January of 1972 to December of 2022, with bond yields being similar at the beginning and end of our sample period. As such, our core findings are not due to a mismatch between the measurement of equity and bond yields or a downward trend in bond yields. Moreover, we model inflation dynamics (and include data on real interest rates in the estimation) so that we can separately estimate the effects of the inflation and term RP.

2 A No Arbitrage Term Structure Model

This section details our no arbitrage term structure model, which builds on GKK. The key addition is that we include factors for nominal and real bonds so as to decompose the equity risk premia term structure into its inflation, term, and cash flow RP components using a common asset pricing framework that satisfies no arbitrage. Subsection 2.1 introduces our return and SDF dynamics, Subsection 2.2 outlines the restrictions imposed by no arbitrage, and Subsections 2.3, 2.4, and 2.5 provide expressions to recover quantities related to bond, inflation, and dividend strips. Technical derivations are provided in Internet Appendix A.

We outline our no arbitrage term structure model in annual horizon and nominal terms to match our empirical analysis. Moreover, to simplify notation, we use lower case letters to reflect the log of the respective capital letter (e.g., $r \equiv log(R)$), Δ to represent first differences (e.g., $\Delta\pi_t = \pi_t - \pi_{t-1}$), tilde to represent shocks (e.g., $\widetilde{r}_t \equiv r_t - \mathbb{E}_{t-1}[r_t]$), and xr to capture returns in excess of the 1-year nominal bond return (i.e., $xr \equiv r - r^{(1)}_{b,t}$). We also continue to suppress time subscripts inside statistical moments when convenient (e.g., $\mathbb{E}_t[r] \equiv \mathbb{E}_t[r_{t+1}]$ and $\mathbb{V}ar_t[r] \equiv \mathbb{V}ar_t[r_{t+1}]$).

2.1 Return Dynamics and the SDF

Let Π_t represent the economy's inflation index (so that $\Delta\pi_t$ is the log inflation rate), $r^{(1)}_{b,t} = y^{(1)}_{b,t-1}$ represent annual log returns on a 1-year nominal bond, $xr_t = r_t - r^{(1)}_{b,t}$ represent a $(n_{xr} \times 1)$ vector of annual log excess returns, and s_t represent a $(n_s \times 1)$ state vector. We summarize the $z_t = [xr_t,\ s_t]'$ dynamics through a Vector Autoregressive (VAR) system of order one:[6]

$$z_t = \phi + \Phi z_{t-1} + \widetilde{z}_t \tag{6}$$

where $\widetilde{z}_t \overset{i.i.d}{=\sim} N(0, \Sigma)$, with $\Sigma = \begin{bmatrix} \Sigma_{xr} & \Sigma'_{xr,s} \\ \Sigma_{xr,s} & \Sigma_s \end{bmatrix}$, $\phi = \begin{bmatrix} \phi_{xr} \\ \phi_s \end{bmatrix}$, and $\Phi = \begin{bmatrix} 0 & \Phi_{xr,s} \\ 0 & \Phi_{s,s} \end{bmatrix}$.

As we detail in the next subsections, to recover information on bond, inflation, and dividend strips, we need to include in r_t the aggregate equity return, $r_{e,t} = log(\frac{P_{e,t}+D_t}{P_{e,t-1}})$. We also need to include in s_t the 1-year Treasury nominal bond yield, $y^{(1)}_{b,t}$, the inflation rate, $\Delta\pi_t$, and the aggregate dividend yield, $y_{e,t} = log(\frac{D_t}{P_{e,t}} + 1)$.[7] As such, everything that follows (including our empirical analysis) imposes $r_{e,t} \,\epsilon\, r_t$ and $[\Delta\pi_t,\ y^{(1)}_{b,t},\ y_{e,t}] \,\epsilon\, s_t$.

Under no arbitrage, a log Stochastic Discount Factor (SDF), m_t, that prices nominal returns exists. We assume m_t is (conditionally) normal and (conditionally) project m_t onto $\Delta\pi_t$, $r^{(1)}_{b,t}$, and r_t:

$$\begin{aligned} m_{t+1} &= \psi_{0,t} - \psi_{\pi,t}\cdot\Delta\pi_{t+1} - \psi_{b,t}\cdot r^{(1)}_{b,t+1} - \psi'_t r_{t+1} + \epsilon_{t+1} && (7) \\ &= \mathbb{E}_t[m] - \psi_{\pi,t}\cdot\widetilde{\Delta\pi}_{t+1} - \psi'_t\widetilde{xr}_{t+1} + \epsilon_{t+1} \\ &= \mathbb{E}_t[m] - \lambda'_t[\widetilde{\Delta\pi}_{t+1}\,;\,\widetilde{xr}^*_{t+1}] + \epsilon_{t+1} \\ &= \mathbb{E}_t[m] - \lambda'_t\Omega\widetilde{z}_{t+1} + \epsilon_{t+1} && (8) \end{aligned}$$

where $\mathbb{E}_t[\epsilon] = \mathbb{E}_t[\epsilon\cdot r^{(1)}_b] = \mathbb{E}_t[\epsilon\cdot\Delta\pi] = \mathbb{E}_t[\epsilon\cdot r] = 0$ holds by construction since Equation 8 represents a conditional projection.[8]

[6]Note that, following Gonçalves (2021a) and GKK, we set the predictive coefficients of excess-returns to zero because returns are not good predictors of future returns or cash flow growth.

[7]Following Gao and Martin (2021) and GKK, we define the dividend yield based on $y_{e,t} = log(D_t/V_{e,t}+1)$ instead of the more common $y_{e,t} = log(D_t/V_{e,t})$. As GKK show, this choice leads to closed-form solutions for equity yields without any approximation.

[8]GKK directly assume m_t is linear in the $\widetilde{z}_t$ shocks associated with returns, which represents Equation 8 with $\epsilon_{t+1} = 0$ (and $\Delta\pi_t \notin z_t$ since they do not explore inflation risk premia). We instead start from the projection in Equation 7 to derive Equation 8. This allows us to show that the assumption required for the SDF is slightly more general than the assumption imposed in GKK (which they must have imposed to simplify the exposition). In particular, we can have $\epsilon_t \neq 0$ so long as $\mathbb{E}_t[\epsilon\cdot s] = 0$, as we discuss in the next subsection.

The move from the second to the third line in the derivation of Equation 8 imposes the restriction that $\Delta\pi_t$ and a $n^*_{xr} \leq n_{xr}$ set of excess returns, $\widetilde{xr}^*_t$, price all excess returns in xr_t (we specify xr^*_t in Section 3). The ϵ_t term allows returns outside of r_t to not be priced by $\Delta\pi_t$ and $\widetilde{xr}^*_t$ (or by xr_t). The $[\widetilde{\Delta\pi}_{t+1}\,;\,\widetilde{xr}^*_{t+1}] = \Omega\tilde{z}_t$ identity (used to go from the third to the fourth line) is useful in simplifying some of the later expressions, but it imposes no further restrictions on our SDF dynamics.

To simplify exposition, for now on we refer to $\Delta\pi_t$ and xr^*_t as risk factors and the expected excess returns implied by the model as risk premia. However, our no arbitrage framework does not guarantee (or require) that these pricing variables reflect fundamental risks relevant to the marginal investor. For instance, they could instead reflect the pricing of sentiment as in Kozak, Nagel, and Santosh (2018).

2.2 Risk Premia Constraints under No Arbitrage

Given the structure outlined in the previous subsection, the no arbitrage condition $\mathbb{E}_t[e^{m_{t+1}+r^{(1)}_{b,t+1}}] = 1$ can be written as

$$\mathbb{E}_t[m] \;+\; 0.5 \cdot \mathbb{V}ar_t[m] = \;-\, y^{(1)}_{b,t} \tag{9}$$

and combining $\mathbb{E}_t[e^{m_{t+1}+r^{(1)}_{b,t+1}}] = 1$ with $\mathbb{E}_t[e^{m_{t+1}+r_{j,t+1}}] = 1$ yields

$$\begin{aligned} \mathbb{E}_t[xr_j] \;+\; 0.5 \cdot \mathbb{V}ar_t[xr_j] \;&=\; -\,\mathbb{C}ov_t[xr_j, m] \\ &\Downarrow \\ 1'_{xr_j}(\phi \;+\; \Phi z_t) \;+\; 0.5 \cdot 1'_{xr_j}\Sigma 1_{xr_j} \;&=\, 1'_{xr_j}\Sigma\Omega'\lambda_t \end{aligned} \tag{10}$$

where 1_{xr_j} is a selector vector such that $1'_{xr_j} z_t = xr_{j,t}$.

Equation 10 imposes no arbitrage restrictions linking the VAR dynamics for $\mathbb{E}_t[xr]$ and the risk prices embedded in λ_t. Specifically,

$$\lambda_t \;=\; \underbrace{\lambda}_{(n^*_{xr}\times 1)} \;+\; \underbrace{\Lambda}_{(n^*_{xr}\times n_z)} z_t \tag{11}$$

with

$$1'_{xr_j}\phi \ + \ 0.5\cdot 1'_{xr_j}\Sigma 1_{xr_j} \ = 1'_{xr_j}\Sigma\Omega'\lambda \tag{12}$$

and

$$1'_{xr_j}\Phi \ = 1'_{xr_j}\Sigma\Omega'\Lambda \tag{13}$$

which implies we can directly estimate the dynamics of risk prices (i.e., λ and Λ) and recover ϕ_{xr} and $\Phi_{xr,s}$ from the no arbitrage conditions in Equations 12 and 13.

Section 3 explains the estimation of ϕ_s, $\Phi_{s,s}$, Σ, λ, and Λ, which is what we need to jointly recover the VAR and λ_t dynamics. The model term structure solution in the next subsections relies on these dynamics as well as on the identifying assumption $\mathbb{E}_t[\epsilon\cdot s]=0$.[9] If $\Delta\pi_t$ and xr^*_t price all assets as assumed in GKK, then $\mathbb{E}_t[\epsilon\cdot s]=0$ holds by construction since $\epsilon_t=0$.

2.3 Bond Strips

We define an h-year bond strip as a contract that pays one dollar (in nominal terms) at time $t+h$ and no cash flows in between. Then, the no arbitrage condition for a bond strip can be written as

$$P^{(h)}_{b,t} \ \equiv \ e^{-h\cdot y^{(h)}_{b,t}} \ = \mathbb{E}_t\left[M_{t+1}\cdot P^{(h-1)}_{b,t+1}\right] \ = \ \mathbb{E}_t\left[e^{m_{t+1}-(h-1)\cdot y^{(h-1)}_{b,t+1}}\right] \tag{14}$$

with boundary condition $P^{(0)}_{b,t}=1$ so that $y^{(0)}_{b,t}=0$.

Internet Appendix A shows that, as long as $y^{(1)}_{b,t}\,\epsilon\,s_t$, the no arbitrage condition in Equation 14 implies

$$y^{(h)}_{b,t} \ = a^{(h)}_{y_b} \ + \ b^{(h)\prime}_{y_b} z_t \tag{15}$$

[9]Formally, let $\widetilde{s}_t = B\widetilde{r}^{all}_t + u_t$ be a projection of $\widetilde{s}_t$ onto the entire return space, $\widetilde{r}^{all}_t$, which can include managed portfolios (and it also includes $\widetilde{\Delta\pi}$ since $\widetilde{r}^{(1)}_\pi = \widetilde{\Delta\pi}$). Note that $\widetilde{r}_{j,t} = \widetilde{xr}_{j,t}\ \forall\ j$ so that the log SDF can always be written as $\widetilde{m}_{t+1} = -\lambda^{all\prime}_t\widetilde{r}^{all}_{t+1}$, and thus $\epsilon_{t+1}=\lambda'_t[\widetilde{\Delta\pi}_{t+1}\,;\,\widetilde{xr}^*_{t+1}]-\lambda^{all\prime}_t\widetilde{r}^{all}_{t+1}$ must be in the return space, which implies $\mathbb{E}_t[\epsilon\cdot u]=0$. As such, we only require $\Delta\pi$ and r_t to span the space of the mimicking portfolios for s_t (i.e., $B\widetilde{r}^{all}_t = \Gamma[\widetilde{\Delta\pi}\,;\,\widetilde{r}_t]$ for some Γ) because, in this case, $\mathbb{E}_t[\epsilon\cdot s]=\mathbb{E}_t[\epsilon\cdot(B\widetilde{r}^{all}+u)]=\mathbb{E}_t[\epsilon\cdot(\Gamma[\widetilde{\Delta\pi}\,;\,\widetilde{r}_t]+u)]=0$.

$$\mathbb{E}_t[xr_b^{(h)}] \;= a_{\mathbb{E}_b}^{(h)} \;+\; b_{\mathbb{E}_b}^{(h)'} z_t \tag{16}$$

and

$$\mathbb{V}ar_t[r_b^{(h)}] \;= b_{\mathbb{V}_b}^{(h)'} \Sigma b_{\mathbb{V}_b}^{(h)} \tag{17}$$

with boundary condition $a_{y_b}^{(0)} = b_{y_b}^{(0)} = 0$ and recursive parameters

$a_{y_b}^{(h)} = \frac{(h-1)}{h} \cdot \left[a_{y_b}^{(h-1)} + b_{y_b}^{(h-1)'}(\phi - \Sigma\Omega'\lambda - 0.5 \cdot (h-1) \cdot \Sigma b_{y_b}^{(h-1)}) \right]$

$b_{y_b}^{(h)'} = \frac{1}{h} \cdot 1_{y_b}' + \frac{(h-1)}{h} \cdot \left[b_{y_b}^{(h-1)'}(\Phi - \Sigma\Omega'\Lambda) \right]$

$a_{\mathbb{E}_b}^{(h)} = h \cdot a_{y_b}^{(h)} - (h-1) \cdot (a_{y_b}^{(h-1)} + b_{y_b}^{(h-1)'}\phi)$

$b_{\mathbb{E}_b}^{(h)'} = h \cdot b_{y_b}^{(h)'} - (h-1) \cdot b_{y_b}^{(h-1)'}\Phi - 1_{y_b}'$

$b_{\mathbb{V}_b}^{(h)'} = -(h-1) \cdot b_{y_b}^{(h-1)'}$

Given Equations 15 to 17, bond strip realized returns and risk premia follow from

$$R_{b,t}^{(h)} \;= \frac{P_{b,t}^{(h-1)}}{P_{b,t-1}^{(h)}} \;=\; e^{h \cdot y_{b,t-1}^{(h)} - (h-1) \cdot y_{b,t}^{(h-1)}} \tag{18}$$

and

$$\mathbb{E}_t[R_b^{(h)} - R_b^{(1)}] \;=\; \left(e^{\mathbb{E}_t[xr_b^{(h)}] + 0.5 \cdot \mathbb{V}ar_t[r_b^{(h)}]} - 1 \right) \cdot e^{y_{b,t}^{(1)}} \tag{19}$$

Moreover, since $r_{b,t\to t+h}^{(h)} = log(1/P_{b,t}^{(h)})$, we have that each bond strip (log) discount rate equals the respective bond strip yield:

$$dr_{b,t}^{(h)} \;= \frac{1}{h} \cdot \mathbb{E}_t \left[r_{b,t\to t+h}^{(h)} \right] \;=\; y_{b,t}^{(h)} \tag{20}$$

2.4 Inflation Strips

We define an h-year inflation strip (which is the same as a real bond strip) as a contract that pays Π_{t+h} (in nominal terms) at time $t+h$ and no cash flows in between (with Π_t representing the economy's inflation index). Then, the no arbitrage condition for an inflation strip can be written as

$$\frac{P_{\pi,t}^{(h)}}{\Pi_t} \equiv e^{-h\cdot y_{\pi,t}^{(h)}} = \mathbb{E}_t\left[M_{t+1}\cdot\frac{P_{\pi,t+1}^{(h-1)}}{\Pi_t}\right] = \mathbb{E}_t\left[e^{m_{t+1}-(h-1)\cdot y_{\pi,t+1}^{(h-1)}+\Delta\pi_{t+1}}\right] \tag{21}$$

with boundary condition $P_{\pi,t}^{(0)} = \Pi_t$ so that $y_{\pi,t}^{(0)} = 0$.

Internet Appendix A shows that, as long as $(\Delta\pi_t\,,\,y_{b,t}^{(1)})\,\epsilon\,s_t$, the no arbitrage condition in Equation 21 implies

$$y_{\pi,t}^{(h)} = a_{y_\pi}^{(h)} + b_{y_\pi}^{(h)'} z_t \tag{22}$$

$$\mathbb{E}_t[xr_\pi^{(h)}] = a_{\mathbb{E}_\pi}^{(h)} + b_{\mathbb{E}_\pi}^{(h)'} z_t \tag{23}$$

and

$$\mathbb{V}ar_t[r_\pi^{(h)}] = b_{\mathbb{V}_\pi}^{(h)'}\Sigma b_{\mathbb{V}_\pi}^{(h)} \tag{24}$$

with boundary conditions $a_{y_\pi}^{(0)} = b_{y_\pi}^{(0)} = 0$, and recursive parameters

$$a_{y_\pi}^{(h)} = \tfrac{1}{h}\cdot\left[(h-1)\cdot a_{y_\pi}^{(h-1)} - (1_\pi-(h-1)\cdot b_{y_\pi}^{(h-1)})'(\phi-\Sigma\Omega'\lambda+0.5\cdot\Sigma(1_\pi-(h-1)\cdot b_{y_\pi}^{(h-1)})\right]$$

$$b_{y_\pi}^{(h)'} = \tfrac{1}{h}\cdot\left[1_{y_b}' - (1_\pi-(h-1)\cdot b_{y_\pi}^{(h-1)})'(\Phi-\Sigma\Omega'\Lambda)\right]$$

$$a_{\mathbb{E}_\pi}^{(h)} = h\cdot a_{y_\pi}^{(h)} - (h-1)\cdot a_{y_\pi}^{(h-1)} + (1_\pi-(h-1)\cdot b_{y_\pi}^{(h-1)})'\phi$$

$$b_{\mathbb{E}_\pi}^{(h)'} = (1_\pi-(h-1)\cdot b_{y_\pi}^{(h-1)})'\Phi + (h\cdot b_{y_\pi}^{(h)})' - 1_{y_b}'$$

$$b_{\mathbb{V}_\pi}^{(h)'} = (1_\pi-(h-1)\cdot b_{y_\pi}^{(h-1)})'$$

Given Equations 22 to 24, inflation strip realized returns and risk premia follow from

$$R_{\pi,t}^{(h)} = \frac{P_{\pi,t}^{(h-1)}}{P_{\pi,t-1}^{(h)}} = e^{\Delta\pi_t+h\cdot y_{\pi,t-1}^{(h)}-(h-1)\cdot y_{\pi,t}^{(h-1)}} \tag{25}$$

and

$$\mathbb{E}_t[R_\pi^{(h)} - R_b^{(1)}] = \left(e^{\mathbb{E}_t[xr_\pi^{(h)}]+0.5\cdot\mathbb{V}ar_t[r_\pi^{(h)}]} - 1\right)\cdot e^{y_{b,t}^{(1)}} \tag{26}$$

We can also obtain each inflation strip (log) discount rate from

$$dr^{(h)}_{\pi,t} = \frac{1}{h} \cdot \mathbb{E}_t \left[r^{(h)}_{\pi,t\to t+h} \right] = y^{(h)}_{\pi,t} + \frac{1}{h} \cdot \mathbb{E}_t \left[\Delta\pi_{t\to t+h} \right]$$

$$= y^{(h)}_{\pi,t} + a^{(h)}_{g_\pi} + b^{(h)\prime}_{g_\pi} z_t \tag{27}$$

where $g^{(h)}_{\pi,t} = \frac{1}{h} \cdot \mathbb{E}_t \left[\Delta\pi_{t\to t+h} \right] = a^{(h)}_{g_\pi} + b^{(h)\prime}_{g_\pi} z_t$, with boundary conditions $a^{(0)}_{g_\pi} = b^{(0)\prime}_{g_\pi} = 0$, and recursive parameters

$a^{(h)}_{g_\pi} = \frac{1}{h} \cdot 1^{\prime}_{\pi}\phi + \frac{h-1}{h} \cdot (a^{(h-1)}_{g_\pi} + b^{(h-1)\prime}_{g_\pi}\phi)$

$b^{(h)^{\prime}}_{g_\pi} = \frac{1}{h} \cdot 1^{\prime}_{\pi}\Phi + \frac{h-1}{h} \cdot b^{(h-1)\prime}_{g_\pi}\Phi$

2.5 Dividend Strips

We define an h-year dividend strip as a contract that pays D_{t+h} (in nominal terms) at time $t+h$ and no cash flows in between (with D_t representing the aggregate dividend).[10] Then, the no arbitrage condition for a dividend strip can be written as

$$\frac{P^{(h)}_{e,t}}{P_{e,t}} \equiv w^{(h)}_{e,t} = \mathbb{E}_t \left[M_{t+1} \cdot \frac{P^{(h-1)}_{e,t+1}}{P_{e,t}} \right] = \mathbb{E}_t \left[w^{(h-1)}_{e,t+1} \cdot e^{m_{t+1}+r_{e,t+1}-y_{e,t+1}} \right] \tag{28}$$

with boundary condition $V^{(0)}_{e,t} = D_t$ so that $w^{(0)}_{e,t} = e^{y_{e,t}} - 1$.

Internet Appendix A shows that, as long as $r_{e,t} \,\epsilon\, r_t$ and $(y^{(1)}_{b,t},\, y_{e,t}) \,\epsilon\, s_t$, the no arbitrage condition in Equation 28 implies

$$w^{(h)}_{e,t} = e^{a^{(h)}_{1,w_e} + b^{(h)\prime}_{1,w_e} z_t} - e^{a^{(h)}_{2,w_e} + b^{(h)\prime}_{2,w_e} z_t} \tag{29}$$

with boundary conditions $a^{(0)}_{1,w_e} = a^{(0)}_{2,w_e} = b^{(0)}_{2,w_e} = 0$ and $b^{(0)}_{1,w_e} = 1_{y_e}$, and recursive parameters

$a^{(h)}_{k,w_e} = a^{(h-1)}_{k,w_e} + (b^{(h-1)}_{k,w_e} + 1_{xr_e} - 1_{y_e})^{\prime}(\phi - \Sigma\Omega^{\prime}\lambda + 0.5 \cdot \Sigma(b^{(h-1)}_{k,w_e} + 1_{xr_e} - 1_{y_e}))$

$b^{(h)\prime}_{k,w_e} = (b^{(h-1)}_{k,w_e} + 1_{xr_e} - 1_{y_e})^{\prime}(\Phi - \Sigma\Omega^{\prime}\Lambda)$

[10]The expressions we obtain for dividend strips apply equally to the cash flow strips of any other asset paying positive cash flows (beyond the aggregate public equity market). Using this result, a previous version of this paper also studied the cash flow strips from the aggregate market of public Real Estate Investment Trusts (REITs). We no longer report the results from public REITs as they are very similar to the dividend strip results we obtain, and thus are not needed for the main message of this paper.

Note that since $D_t > 0$, we have $P_{e,t}^{(h)} > 0$ and $w_{i,t}^{(h)} > 0$, which allows us to also define dividend strip yields (or simply equity yields) as[11]

$$y_{e,t}^{(h)} = \frac{1}{h} \cdot log \left(\frac{D_t}{P_{e,t}^{(h)}} \right) = \frac{1}{h} \cdot \left[log \left(e^{y_{e,t}} - 1 \right) - log \left(w_{e,t}^{(h)} \right) \right] \tag{30}$$

Furthermore, from the dividend strip weights in Equation 29, we can calculate dividend strip realized returns and risk premia from

$$R_{e,t}^{(h)} = \frac{P_{e,t}^{(h-1)}}{P_{e,t-1}^{(h)}} = \frac{w_{e,t}^{(h-1)}}{w_{e,t-1}^{(h)}} \cdot e^{r_{e,t} - y_{e,t}} \tag{31}$$

and

$$\mathbb{E}_t \left[R_e^{(h)} - R_b^{(1)} \right] = \frac{1}{w_{e,t}^{(h)}} \cdot \left[e^{a_{1,\mathbb{E}e}^{(h)} + b_{1,\mathbb{E}e}^{(h)\prime} z_t} - e^{a_{2,\mathbb{E}e}^{(h)} + b_{2,\mathbb{E}e}^{(h)\prime} z_t} \right] - e^{y_{b,t}^{(1)}} \tag{32}$$

with recursive parameters given by

$\theta_{k,\mathbb{E}e}^{(h)} = b_{k,w_e}^{(h-1)} + 1_{xr_e} - 1_{y_e}$

$a_{k,\mathbb{E}e}^{(h)} = a_{k,w_e}^{(h-1)} + \theta_{k,\mathbb{E}e}^{(h)\prime} (\phi + 0.5 \cdot \Sigma \theta_{k,\mathbb{E}e}^{(h)})$

$b_{k,\mathbb{E}e}^{(h)\prime} = \theta_{k,\mathbb{E}e}^{(h)\prime} \Phi + 1_{y_b}^{\prime}$

Moreover, from the dividend strip valuation identity, $P_{e,t}^{(h)} = \mathbb{E}_t \left[D_{t+h} \right] \cdot e^{-h \cdot dr_{e,t}^{(h)}}$, the dividend strip (log) discount rate and the dividend (log) expected growth are given by

$$dr_{e,t}^{(h)} = \frac{1}{h} \cdot log \left(\mathbb{E}_t \left[\frac{D_{t+h}}{P_{e,t}^{(h)}} \right] \right) = \frac{1}{h} \cdot log \left(\frac{1}{w_{e,t}^{(h)}} \cdot \left[e^{a_{1,dr_e}^{(h)} + b_{1,dr_e}^{(h)\prime} z_t} - e^{a_{2,dr_e}^{(h)} + b_{2,dr_e}^{(h)\prime} z_t} \right] \right) \tag{33}$$

[11]While Equations 29 and 30 are consistent with GKK, they lead to highly non-linear dividend strip risk premia (even in logs). To ensure our results are not due to strong non-linearities (which can exacerbate any potential effect of model mispecification), Internet Appendix D.1 uses the log-linear approximation in Gao and Martin (2021) (which is an improved version of the Campbell and Shiller (1989) log-linear approximation) to obtain $y_{e,t}^{(h)}$ that is linear in z_t, leading to log-linear dividend strip risk premia. The results obtained from this alternative analysis are similar to the ones we report in the main text.

and

$$g_{e,t}^{(h)} \;=\frac{1}{h}\cdot log\left(\mathbb{E}_t\left[\frac{D_{t+h}}{D_t}\right]\right) \;=\; dr_{e,t}^{(h)} \;-\; y_{e,t}^{(h)} \tag{34}$$

with boundary conditions $\theta_{1,dr_e}^{(1)} = 1_{xr_e}$, $\theta_{2,dr_e}^{(1)} = 1_{xr_e} - 1_{y_e}$, and $a_{k,dr_e}^{(0)} = 0$, and recursive parameters

$$\theta_{k,dr_e}^{(h)'} \;=\; \theta_{k,dr_e}^{(h-1)'}\Phi \;+\; 1_{xr_e} \;-\; 1_{y_e} \;+\; 1_{y_b}$$

$$a_{k,dr_e}^{(h)} \;=\; a_{k,dr_e}^{(h-1)} \;+\; \theta_{k,dr_e}^{(h)'}\phi \;+\; 0.5\cdot\theta_{k,dr_e}^{(h)'}\Sigma\theta_{k,dr_e}^{(h)}$$

$$b_{k,dr_e}^{(h)'} \;=\; \theta_{k,dr_e}^{(h)'}\Phi \;+\; 1_{y_b}$$

3 Specification of the No Arbitrage Term Structure Model

This section covers our VAR and SDF specifications. Subsection 3.1 details the variables included in s_t, r_t, and $\widetilde{xr}_t^*$, Subsection 3.2 briefly explains the measurement of these variables, and Subsection 3.3 briefly discuss the VAR and SDF estimation and its results. Further details about the estimation procedure are provided in Internet Appendix B.

3.1 Variables in s_t and r_t

As pointed out in Section 2, our no arbitrage term structure framework requires $r_{e,t}\,\epsilon\, r_t$ and $[\Delta\pi_t,\, y_{b,t}^{(1)},\, y_{e,t}]\,\epsilon\, s_t$, and is based on three identifying assumptions:

1. The VAR in Equation 6 summarizes the $\mathbb{E}_t[s]$ and $\mathbb{E}_t[xr]$ dynamics

2. $\Delta\pi$ and r_t span the space of the mimicking portfolios for s_t (see Footnote 9)

3. xr_t^* prices xr_t

Our guiding principle when choosing s_t, r_t, and xr_t^* is to build a parsimonious specification for these vectors that is consistent with the prior literature while reasonably satisfying the three conditions above. Below, we describe exactly how we build s_t, r_t, and xr_t^*, with measurement details provided in the next subsection.

We set $s_t = [\Delta\pi_t,\ y_{\pi,t}^{(Level)},\ y_{\pi,t}^{(Slope)},\ y_{b,t}^{(Level)},\ y_{b,t}^{(Slope)},\ y_{e,t},\ y_{e,t}^{(PC1)},\ y_{e,t}^{(PC2)},\ y_{e,t}^{(PC3)}]'$ with $y_{b,t}^{(Level)} = y_{b,t}^{(1)}$ so that our state vector satisfies $[\Delta\pi_t,\ y_{b,t}^{(1)},\ y_{e,t}] \epsilon\, s_t$ and is entirely composed of yield measures, except for the inflation rate, which is required to obtain the term structure of inflation risk premia. Using yields is consistent with GKK and with identifying assumption (1) since we need to have state variables that capture the $\mathbb{E}_t[xr]$ dynamics (with yields being essential for this purpose). We include a yield level and slope for real and nominal bonds since the bond term structure literature shows that two yield factors are enough to capture much of the variation in bond yields.[12] For equities, we follow GKK and include the overall dividend yield on the equity market as well as yields on Principal Components (PCs) for equity anomaly portfolios.

We use $r_t = [\{r_{\pi,t}^{(Dur)}\},\ \{r_{b,t}^{(Dur)}\},\ r_{e,t},\ \{r_{e,t}^{(Anom)}\}]'$, where $\{r_{\pi,t}^{(Dur)}\}$ and $\{r_{b,t}^{(Dur)}\}$ contain log returns on a set of real and nominal bond portfolios that vary in duration and $\{r_{e,t}^{(Anom)}\}$ contains log returns on long and short anomaly portfolios. The logic of choosing portfolios with different bond duration is that they are deferentially exposed to yield shocks, and thus reasonably span the space of mimicking portfolios for s_t (satisfying the identifying condition (2)). For equities, we include anomaly portfolios to keep our specification as close as possible to the one in GKK.

We set $[\widetilde{\Delta\pi}_t\,;\ \widetilde{xr}_t^*]= [\widetilde{xr}_{\pi,t}^{(Level)},\ \widetilde{xr}_{\pi,t}^{(Slope)},\ \widetilde{xr}_{b,t}^{(Level)},\ \widetilde{xr}_{b,t}^{(Slope)},\ \widetilde{xr}_{e,t},\ \widetilde{xr}_{e,t}^{(PC1)},\ \widetilde{xr}_{e,t}^{(PC2)},\ \widetilde{xr}_{e,t}^{(PC3)}]'$, where $\widetilde{xr}_{\pi,t}^{(Level)} = \widetilde{xr}_{\pi,t}^{(1)} = \widetilde{\Delta\pi}_t$.[13] As such, real and nominal bonds each have a "level" and a "slope" factor while equities have an overall equity market factor as well as principal components to price anomaly portfolios (as in GKK). All these factors are linear combinations of the returns in r_t, satisfying the technical condition that $[\widetilde{\Delta\pi}_t\,;\ \widetilde{xr}_t^*] = \Omega[\widetilde{xr}_t,\ \widetilde{s}_t]'$.

While the choices we make for the state variables, returns, and factors associated with equities are consistent with GKK, an alternative approach would be to make choices analogous to the ones we make for real and nominal bonds. Internet Appendix D.3 provides results in

[12]Internet Appendix D.4 considers a specification with three nominal yields and three real yields in the state vector. The results are similar to the ones we report in the main text.

[13]Note that $r_{\pi,t}^{(1)} = \Delta\pi_t + y_{\pi,t-1}^{(1)}$ so that 1-year inflation shocks are equivalent to shocks to annual excess returns on a 1-year real bond (i.e., $\widetilde{xr}_{\pi,t}^{(1)} = \widetilde{\Delta\pi}_t$).

line with this logic. Specifically, we replace $[y_{e,t}^{(PC1)}, y_{e,t}^{(PC2)}, y_{e,t}^{(PC3)}]$ with $y_{e,t}^{(Slope)}$ in the state vector, $\{r_{e,t}^{(Anom)}\}$ with $\{r_{e,t}^{(Dur)}\}$ in r_t, and $[\widetilde{xr}_{e,t}^{(PC1)}, \widetilde{xr}_{e,t}^{(PC2)}, \widetilde{xr}_{e,t}^{(PC3)}]$ with $\widetilde{xr}_{e,t}^{(Slope)}$ in $\widetilde{xr}_t^*$. Then, we obtain $y_{e,t}^{(Slope)}$, $\{r_{e,t}^{(Dur)}\}$, and $\widetilde{xr}_{e,t}^{(Slope)}$ from portfolios sorted on the equity duration measure of Gonçalves (2021b). That analysis leads to results that are similar to the ones we report in the main text (see Internet Appendix D.3 for the details).

3.2 Data Sources and Measurement

We rely on a multivariate time series of overlapping monthly observations in which yields are in annual units and measured at the end of each month whereas flow variables (i.e., returns and inflation rate) have annual measurement (i.e., t and $t-1$ have a one year gap). The dataset covers from 01-1972 to 12-2022, with the initial date constrained by the availability of information on some equity signals as well as on the real and nominal bond yields we use. This section provides only a brief overview of the measurement and data sources, with all details provided in Internet Appendix C.

In terms of nominal bonds, we obtain external bond yields, $\{\widehat{y}_{b,t}^{(h)}\}_{h=1}^{h=15}$, from the interpolated bond yield dataset of Liu and Wu (2021), and use $y_{b,t}^{(Level)} = y_{b,t}^{(1)} = \widehat{y}_{b,t}^{(1)}$ and $y_{b,t}^{(Slope)} = \widehat{y}_{b,t}^{(15)} - \widehat{y}_{b,t}^{(1)}$.[14] Moreover, we construct $\{r_{b,t}^{(Dur)}\} \subset r_t$ using the seven CRSP Fama bond portfolios (labeled $r_{b,t}^{(H1\text{to}H2)}$), which reflect Treasury bond portfolios with bond maturities between $H1$ and $H2$ years (the shortest duration portfolio has $H1 = 0$ and $H2 = 1$ and the longest duration portfolio has $H1 = 10$ and $H2 = 30$). We then set $\widetilde{xr}_{b,t}^{(Level)} = \widetilde{xr}_{b,t}^{(5\text{to}10)}$ and $\widetilde{xr}_{b,t}^{(Slope)} = \widetilde{xr}_{b,t}^{(10\text{to}30)} - \widetilde{xr}_{b,t}^{(0\text{to}1)}$.[15]

For real bonds, we obtain external bond yields, $\{\widehat{y}_{\pi,t}^{(h)}\}_{h=1}^{h=10}$, by combining the no-arbitrage

[14] The preliminary analysis of Section 1 also requires $\{\widehat{y}_{b,t}^{(h)}\}_{h=16}^{h=30}$. For these yields, we also use the Liu and Wu (2021) dataset, with linear interpolation applied for yields not available in a given month. The linear interpolation is done between the longest maturity yield available in the Liu and Wu (2021) dataset in the given month and the GS30 series from the Federal Reserve Economic Data (FRED), which reflects a 30-year nominal bond yield.

[15] Internet Appendix D provides two robustness checks on the empirical decisions related to nominal bonds. The first (in Internet Appendix D.5) uses the interpolated bond yield dataset of Gürkaynak, Sack, and Wright (2007) (instead of the one from Liu and Wu (2021)). The second (in Internet Appendix D.6) uses bond returns directly implied by the yields (instead of relying on the CRSP Fama portfolios). In both cases, the results are similar to the ones we report in the main text.

bond yields of Chernov and Mueller (2012) with the interpolated bond yields of Gürkaynak, Sack, and Wright (2010), and use $y_{\pi,t}^{(Level)} = \widehat{y}_{\pi,t}^{(1)}$ and $y_{\pi,t}^{(Slope)} = \widehat{y}_{\pi,t}^{(10)} - \widehat{y}_{\pi,t}^{(1)}$. Moreover, we construct $\{r_{\pi,t}^{(Dur)}\} \subset r_t$ using $\widehat{r}_{\pi,t}^{(h)} = \Delta\pi_t + h \cdot \widehat{y}_{\pi,t-1}^{(h)} - (h-1) \cdot \widehat{y}_{\pi,t}^{(h-1)}$ for $h = 1, 2, ..., 10$. These $\widehat{r}_{\pi,t}^{(h)}$ returns are not tradable, and thus we use them in the estimation in a way that is robust to this fact (see Internet Appendix B for details). However, our approach limits our ability to extract information about the inflation risk premia dynamics from these $\widehat{r}_{\pi,t}^{(h)}$ returns. So, we add to $\{r_{\pi,t}^{(Dur)}\}$ log returns on gold obtained from Bloomberg ($r_{Gold,t}$) since gold is often viewed by market participants a hedge for shocks to expected inflation. In turn, we set $\widetilde{xr}_{\pi,t}^{(Level)} = \widetilde{xr}_{\pi,t}^{(1)} = \widetilde{\Delta\pi}_t$ and $\widetilde{xr}_{\pi,t}^{(Slope)} = \widetilde{xr}_{Gold,t} - \widetilde{xr}_{\pi,t}^{(1)} = \widetilde{xr}_{Gold,t} - \widetilde{\Delta\pi}_t$, which ensures the $\widehat{r}_{\pi,t}^{(h)}$ artificial returns are not used as priced factors in the SDF.[16]

For equities, we measure the aggregate annual return, $r_{e,t}$, and the aggregate annual dividend yield, $y_{e,t}$, exactly as in Gonçalves (2021b). We also have $[y_{e,t}^{(PC1)},\ y_{e,t}^{(PC2)},\ y_{e,t}^{(PC3)}] \subset s_t$, $\{r_{e,t}^{(Anom)}\} \subset r_t$, and $[\widetilde{xr}_{e,t}^{(PC1)}, \widetilde{xr}_{e,t}^{(PC2)}, \widetilde{xr}_{e,t}^{(PC3)}] \subset \widetilde{xr}_t^*$. Following GKK, $\{r_{e,t}^{(Anom)}\}$ contains long and short value-weighted tercile portfolios associated with 51 anomaly signals (so 102 portfolios in total). Following the exact methodology of GKK, we construct principal component weights and apply those weights to stock-level returns and yields, which gives us $[y_{e,t}^{(PC1)},\ y_{e,t}^{(PC2)},\ y_{e,t}^{(PC3)}]$ and $[xr_{e,t}^{(PC1)}, xr_{e,t}^{(PC2)}, xr_{e,t}^{(PC3)}]$.

3.3 VAR and SDF Estimation

We estimate our no arbitrage term structure model relying on an adaptation of the regression-based method proposed by Adrian, Crump, and Moench (2013) to our particular empirical analysis. The procedure is based on three simple steps, which provide consistent estimates (for π, Π, Σ, λ, and Λ) while imposing the no arbitrage restrictions in Equations 12 and 13. First, we estimate the VAR system through equation by equation OLS, which yields consistent estimates of π, Π, and Σ that do not impose the non-arbitrage restrictions. Second, we use

[16]Internet Appendix D.9 considers a specification that entirely removes information on real bonds from the analysis. This specification leads to results that are similar to the ones we report in the main text, except that we cannot separately identify the effect of term and inflation RP implicit in the bond RP. So, the results from this alternative specification are based on the decomposition in Equation 3 instead of Equation 35.

the resulting Σ estimate in a restricted least squares estimation of λ and Λ that imposes the non-arbitrage restrictions (from Equations 10 and 11). Third, we combine the resulting λ and Λ estimates with the restrictions in Equations 12 and 13 to update our π and Π estimates so that they satisfy the non-arbitrage restrictions, which in turn allows us to also update Σ. Further estimation details are provided in Internet Appendix B.

Table 1 reports the VAR coefficients (in standard deviation units) as well as their t-stats (in parentheses) and each predictive regression R^2.[17] To conserve space, we focus on the state variables, s_t, and risk factors, xr_t^*, omitting the results for the full vector of test assets, xr_t. Panel A reports the 1st step estimates (i.e., the VAR OLS estimates) while Panel B focuses on our final estimates (i.e., the 3-step estimates that impose the no arbitrage restrictions). Each state variable in s_t is a significant predictor of at least one other state variable in s_t or one risk factor in xr_t^*. The Panels A and B estimates are identical for s_t (by construction) and relatively similar for xr_t^*, which indicates the model's no arbitrage conditions are not overly restrictive in our estimation process.

Table 2 shows the correlation matrix of the shocks in s_t and xr_t^*. The most important observation from this table is that the correlations between the state variable shocks tend to be moderate so that each state variable displays substantial independent variable. A similar observation holds for the risk factors.

Table 3 provides the estimated λ_t coefficients (in standard deviation units), which summarize the risk prices. The average risk prices are statistically significant for all risk factors. The only exceptions are the risk prices on xr_i^{Level} and xr_e^{PC3}, but time variation in these risk prices is significantly connected to our state variables, indicating that xr_i^{Level} and xr_e^{PC3} are still important for capturing conditional risk premia. More broadly, each risk price displays statistically significant connection to time variation in multiple state variables. These results suggest that all risk factors we use are relevant to properly capture the risk premia dynamics

[17] Specifically, the VAR coefficient capturing the effect of x on y, $\pi_{y,x}$, is normalized to $(\sigma_x/\sigma_y) \cdot \pi_{y,x}$. With this normalization, an estimate of 0.10 means that a one standard deviation movement in the x variable today predicts a 0.10 standard deviation movement in the y variable in one year. In the case of xr^*, we treat the VAR-implied $\mathbb{E}_t[xr^*]$ as the y variable for the normalization.

in our analysis.

4 Validation of the No Arbitrage Term Structure Model

Before presenting the results from our decomposition of the term structure of equity premia, this sections provides a brief validation of our no arbitrage model. Subsection 4.1 demonstrates that our no arbitrage model captures (unconditional and conditional) risk premia on the test assets and risk factors studied and Subsection 4.2 shows that the model also captures dynamics of yields on bond and dividend strips obtained from external data sources.

4.1 Model Fit to Risk Premia of Test Assets and Risk Factors

Figure 3 provides scatter plots with x and y axes reflecting the risk premia on the test assets (i.e., average $\mathbb{E}_t[xR_j] \equiv \mathbb{E}_t[xr_j] + 0.5 \cdot \sigma_j^2$ values). The x-axes obtain $\mathbb{E}_t[xR_j]$ under the model (i.e., the VAR estimated under no arbitrage restrictions) while the y-axes obtain $\mathbb{E}_t[xR_j]$ under the data (i.e., the unrestricted VAR estimated by OLS, which has an average $\mathbb{E}_t[xr_j]$ that matches the average xr_j value). For equities, we show the results for the risk factors as the PCs properly summarize the excess returns on all anomaly strategies considered.[18] Figure 3(a) shows that the average risk premia in the data are well captured by the model. Figures 3(b), 3(c), and 3(d) consider risk premia conditioned on different levels of $\mathbb{V}ar_t[m]$, which captures the overall level of risk premia in the model. Overall, the model captures not only the average risk premia, but also conditional risk premia.

Figure 4 compares the time variation in the factor risk premia under the data (i.e., unrestricted VAR) and model (i.e., VAR under no arbitrage restrictions). Clearly, the model fits well the factor risk premia time variation. We also add the risk premia on a curvature bond factor (which is not a risk factor under the model) to show that the model fit is also very good there.

[18]Letting $w^{(PCk)}$ represent the weights of PCk on all returns, note that $\sigma^2_{PCk} = \sum_j w_j^{(PCk)} \cdot \mathbb{V}ar[xr_j]$ and not $\sigma^2_{PCk} = \mathbb{V}ar[xr_e^{(PCk)}]$. The economic reason is that $xr_{e,t}^{(PCk)}$ is not the log excess return on a tradable portfolio. Instead, it is the weighted average of the log excess returns on the tradable portfolios in $\{r_{e,t}^{(Anom)}\}$.

4.2 Model Fit to Yields of Bond and Dividend Strips

Since the model is estimated to fit the risk premia dynamics of test assets that are closely connected to the risk factors in the model (by design), it is perhaps not surprising that the model provides a good fit to the risk premia on the test assets and risk factors considered. A more relevant question for the purpose of our analysis is whether the model generates reasonable dynamics for the yields on bonds and dividend strips since these are directly used in our decomposition for the term structure of equity risk premia, and we do not directly target the dynamics of these yields in our estimation process (except for $y_{b,t}^{(1)}$, which the model replicates by construction). Figure 5 provides the time-series of bond and equity yields in the model as compared to alternative series obtained directly from data external to the model.

Figures 5(a), 5(d), and 5(g) plot the dynamics of real bond yields, $y_{\pi}^{(h)}$. As discussed in Section 3.2, the "external data" version of these yields comes from a combination of a flexible no arbitrage model in the literature (from Chernov and Mueller (2012)) and interpolated TIPS yields (from Gürkaynak, Sack, and Wright (2010)). Our model produces real bond yields with dynamics that are remarkably similar to the dynamics of these external yields. In particular, the 1-year real yield displays cycles over the sample period, ending at a real interest rate level that is similar to the initial real interest rate in the sample. Moreover, the real interest rate is negative for most of the 2010s.

Figures 5(b), 5(e), and 5(h) plot the dynamics of nominal bond yields, $y_b^{(h)}$. As discussed in Section 3.2, the "external data" version of these yields come from the interpolated bond yields of Liu and Wu (2021) (with Internet Appendix D.5 providing a robustness analysis using nominal bond yields from Gürkaynak, Sack, and Wright (2007)). Figures 5(b) shows that the model perfectly matches the 1-year bond yield dynamics (by design). The nominal interest rate does not display a simple secular decline over our sample period. It displays long periods of interest rate increases (e.g., from the 1970s to the early 1980s) and long periods of interest rate declines (e.g., from the 1980s to the early 2000s), with many cycles within these periods. Moreover, it ends at an interest rate level that is roughly the same as (and even slightly higher than) the initial interest rate level. There is an asymmetry in the speed of interest rate increases versus declines, but this aspect does not induce a non-stationarity in the nominal interest rate that would undermine our VAR estimation. Figures 5(e) and 5(h) show that the model also matches long-term bond yield dynamics remarkably well despite not directly targeting them.

Figures 5(c), 5(f), and 5(i) plot the dynamics of equity yields, $y_e^{(h)}$. The "external data" version of these yields come from GKK. The overall dynamics between our model and GKK are very similar over long periods. However, they do deviate at short periods. These deviations are mainly due to the fact that, as detailed in Internet Appendix C.3, we rely on the same dividend measurement as Gonçalves (2021b), which accounts for M&A paid in cash. Incorporating M&A paid in cash helps in making $y_{e,t}$ more stationary and is the right way to account for aggregate dividends paid to shareholders, as highlighted in Allen and Michaely (2003) and Sabbatucci (2022). However, Internet Appendix D.2 shows that our equity term structure decomposition results are similar if we instead use a D_t measure that accounts only for ordinary dividends.

5 Results from the No Arbitrage Term Structure Model

This section presents the main empirical results from our decomposition of the equity term structure through the lens of our no arbitrage term structure model. Subsection 5.1 focuses on the average equity risk premia term structure, Subsection 5.1 considers time variation in the equity premia term structure, and Subsection 5.1 explores the implications for the excess volatility puzzle.

5.1 The Average Equity Risk Premia Term Structure

Our empirical analysis is based the following equity RP decomposition:[19]

$$\underbrace{\mathbb{E}_t[R_e^{(h)} - R_\pi^{(1)}]}_{\text{Equity RP}} = \underbrace{\mathbb{E}_t[R_\pi^{(h)} - R_\pi^{(1)}]}_{\text{Term RP}} + \underbrace{\mathbb{E}_t[R_b^{(h)} - R_\pi^{(h)}]}_{\text{Inflation RP}} + \underbrace{\mathbb{E}_t[R_e^{(h)} - R_b^{(h)}]}_{\text{Cash Flow RP}} \tag{35}$$

Equation 35 generalizes the decomposition in our preliminary analysis of Section 1 (from Equation 3). The key improvements are that (i) all terms are measured consistently through a no arbitrage framework and (ii) it allows us to separately identify the effects of the term and inflation RP implicitly present in the bond RP of Equation 3. A more nuanced difference is that Equation 35 defines the equity RP using $\mathbb{E}[R_e^{(h)} - R_\pi^{(1)}]$ instead of $\mathbb{E}[R_e^{(h)} - R_b^{(1)}]$, which facilitates the exposition.[20]

Figure 6 shows the average model-implied equity RP and their respective term, inflation, and cash flow RP components (from Equation 35).[21] The black solid line shows that equity RP increase in dividend strip maturity. The other three lines show that this effect is not uniform across the three equity RP components. Specifically, cash flow RP increase over short maturities of up to around 5 years and then start to decrease, getting close to 0% at a 30-year maturity. In contrast, the term and inflation risk premia are strongly increasing in maturity, and thus drive the increasing pattern of equity risk premia over long maturities.

The hump-shaped term structure of cash flow RP in Figure 6 can be seen as an extension of the Binsbergen (2025) result that the equity premium is close to zero or even negative

[19]The cash flow RP terminology comes from Ang and Ulrich (2012), who explore a decomposition similar to the one in Equation 35. However, their decomposition applies to different return horizons for the aggregate equity index (instead of different dividend strip maturities) since their objective is to identify the macro determinants of equity premia variation at different investment horizons.

[20]An alternative to Equation 35 would be the decomposition

$$\underbrace{\mathbb{E}[R_e^{(h)} - R_b^{(1)}]}_{\text{Equity RP}} = \underbrace{\mathbb{E}[R_\pi^{(h)} - R_\pi^{(1)}]}_{\text{Term RP}} + \underbrace{\mathbb{E}[(R_b^{(h)} - R_b^{(1)}) - (R_\pi^{(h)} - R_\pi^{(1)})]}_{\text{Inflation RP}} + \underbrace{\mathbb{E}[R_e^{(h)} - R_b^{(h)}]}_{\text{Cash Flow RP}}$$

which is a better analogue to Equation 3. Since $\mathbb{E}[R_b^{(1)} - R_\pi^{(1)}]$ is small on average and has little variability over time, the two decompositions yield very similar results. As such, we focus on Equation 35, which facilitates the exposition as it has a simpler expression for the inflation RP.

[21]Averaging realized risk premia (using Equations 18, 25, and 31) instead of the conditional risk premia (from Equations 19, 26, and 32) leads to results that are almost identical to the ones presented in Figure 6.

over the past five decades when it is measured as average equity returns in excess of a duration-matched Treasury bond portfolio, $\mathbb{E}[R_e - R_b^{(eDur)}]$. In particular, Figure 6 extends this unconditional result to the entire equity term structure, showing that the average risk premia of dividend strips are almost entirely driven by the cash flow RP component for short maturity contracts and almost entirely driven by the bond RP components for long maturity contracts.

While the hump-shaped of the average term structure of cash flow RP may seem surprising, it is entirely consistent with early results from the equity term structure literature. Specifically, Binsbergen and Koijen (2017) demonstrate that

$$\underbrace{\mathbb{E}_t[R_e - R_b^{(eDur)}]}_{\text{Duration-Matched Equity RP}} = \sum_{h=1}^{\infty} w_{e,t}^{(h)} \cdot \underbrace{\mathbb{E}_t[R_e^{(h)} - R_b^{(h)}]}_{\text{Cash Flow RP}} \approx \sum_{h=1}^{\infty} w_{e,t}^{(h)} \cdot \underbrace{\mathbb{E}_t[fR_e^{(h)}]}_{\text{Dividend Future RP}} \quad (36)$$

and then find that, from 2002 to 2014, the average $fR_e^{(h)}$ for maturities from one to five years tend to (i) increase with maturity and (ii) be higher than the average $R_e - R_b^{(eDur)}$. Considering that the h-year dividend future RP is approximately the same as the h-year dividend future expected return (up to a Jensen's inequality adjustment, see Footnote 4), these results point to a potential hump-shape in the the term structure of cash flow risk premia, which is exactly what our Figure 6 confirms in a more formal way.

5.2 The Time Variation in the Equity Risk Premia Term Structure

Figure 7 plots (demeaned) equity RP over time for three maturities ($h = 1, 10, 30$ years) together with their components, which are the term, inflation, and cash flow RP from Equation 35. At the 1-year maturity, equity and cash flow RP track each other almost perfectly, with a 0.96 correlation. In contrast, the term RP is constant (by design) and the inflation RP has little volatility and a moderately weak correlation with the equity RP. As we look at an intermediate maturity of 10-years, the correlation between the equity and cash flow RP declines to 0.71 and we see more volatility in the term and inflation RP, both of which display a moderately weak correlation with the equity RP that increases quite drastically over some periods. For instance, while the overall correlation between the 10-year equity and inflation RP is only 0.15, the two series track each other very well in the late 1970s and during the 1980s, with the inflation RP becoming much less volatile starting in the 1990s. For a long maturity of 30-years, the equity and cash flow RP display a very weak 0.05 correlation, with periods in which they move in the same direction and periods in which they move in opposite directions. In contrast, the 30-year term and inflation RP display substantial volatility and track the equity RP well, both displaying a 0.58 correlation with the equity RP.

Figure 8 formalizes some of these time-series patterns through the decomposition

$$1 \;=\; \theta^{(h)}_{\text{Term}} \;+\; \theta^{(h)}_{\text{Inflation}} \;+\; \theta^{(h)}_{\text{Cash Flow}} \tag{37}$$

where $\theta^{(h)}_{\text{Cash Flow}} = \frac{\mathbb{C}ov\left(\mathbb{E}_t[R^{(h)}_e - R^{(1)}_\pi]\,,\,\mathbb{E}_t[R^{(h)}_e - R^{(h)}_b]\right)}{\mathbb{V}ar\left(\mathbb{E}_t[R^{(h)}_e - R^{(1)}_\pi]\right)}$ is the fraction of the h-year equity RP variability explained by the h-year cash flow RP, with analogous definitions for $\theta^{(h)}_{\text{Term}}$ and $\theta^{(h)}_{\text{Inflation}}$.

Figure 8(a) shows that variation in short-maturity equity RP is almost entirely driven by cash flow RP whereas term and inflation RP play the dominant role for long-maturity equity RP variation. In principle, we could have a different pattern for persistent versus transitory variation in equity RP. However, Figure 8(b) shows that this is not the case. Specifically, that figure considers a decomposition analogous to Equation 37 but that defines the θ terms using annual changes in risk premia. The variance decomposition results are qualitatively similar to the ones observed in Figure 8(a). That is, cash flow RP dominate for short maturity strips while term and inflation RP dominate for long maturity strips.

Similar to the discussion in Section 1, we have

$$\theta^{(h)}_{\text{Cash Flow}} \;=\; \mathbb{C}or\left(\mathbb{E}_t[R^{(h)}_e - R^{(1)}_\pi]\,,\,\mathbb{E}_t[R^{(h)}_e - R^{(h)}_b]\right) \cdot \frac{\sigma\left(\mathbb{E}_t[R^{(h)}_e - R^{(h)}_b]\right)}{\sigma\left(\mathbb{E}_t[R^{(h)}_e - R^{(1)}_\pi]\right)}, \tag{38}$$

and likewise for $\theta^{(h)}_{\text{Term}}$ and $\theta^{(h)}_{\text{Inflation}}$. As such, the θ patterns in Figure 8 can be due to the term structures of correlations with the equity RP or the term structures of volatilities for the different equity RP components. Figure 9 shows that, as in our preliminary analysis, both channels are important given their complementarity on the total θ effects (since Equation

38 is multiplicative). In particular, the correlation between equity RP and cash flow RP is close to one for the 1-year dividend strip and close to zero for the 30-year dividend strip. The opposite pattern is observed for term and inflation RP, which have correlations with equity RP that are close to zero at the 1-year maturity and above 0.50 at a 30-year maturity. Similar patterns are observed for annual changes in RP, but the quantitative effects are less pronounced (albeit they remain large). These findings highlight that the common component of the equity and bond risk premia (through term and inflation RP) is an important driver of time variation in the overall equity premium (which mainly reflects the RP of long-maturity dividend strips).

5.3 Time Variation in Equity Yields and the Excess Volatility Puzzle

The results from the prior subsection highlight that equity RP variation is mainly driven by term and inflation RP variation. We now show that this result has important implications for research attempting to explain the excess volatility puzzle of Shiller (1981).

In modern asset pricing terminology, the excess volatility puzzle in equities refers to the fact that a substantial fraction of the variation in the aggregate dividend yield (which mainly reflects aggregate equity price variation) is driven by discount rate movements. We can see this puzzle from equity yields as well. Specifically, Equation 34 can be written as

$$y_{e,t}^{(h)} = \underbrace{(dr_{e,t}^{(h)} - g_{\pi,t}^{(h)})}_{\text{Equity Real Discount Rate}} - \underbrace{(g_{e,t}^{(h)} - g_{\pi,t}^{(h)})}_{\text{Expected Real Dividend Growth}} \tag{39}$$

which implies the equity yield variance decomposition

$$1 = \varphi_{dr}^{(h)} + \varphi_{g}^{(h)} \tag{40}$$

where $\varphi_{dr}^{(h)} = \frac{\mathbb{C}ov\left((dr_{e,t}^{(h)} - g_{\pi,t}^{(h)}), y_{e,t}^{(h)}\right)}{\mathbb{V}ar\left(y_{e,t}^{(h)}\right)}$ and $\varphi_{g}^{(h)} = \frac{\mathbb{C}ov\left(-(g_{e,t}^{(h)} - g_{\pi,t}^{(h)}), y_{e,t}^{(h)}\right)}{\mathbb{V}ar\left(y_{e,t}^{(h)}\right)}$ are the fractions of the h-year equity yield variability explained by the h-year equity real discount rate and expected real dividend growth, respectively.

Figure 10(a) reports the term structure of decompositions from Equation 40. The discount rate effect is around 20% for a 1-year dividend strip but increases over dividend strip maturities, reaching close to 50% for a 30-year dividend strip. Since the equity index has a duration that is higher than 30 years empirically (see, e.g., Gonçalves (2023)), a substantial fraction of the equity index dividend yield variability comes from discount rate movements. This is exactly the excess volatility puzzle in equities.

The fact that $\varphi_{dr}^{(h)}$ increases with h is consistent with prior findings in the equity term structure literature (e.g., Binsbergen et al. (2013) and Golez and Koudijs (2025)). Moreover, it indicates the excess volatility puzzle is quantitatively much stronger for long maturity dividend strips. To shed further light on the economic mechanism for the excess volatility puzzle, we decompose the equity real discount rate component of Equation 39 in a way analogous to what we did for the equity RP in Equation 35:[22]

$$\underbrace{(dr_{e,t}^{(h)} - g_{\pi,t}^{(h)})}_{\text{Equity Real Discount Rate}} = \underbrace{(dr_{\pi,t}^{(h)} - g_{\pi,t}^{(h)})}_{\text{Term RP Component}} + \underbrace{(dr_{b,t}^{(h)} - dr_{\pi,t}^{(h)})}_{\text{Inflation RP Component}} + \underbrace{(dr_{e,t}^{(h)} - dr_{b,t}^{(h)})}_{\text{Cash Flow RP Component}} \tag{41}$$

which implies

$$1 = \varphi_{\text{Term}}^{(h)} + \varphi_{\text{Inflation}}^{(h)} + \varphi_{\text{Cash Flow}}^{(h)} + \varphi_{g}^{(h)} \tag{42}$$

where $\varphi_{\text{Cash Flow}}^{(h)} = \frac{\mathbb{C}ov\left((dr_{e,t}^{(h)} - dr_{b,t}^{(h)}), y_{e,t}^{(h)}\right)}{\mathbb{V}ar\left(y_{e,t}^{(h)}\right)}$ is the fraction of the h-year equity yield variability explained by the h-year cash flow RP component, with analogous definitions for $\varphi_{\text{Term}}^{(h)}$ and $\varphi_{\text{Inflation}}^{(h)}$.

Figure 10(b) reports the term structure of decompositions from Equation 42. The key result is that the term and inflation RP components are the main drivers of the excess volatility puzzle. So, economic explanations for the excess volatility puzzle that hinge on the cash flow RP component of the equity RP are inconsistent with the data. Only economic

[22] Technically, the term RP component in Equation 41 also includes a real interest rate component since

$$(dr_{\pi,t}^{(h)} - g_{\pi,t}^{(h)}) = (dr_{\pi,t}^{(h)} - ir_{\pi,t}^{(h)}) + (ir_{\pi,t}^{(h)} - g_{\pi,t}^{(h)})$$

where $ir_{\pi,t}^{(h)} = \frac{1}{h} \cdot \sum_{\tau=1}^{h} \mathbb{E}_t[r_{\pi,t+\tau}^{(1)}]$. However, the $dr_{\pi,t}^{(h)} - g_{\pi,t}^{(h)}$ dynamics are almost completely driven by $dr_{\pi,t}^{(h)} - ir_{\pi,t}^{(h)}$ (because $ir_{\pi,t}^{(h)} - g_{\pi,t}^{(h)}$ displays relatively little variation over time), so we simplify the exposition by keeping only the combined term in our decomposition instead of treating the real term RP and real interest rate components separately.

mechanisms that affect the equity RP through the term and inflation RP components can provide an empirically plausible explanation for the excess volatility puzzle.

The results from Figure 10(b) impose non-trivial restrictions on possible explanations for the excess volatility puzzle in equities. For instance, the habit model of Campbell and Cochrane (1999) is traditionally viewed as providing a reasonable explanation for this excess volatility puzzle (even if it may fail on other asset pricing dimensions). Our evidence contradicts this view. The reason is that the model embeds no inflation RP (because inflation is artificially zero in the model). Of course, subsequent literature has added inflation to the habit model in order to explain the term structure of interest rates (e.g., Wachter (2006)). However, our point is that, to be consistent with the evidence, the model should not be able to produce even the equity excess volatility puzzle in the absence of inflation dynamics.

We pick the habit model as an example in our discussion because this model was introduced precisely to explain the excess volatility puzzle in equities. However, our evidence provides restrictions for any model that proposes an explanation for the time-varying equity premium (and thus for the excess volatility puzzle in equities). Perhaps most strikingly, our results suggest that no model can credibly explain the excess volatility puzzle in the absence of reasonable inflation dynamics (and also real term premium dynamics). While, traditionally, equity and bond dimensions of asset pricing have been tackled separately, our findings indicate that we need to tackle them jointly (as, e.g., in Koijen, Lustig, and Nieuwerburgh (2017)) even when the goal is to explain only the equity risk premium dynamics.

6 Conclusion

In this paper, we develop and estimate a unified, no arbitrage term structure model that jointly prices nominal bonds, real bonds, and dividend strips from 1972 to 2022. Building on the Giglio, Kelly, and Kozak (2024) framework, we introduce state variables capturing both nominal and real bond yield factors, allowing us to decompose the term structure of equity risk premia into three economically meaningful components: term risk premia, inflation risk premia, and pure cash-flow risk premia (i.e., dividend strip expected returns in excess of maturity-matched nominal bond strips). Our key findings are twofold. First, while term and inflation risk premia rise monotonically with maturity, cash-flow risk premia exhibit a hump-shaped profile—peaking at intermediate maturities and falling at long maturities. Second, short-maturity equity premia variation is driven almost entirely by cash-flow risk premia, whereas long-maturity equity premia variation is dominated by bond-based (term and inflation) risk premia. These results imply that credible explanations for the equity excess volatility puzzle must operate through bond risk premia dynamics

Our approach addresses three limitations of a simpler analysis we provide that directly uses bond and equity yields available in the literature: (i) it spans a long sample period with bond yields that are at similar levels in the beginning and end of the sample, (ii) it imposes internal consistency by pricing bonds and dividend claims within one SDF, and (iii) it disentangles inflation and real term premia. Compared with the unconditional insights of Binsbergen (2025), our framework extends the analysis to the full term structure, showing that the average equity premium at short maturities is almost entirely driven by cash flow risk premia, whereas at long maturities it is nearly all a bond risk premium phenomenon.

These findings have broad implications. First, they shed light on how different risk premia components drive expected returns at varying cash flow maturities. This aspect is of central importance to academics, who seek to understand the drivers of risk premia, and practitioners, who assess horizon-specific risks when allocating capital across asset classes. Second, they underscore the need to integrate bond market dynamics (through inflation and term risk premia) into models of the equity risk premium and suggest that any successful theory of the equity excess volatility puzzle must also explain the tight connection between equity and bond risk premia at long cash flow maturities. Future work should tie the joint equity and bond risk premia dynamics to macro-financial risks or to variation in sentiment jointly affecting the equity and bond markets.

References

Adrian, T., R. K. Crump, and E. Moench (2013). "Pricing the term structure with linear regressions". In: *Journal of Financial Economics* 110.1, pp. 110–138.

Allen, F. and R. Michaely (2003). "Payout Policy". In: *Handbook of the Economics of Finance.* Ed. by G. M. Constantinides, M. Harris, and R. M. Stulz. Vol. 1. A. Elsevier Science. Chap. 7, pp. 337–429.

Ang, A. and M. Ulrich (2012). "Nominal Bonds, Real Bonds, and Equity". Working Paper.

Backus, D., N. Boyarchenko, and M. Chernov (2018). "Term structures of asset prices and returns". In: *Journal of Financial Economics* 129, pp. 1–23.

Baele, L., G. Bekaert, and K. Inghelbrecht (2010). "The Determinants of Stock and Bond Return Comovements". In: *Review of Financial Studies* 23.6, pp. 2374–2428.

Bansal, R., S. Miller, D. Song, and A. Yaron (2021). "The Term Structure of Equity Risk Premia". In: *Journal of Financial Economics* 142.3, pp. 1209–1228.

Belo, F., P. Collin-Dufresne, and R. S. Goldstein (2015). "Dividend Dynamics and the Term Structure of Dividend Strips". In: *Journal of Finance* 70.3, pp. 1115–1160.

Binsbergen, J. H. v. (2025). "Duration-Based Stock Valuation: Reassessing Stock Market Performance and Volatility". In: *Journal of Financial Economics* Forthcoming.

Binsbergen, J. H. v., M. W. Brandt, and R. S. J. Koijen (2012). "On the Timing and Pricing of Dividends". In: *American Economic Review* 102.4, pp. 1596–1618.

Binsbergen, J. H. v., W. Hueskes, R. S. J. Koijen, and E. Vrugt (2013). "Equity Yields". In: *Journal of Financial Economics* 110, pp. 503–519.

Binsbergen, J. H. v. and R. S. J. Koijen (2017). "The Term Structure of Returns: Facts and Theory". In: *Journal of Financial Economics* 124, pp. 1–21.

Binsbergen, J. H. v. and L. Ma (2025). "The Factor Multiverse: The Role of Interest Rates in Factor Return Measurement". Working Paper.

Boguth, O., M. Carlson, A. Fisher, and M. Simutin (2023). "The TermStructure of Equity Risk Premia: Levered Noise and NewEstimates". In: *Review of Finance* 27.4, pp. 1155–1182.

Campbell, J. Y. and J. Ammer (1993). "What Moves the Stock and Bond Markets? A Variance Decomposition for Long-Term Asset Returns". In: *Journal of Finance* 48.1, pp. 3–37.

Campbell, J. Y. and J. H. Cochrane (1999). "By force of habit: A consumption-based explanation of aggregate stock market behavior". In: *Journal of Political Economy* 107.2, pp. 205–251.

Campbell, J. Y., C. Pflueger, and L. M. Viceira (2020). "Macroeconomic Drivers of Bond and Equity Risks". In: *Journal of Political Economy* 128.8, pp. 3148–3185.

Campbell, J. Y. and R. J. Shiller (1989). "The Dividend-Price Ratio and Expectations of Future Dividends and Discount Factors". In: *Review of Financial Studies* 1.3, pp. 195–228.

Cassella, S., B. Golez, H. Gulen, and P. Kelly (2023). "Horizon Bias and the Term Structure of Equity Returns". In: *Review of Financial Studies* 36.3, pp. 1253–1288.

Cejnek, G. and O. Randl (2016). "Risk and return of short-duration equity investments". In: *Journal of Empirical Finance* 36, pp. 181–198.

Cejnek, G. and O. Randl (2020). "Dividend Risk Premia". In: *Journal of Financial and Quantitative Analysis* 55.4, pp. 1199–1242.

Chabi-Yo, F., A. S. Gonçalves, and J. Loudis (2025). "An Intertemporal Risk Factor Model". In: *Management Science*. Forthcoming.

Chernov, M., L. A. Lochstoer, and D. Song (2024). "The Real Channel for Nominal Bond-Stock Puzzles". Working Paper.

Chernov, M. and P. Mueller (2012). "The Term Structure of Inflation Expectations". In: *Journal of Financial Economics* 106.2, pp. 367–394.

David, A. and P. Veronesi (2013). "What Ties Return Volatilities to Price Valuations and Fundamentals?" In: *Journal of Political Economy* 121.4, pp. 682–746.

Gao, C. and I. Martin (2021). “Volatility, Valuation Ratios, and Bubbles: An Empirical Measure of Market Sentiment”. In: *Journal of Finance* 76.6, pp. 3211–3254.

Giglio, S., B. Kelly, and S. Kozak (2024). “Equity Term Structures without Dividend Strips Data”. In: *Journal of Finance* 79.6, pp. 4143–4196.

Golez, B. and J. Jackwerth (2024). “Holding Period Effects in Dividend Strip Returns”. In: *Review of Financial Studies* 37.10, pp. 3188–3215.

Golez, B. and P. Koudijs (2025). “Equity duration and predictability”. Working Paper.

Golez, B. and B. Matthies (2025). “Fed Information Effects: Evidence from the Equity Term Structure”. In: *Journal of Financial Economics* 165.103988.

Gonçalves, A. S. (2021a). “Reinvestment Risk and the Equity Term Structure”. In: *Journal of Finance* 76.5, pp. 2153–2197.

Gonçalves, A. S. (2021b). “The Short Duration Premium”. In: *Journal of Financial Economics* 141.3, pp. 919–945.

Gonçalves, A. S. (2023). “What Moves Equity Markets? A Term Structure Decomposition for Stock Returns”. Working Paper.

Gormsen, N. J., R. S. Koijen, and I. W. Martin (2021). “Implied Dividend Volatility and Expected Growth”. In: *AEA Papers and Proceedings* 111, pp. 361–365.

Gormsen, N. J. and E. Lazarus (2023). “Duration-Driven Returns”. In: *Journal of Finance* 78.3, pp. 1393–1447.

Gormsen, N. J. (2021). “Time Variation of the Equity Term Structure”. In: *Journal of Finance* 76.4, pp. 1959–1999.

Gormsen, N. J. and R. S. J. Koijen (2020). “Coronavirus: Impact on Stock Prices and Growth Expectations”. In: *Review of Asset Pricing Studies* 10, pp. 574–597.

Gormsen, N. J. and E. Lazarus (2025). “Equity Duration and Interest Rates”. Working Paper.

Gürkaynak, R. S., B. Sack, and J. H. Wright (Nov. 2007). “The U.S. Treasury yield curve: 1961 to the present”. In: *Journal of Monetary Economics* 54.8, pp. 2291–2304.

Gürkaynak, R. S., B. Sack, and J. H. Wright (2010). “The TIPS Yield Curve and Inflation Compensation”. In: *American Economic Journal: Macroeconomics* 2.1, pp. 70–92.

Koijen, R. S. J., H. Lustig, and S. V. Nieuwerburgh (2017). "The Cross-Section and Time Series of Stock and Bond Returns". In: *Journal of Monetary Economics* 88, pp. 60–69.

Kozak, S. (2022). "Dynamics of bond and stock returns". In: *Journal of Monetary Economics* 126, pp. 188–209.

Kozak, S., S. Nagel, and S. Santosh (2018). "Interpreting Factor Models". In: *Journal of Finance* 73.3, pp. 1183–1223.

Laarits, T. (2022). "Precautionary Savings and the Stock-Bond Covariance". Working Paper.

Lettau, M. and J. A. Wachter (2007). "Why is long-horizon equity less risky? A duration-based explanation of the value premium". In: *Journal of Finance* 62.1, pp. 55–92.

Lettau, M. and J. A. Wachter (2011). "The term structures of equity and interest rates". In: *Journal of Financial Economics* 101.1, pp. 90–113.

Li, Y. and C. Wang (2018). "Rediscover Predictability: Information from the Relative Prices of Long-term and Short-term Dividends". Working Paper.

Liu, Y. and J. C. Wu (2021). "Reconstructing the Yield Curve". In: *Journal of Financial Economics* 142.3, pp. 1395–1425.

Miller, S. (2019). "The Term Structures of Equity Risk Premia in the Cross Section of Equities". Working Paper.

Miller, S. (2020). "The Temporal Structure of Risk and the CrossSection of Equity Returns". Working Paper.

Sabbatucci, R. (2022). "Are Dividends and Stock Returns Predictable? New Evidence Using M&A Cash Flows". Working Paper.

Shiller, R. J. (1981). "Do Stock Prices Move Too Much to be Justified by Subsequent Changes in Dividends?" In: *American Economic Review* 71.3, pp. 421–436.

Wachter, J. A. (2006). "A consumption-based model of the term structure of interest rates". In: *Journal of Financial Economics* 79.2, pp. 365–399.

Table 1
VAR Transition Matrix (1972-2022)

The table reports the basic results from the estimation of our no arbitrage term structure model. In particular, the table contains the VAR coefficients as well as their t-statistics (in parentheses) and each predictive regression R2. The VAR coefficients, $\pi_{y,x}$, are normalized to standard deviation units, $(\sigma_x/\sigma_y)\cdot\pi_{y,x}$, with VAR-implied $\mathbb{E}_t[xr^*]$ treated as the y variable in the normalization of the VAR coefficients for xr^*. Panel A focuses on the VAR from the first step of our estimation procedure (which is an unrestricted VAR estimated by OLS) whereas Panel B focuses on the VAR implies by our no arbitrage term structure model. Sections 2 and 3 provide further details about the term structure model and its empirical specification, with Section 3.3 discussing the results from this table.

PANEL A - 1st Step: OLS

	State Variables									Excess Returns							
s_t	$y_i^{(1)}$	$y_i^{(TS)}$	$y_b^{(1)}$	$y_b^{(TS)}$	y_e	y_e^{PC1}	y_e^{PC2}	y_e^{PC3}	$\Delta\pi$	xr_i^{Level}	xr_i^{Slope}	xr_b^{Level}	xr_b^{Slope}	xr_e^{Level}	xr_e^{PC1}	xr_e^{PC2}	xr_e^{PC3}
$y_i^{(1)}$	0.38	0.11	-0.36	0.34	-0.32	-0.59	0.41	-0.25	-1.04	-1.38	1.76	1.84	1.68	-0.37	-0.28	1.29	-0.98
	(1.93)	(0.42)	(-2.70)	(1.34)	(-1.88)	(-3.70)	(1.78)	(-1.10)	(-3.75)	(-3.75)	(2.68)	(4.30)	(3.78)	(-0.57)	(-0.29)	(2.23)	(-1.32)
$y_i^{(TS)}$	0.01	0.43	-0.10	0.08	-0.13	-0.39	0.31	-0.12	-0.36	-0.47	1.29	0.84	0.85	-0.59	0.07	0.32	-1.01
	(0.12)	(2.17)	(-1.05)	(0.40)	(-1.28)	(-3.33)	(1.81)	(-0.78)	(-1.78)	(-1.78)	(2.64)	(2.76)	(2.40)	(-1.22)	(0.12)	(0.75)	(-1.98)
$y_b^{(1)}$	0.80	-0.61	1.31	-0.59	0.70	0.97	-0.48	0.49	1.15	1.52	-1.95	-1.23	-0.88	-1.37	0.93	-1.10	1.26
	(3.83)	(-2.45)	(11.84)	(-2.85)	(3.87)	(5.83)	(-1.94)	(1.99)	(4.30)	(4.30)	(-3.32)	(-3.09)	(-2.25)	(-2.18)	(1.85)	(-2.07)	(1.68)
$y_b^{(TS)}$	0.19	-0.04	0.14	0.47	0.12	0.15	0.23	0.31	-0.07	-0.09	-1.10	0.09	0.22	0.14	0.37	-0.85	0.21
	(1.51)	(-0.28)	(1.85)	(2.79)	(1.20)	(1.75)	(2.11)	(2.45)	(-0.46)	(-0.46)	(-2.60)	(0.34)	(0.81)	(0.39)	(0.83)	(-2.56)	(0.49)
y_e	-0.14	0.05	-0.06	0.16	0.58	-0.11	-0.22	-0.43	-0.05	-0.06	0.86	0.25	0.19	0.88	-1.33	0.50	-0.92
	(-1.38)	(0.43)	(-0.77)	(1.03)	(5.18)	(-1.11)	(-1.41)	(-2.87)	(-0.27)	(-0.27)	(1.86)	(0.99)	(0.74)	(1.80)	(-2.56)	(1.51)	(-2.77)
y_e^{PC1}	-0.18	0.30	-0.15	0.35	-0.23	0.26	0.21	0.25	-0.19	-0.26	-0.61	0.37	0.13	1.13	0.84	-0.62	-0.02
	(-1.53)	(2.13)	(-1.67)	(2.01)	(-1.83)	(2.60)	(1.50)	(1.22)	(-1.46)	(-1.46)	(-1.35)	(1.16)	(0.39)	(2.83)	(1.88)	(-1.61)	(-0.06)
y_e^{PC2}	-0.07	0.06	-0.10	0.14	-0.05	-0.08	0.16	-0.18	-0.22	-0.30	0.08	0.41	0.39	0.79	-0.28	0.52	0.28
	(-0.65)	(0.42)	(-1.57)	(1.02)	(-0.71)	(-0.98)	(1.26)	(-1.35)	(-1.78)	(-1.78)	(0.18)	(1.98)	(1.91)	(2.84)	(-1.34)	(1.95)	(1.05)
y_e^{PC3}	-0.04	0.05	-0.03	-0.02	0.03	-0.06	0.05	0.09	0.01	0.02	-0.16	0.17	0.17	-0.09	0.17	-0.22	0.65
	(-0.52)	(0.59)	(-0.79)	(-0.26)	(0.46)	(-1.17)	(0.65)	(1.04)	(0.18)	(0.18)	(-0.74)	(1.13)	(1.11)	(-0.42)	(0.83)	(-1.39)	(3.67)
R^2	65.6%	31.9%	83.5%	41.5%	71.8%	72.7%	44.3%	15.0%	57.2%	57.2%	23.9%	28.8%	25.0%	17.1%	14.1%	21.4%	17.1%

PANEL B - 2nd Step: Implied by SDF

	State Variables									Excess Returns							
s_t	$y_i^{(1)}$	$y_i^{(TS)}$	$y_b^{(1)}$	$y_b^{(TS)}$	y_e	y_e^{PC1}	y_e^{PC2}	y_e^{PC3}	$\Delta\pi$	xr_i^{Level}	xr_i^{Slope}	xr_b^{Level}	xr_b^{Slope}	xr_e^{Level}	xr_e^{PC1}	xr_e^{PC2}	xr_e^{PC3}
$y_i^{(1)}$	0.38	0.11	-0.36	0.34	-0.32	-0.59	0.41	-0.25	-1.04	-1.38	1.76	1.87	1.65	-0.37	-0.28	1.29	-0.98
$y_i^{(TS)}$	0.01	0.43	-0.10	0.08	-0.13	-0.39	0.31	-0.12	-0.36	-0.47	1.29	0.83	0.84	-0.59	0.07	0.32	-1.01
$y_b^{(1)}$	0.80	-0.61	1.31	-0.59	0.70	0.97	-0.48	0.49	1.15	1.52	-1.95	-1.26	-0.84	-1.37	0.93	-1.10	1.26
$y_b^{(TS)}$	0.19	-0.04	0.14	0.47	0.12	0.15	0.23	0.31	-0.07	-0.09	-1.10	0.06	0.24	0.14	0.37	-0.85	0.21
y_e	-0.14	0.05	-0.06	0.16	0.58	-0.11	-0.22	-0.43	-0.05	-0.06	0.86	0.23	0.17	0.88	-1.33	0.50	-0.92
y_e^{PC1}	-0.18	0.30	-0.15	0.35	-0.23	0.26	0.21	0.25	-0.19	-0.26	-0.61	0.38	0.13	1.13	0.84	-0.62	-0.02
y_e^{PC2}	-0.07	0.06	-0.10	0.14	-0.05	-0.08	0.16	-0.18	-0.22	-0.30	0.08	0.42	0.39	0.79	-0.28	0.52	0.28
y_e^{PC3}	-0.04	0.05	-0.03	-0.02	0.03	-0.06	0.05	0.09	0.01	0.02	-0.16	0.17	0.18	-0.09	0.17	-0.22	0.65
R^2	65.6%	31.9%	83.5%	41.5%	71.8%	72.7%	44.3%	15.0%	57.2%	57.2%	23.9%	28.7%	25.0%	17.1%	14.1%	21.4%	17.1%

Table 2

Correlation Matrix of VAR Shocks (1972-2022)

The table reports the basic results from the estimation of our no arbitrage term structure model. In particular, it contains the correlation matrix of shocks to the key variables in our analysis (state variables and risk factors). Shocks are obtained from the VAR implied by our no arbitrage term structure model. Sections 2 and 3 provide further details about the term structure model and its empirical specification, with Section 3.3 discussing the results from this table.

	$y_i^{(1)}$	$y_i^{(TS)}$	$y_b^{(1)}$	$y_b^{(TS)}$	y_e	y_e^{PC1}	y_e^{PC2}	y_e^{PC3}	$\Delta\pi$	xr_i^{Level}	xr_i^{Slope}	xr_b^{Level}	xr_b^{Slope}	xr_e^{Level}	xr_e^{PC1}	xr_e^{PC2}	xr_e^{PC3}
$y_i^{(1)}$	1	-0.87	0.49	-0.44	0.13	0.25	-0.16	0.01	-0.28	-0.28	-0.30	-0.34	-0.24	0.02	-0.14	0.18	-0.15
$y_i^{(TS)}$	-0.87	1	-0.36	0.52	-0.11	-0.25	0.16	0.02	0.23	0.23	0.12	0.07	-0.08	-0.08	0.21	-0.19	0.12
$y_b^{(1)}$	0.49	-0.36	1	-0.78	0.20	0.29	-0.20	0.03	0.49	0.49	0.12	-0.84	-0.70	0.06	-0.05	-0.05	-0.04
$y_b^{(TS)}$	-0.44	0.52	-0.78	1	-0.16	-0.31	0.20	-0.05	-0.33	-0.33	-0.13	0.39	0.19	-0.10	0.10	-0.09	0.01
y_e	0.13	-0.11	0.20	-0.16	1	0.42	-0.36	0.32	0.22	0.22	0.06	-0.16	-0.16	-0.59	0.20	0.15	-0.05
y_e^{PC1}	0.25	-0.25	0.29	-0.31	0.42	1	-0.66	-0.01	0.16	0.16	0.19	-0.19	-0.10	-0.42	-0.16	0.38	-0.05
y_e^{PC2}	-0.16	0.16	-0.20	0.20	-0.36	-0.66	1	0.06	-0.18	-0.18	-0.18	0.13	0.07	0.41	0.13	-0.43	0.04
y_e^{PC3}	0.01	0.02	0.03	-0.05	0.32	-0.01	0.06	1	0.06	0.06	-0.16	0.00	-0.04	-0.24	0.37	0.02	-0.16
$\Delta\pi$	-0.28	0.23	0.49	-0.33	0.22	0.16	-0.18	0.06	1	1.00	0.52	-0.45	-0.44	-0.12	0.15	-0.12	0.12
xr_i^{Level}	-0.28	0.23	0.49	-0.33	0.22	0.16	-0.18	0.06	1.00	1	0.52	-0.45	-0.44	-0.12	0.15	-0.12	0.12
xr_i^{Slope}	-0.30	0.12	0.12	-0.13	0.06	0.19	-0.18	-0.16	0.52	0.52	1	-0.05	-0.03	-0.12	-0.09	0.00	0.32
xr_b^{Level}	-0.34	0.07	-0.84	0.39	-0.16	-0.19	0.13	0.00	-0.45	-0.45	-0.05	1	0.94	0.01	-0.01	0.18	0.07
xr_b^{Slope}	-0.24	-0.08	-0.70	0.19	-0.16	-0.10	0.07	-0.04	-0.44	-0.44	-0.03	0.94	1	0.06	-0.10	0.22	0.01
xr_e^{Level}	0.02	-0.08	0.06	-0.10	-0.59	-0.42	0.41	-0.24	-0.12	-0.12	-0.12	0.01	0.06	1	-0.48	-0.39	0.04
xr_e^{PC1}	-0.14	0.21	-0.05	0.10	0.20	-0.16	0.13	0.37	0.15	0.15	-0.09	-0.01	-0.10	-0.48	1	0.07	0.06
xr_e^{PC2}	0.18	-0.19	-0.05	-0.09	0.15	0.38	-0.43	0.02	-0.12	-0.12	0.00	0.18	0.22	-0.39	0.07	1	-0.11
xr_e^{PC3}	-0.15	0.12	-0.04	0.01	-0.05	-0.05	0.04	-0.16	0.12	0.12	0.32	0.07	0.01	0.04	0.06	-0.11	1

Table 3

SDF Risk Price Parameters (1972-2022)

The table reports the basic results from the estimation of our no arbitrage term structure model. In particular, the table contains the λ_t coefficients as well as their t-statistics (in parentheses). The λ_t coefficients are normalized so that an average coefficient of 1 implies a one standard deviation positive shock to the respective risk factor implies a $\widetilde{m}$ that is one standard deviation above zero. Similarly, a coefficient of 1 for the effect of s_i on risk factor xr_j^* implies a one standard deviation increase in s_i is associated with a one standard deviation increase in the risk price of factor xr_j^*. Sections 2 and 3 provide further details about the term structure model and its empirical specification, with Section 3.3 discussing the results from this table.

	Average	$y_i^{(1)}$	$y_i^{(TS)}$	$y_b^{(1)}$	$y_b^{(TS)}$	y_e	y_e^{PC1}	y_e^{PC2}	y_e^{PC3}
xr_i^{Level}	0.05	-0.81	-1.49	-0.13	0.42	-0.35	-0.29	-0.47	0.23
	(0.48)	(-2.00)	(-4.63)	(-0.35)	(1.81)	(-1.53)	(-1.05)	(-2.91)	(1.81)
xr_i^{Slope}	0.23	1.96	2.00	-1.75	-1.12	1.09	0.05	0.43	-0.39
	(3.08)	(6.08)	(7.83)	(-6.68)	(-5.20)	(5.19)	(0.19)	(1.97)	(-3.17)
xr_b^{Level}	0.61	1.56	0.25	-2.32	-0.66	0.72	0.60	0.28	-0.11
	(3.17)	(4.32)	(0.77)	(-7.96)	(-2.59)	(3.82)	(2.50)	(1.59)	(-0.88)
xr_b^{Slope}	-0.45	-1.37	-0.28	2.34	0.96	-0.88	-0.65	-0.36	0.25
	(-2.52)	(-3.31)	(-0.68)	(7.84)	(3.39)	(-4.16)	(-2.63)	(-1.88)	(1.88)
xr_e^{Level}	0.54	0.66	0.04	-2.26	-0.53	0.97	1.19	0.96	-0.28
	(7.61)	(1.47)	(0.10)	(-4.78)	(-2.12)	(3.44)	(4.30)	(4.15)	(-1.87)
xr_e^{PC1}	0.35	0.48	1.00	-0.41	-0.04	-0.41	1.59	0.52	-0.15
	(5.47)	(0.63)	(1.91)	(-0.83)	(-0.11)	(-0.94)	(4.16)	(2.11)	(-0.82)
xr_e^{PC2}	0.25	0.84	-0.12	-1.53	-0.85	0.68	-0.07	0.67	-0.24
	(3.61)	(2.09)	(-0.42)	(-4.56)	(-3.95)	(3.27)	(-0.26)	(3.19)	(-1.97)
xr_e^{PC3}	-0.10	-1.60	-1.38	1.98	0.58	-1.10	-0.24	0.05	0.57
	(-1.65)	(-3.41)	(-4.14)	(4.06)	(2.30)	(-5.05)	(-1.01)	(0.35)	(4.19)

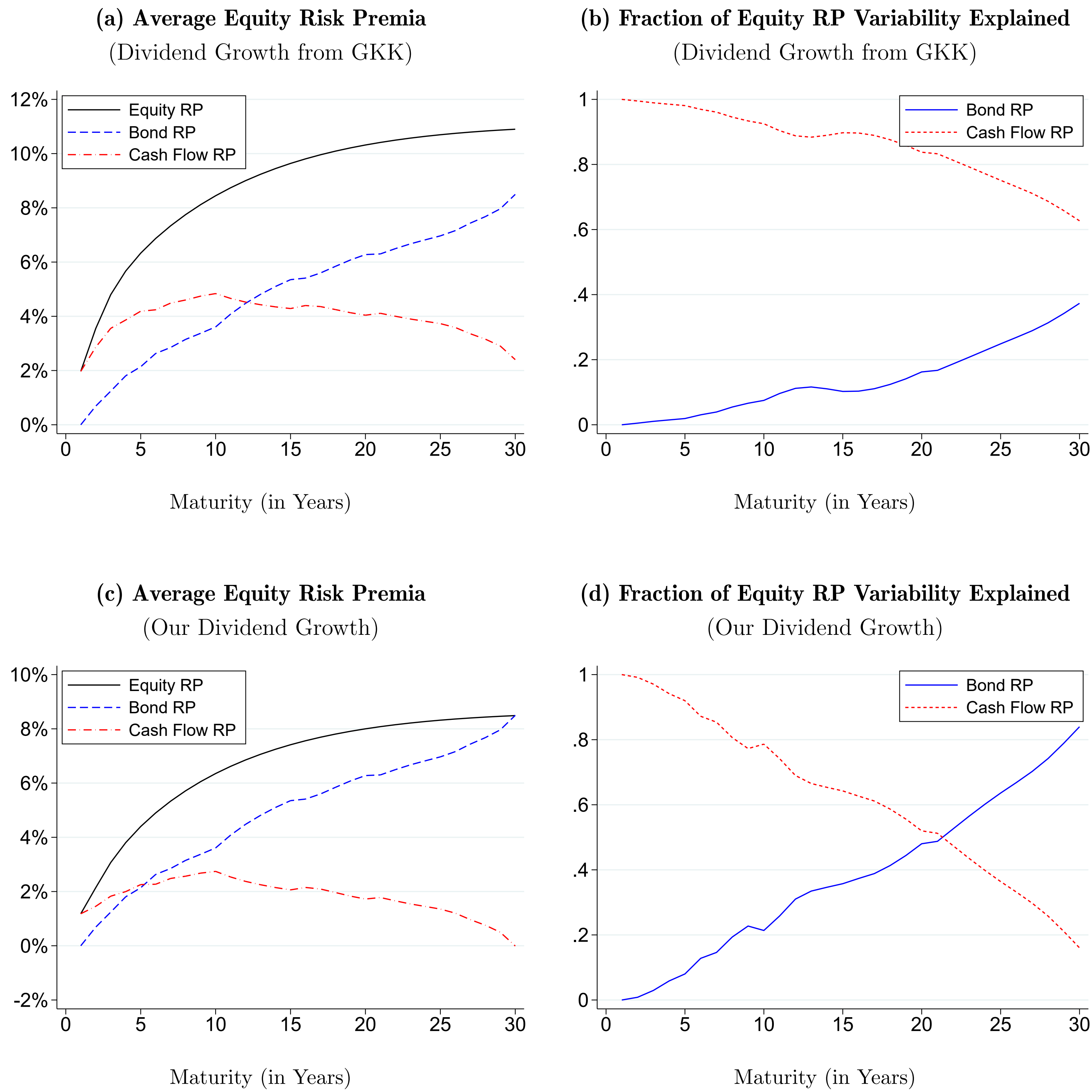
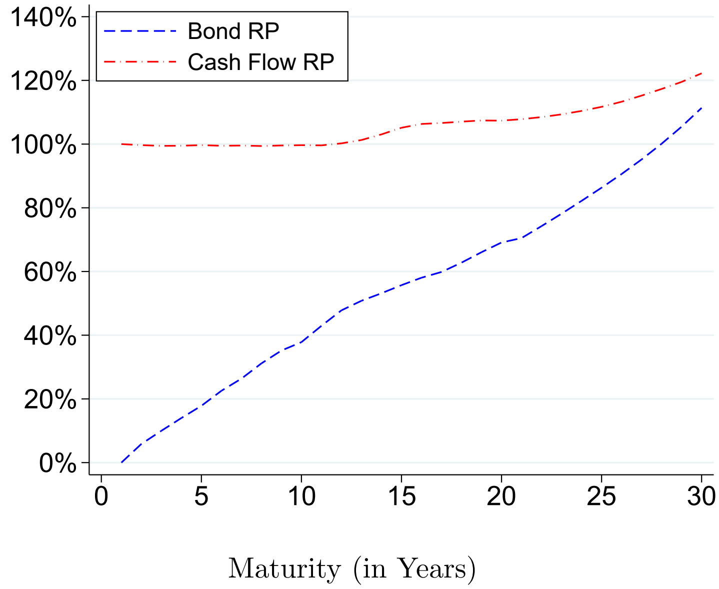


Figure 1

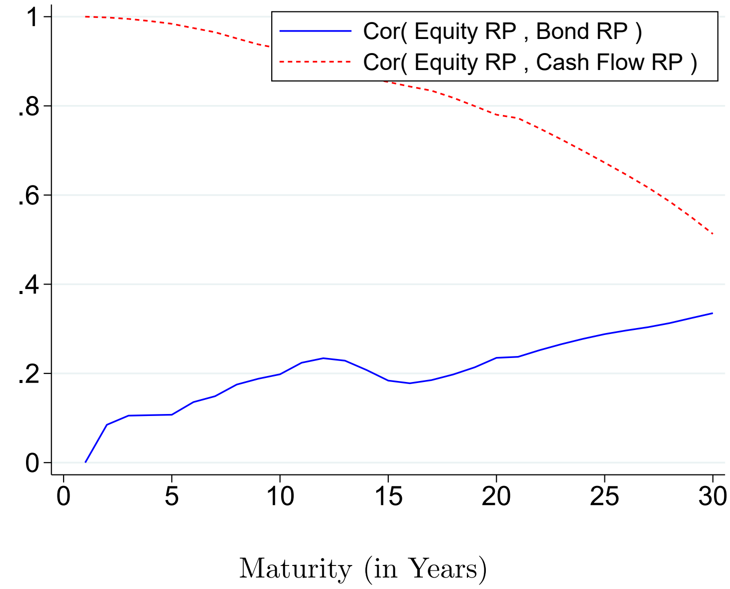
Preliminary Analysis: Decomposing Equity RP Term Structure Average and Time Variation

The graphs display the results from our preliminary analysis of the equity term structure, which is based on bond and dividend strip yields from the prior literature (i.e., without requiring our no arbitrage term structure model). Panels (a) and (c) report the average equity RP term structure and its cash flow and bond RP components (from Equation 3). Panels (b) and (d) report the fraction of equity RP variability explained by its cash flow and bond RP components (from Equation 4). When constructing dividend strip returns, Panels (a) and (b) use dividend growth from Giglio, Kelly, and Kozak (2024) (GKK) whereas Panels (c) and (d) use our dividend growth measure, which follows Gonçalves (2021a) and incorporates M&A paid in cash. Section 1 provides further details about measurement and discusses the results from this figure.

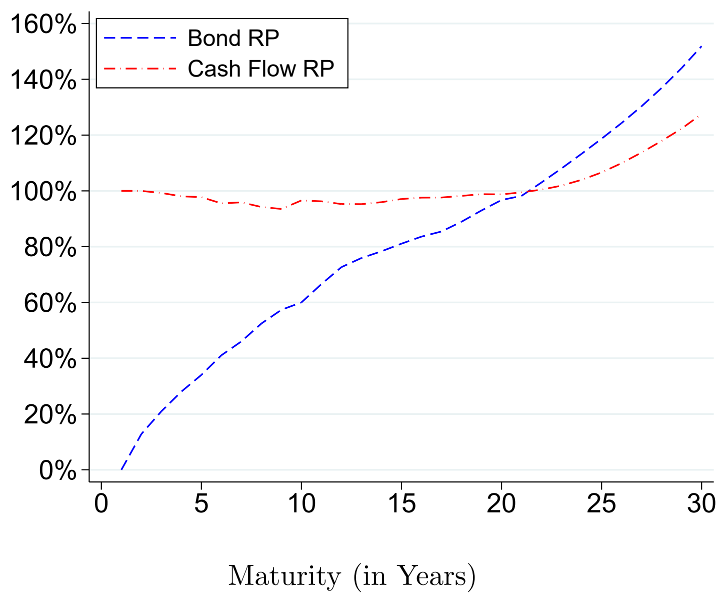
(a) Volatility Ratios of Equity RP Components
(Dividend Growth from GKK)



(b) Correlations with Equity RP
(Dividend Growth from GKK)



(c) Volatility Ratios of Equity RP Components
(Our Dividend Growth)



(d) Correlations with Equity RP
(Our Dividend Growth)

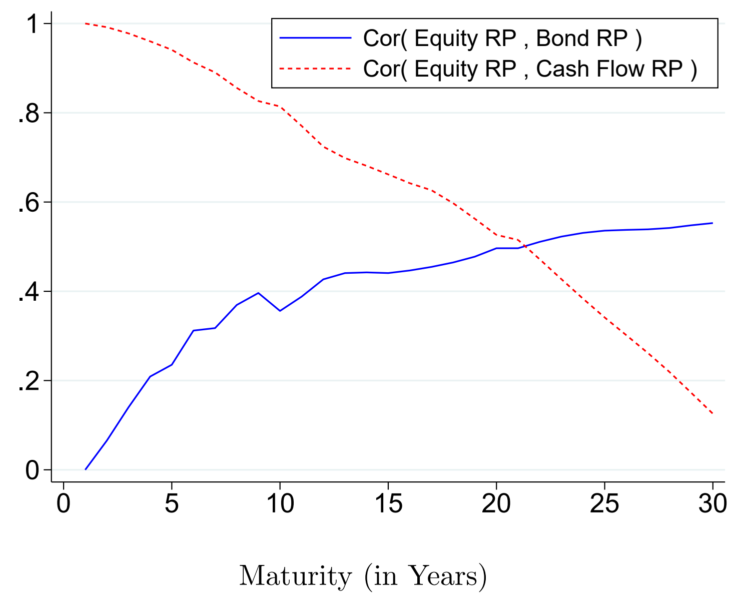


Figure 2
Preliminary Analysis: Volatility Ratios and Correlations with Equity RP

The graphs display the results from our preliminary analysis of the equity term structure, which is based on bond and dividend strip yields from the prior literature (i.e., without requiring our no arbitrage term structure model). Panels (a) and (c) report the volatilities of cash flow and bond RP components as a ratio of the equity RP (as in Equation 5). Panels (b) and (d) report the of equity RP with their cash flow and bond RP components (also as in Equation 5). When constructing dividend strip returns, Panels (a) and (b) use dividend growth from Giglio, Kelly, and Kozak (2024) (GKK) whereas Panels (c) and (d) use our dividend growth measure, which follows Gonçalves (2021a) and incorporates M&A paid in cash. Section 1 provides further details about measurement and discusses the results from this figure.

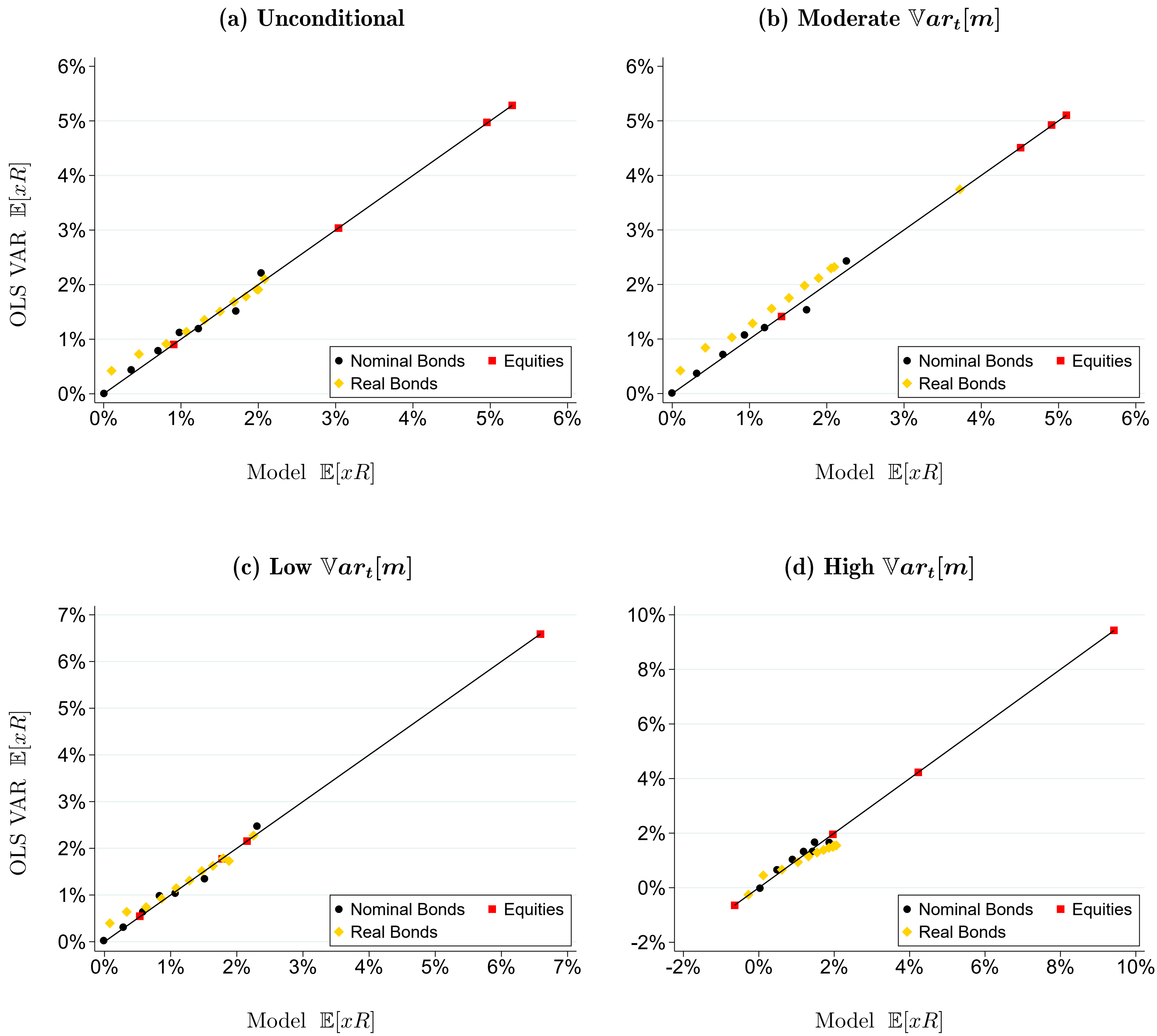


Figure 3
Model Fit: Risk Premia of Test Assets

The graphs display scatter plots with y axes reflecting the risk premia on the testing assets (i.e., average $\mathbb{E}_t[xR_j] = \mathbb{E}_t[xr_j] + 0.5 \cdot \sigma_j^2$ based on our unconstrained VAR) and x axes reflecting the same risk premia according to our no arbitrage model (i.e., average $\mathbb{E}_t[xR_j] = \mathbb{E}_t[xr_j] + 0.5 \cdot \sigma_j^2$ based on the SDF-implied VAR of our model). Sections 2 and 3 provide further details about the term structure model and its empirical specification while Section 4.1 discusses the results from this figure.

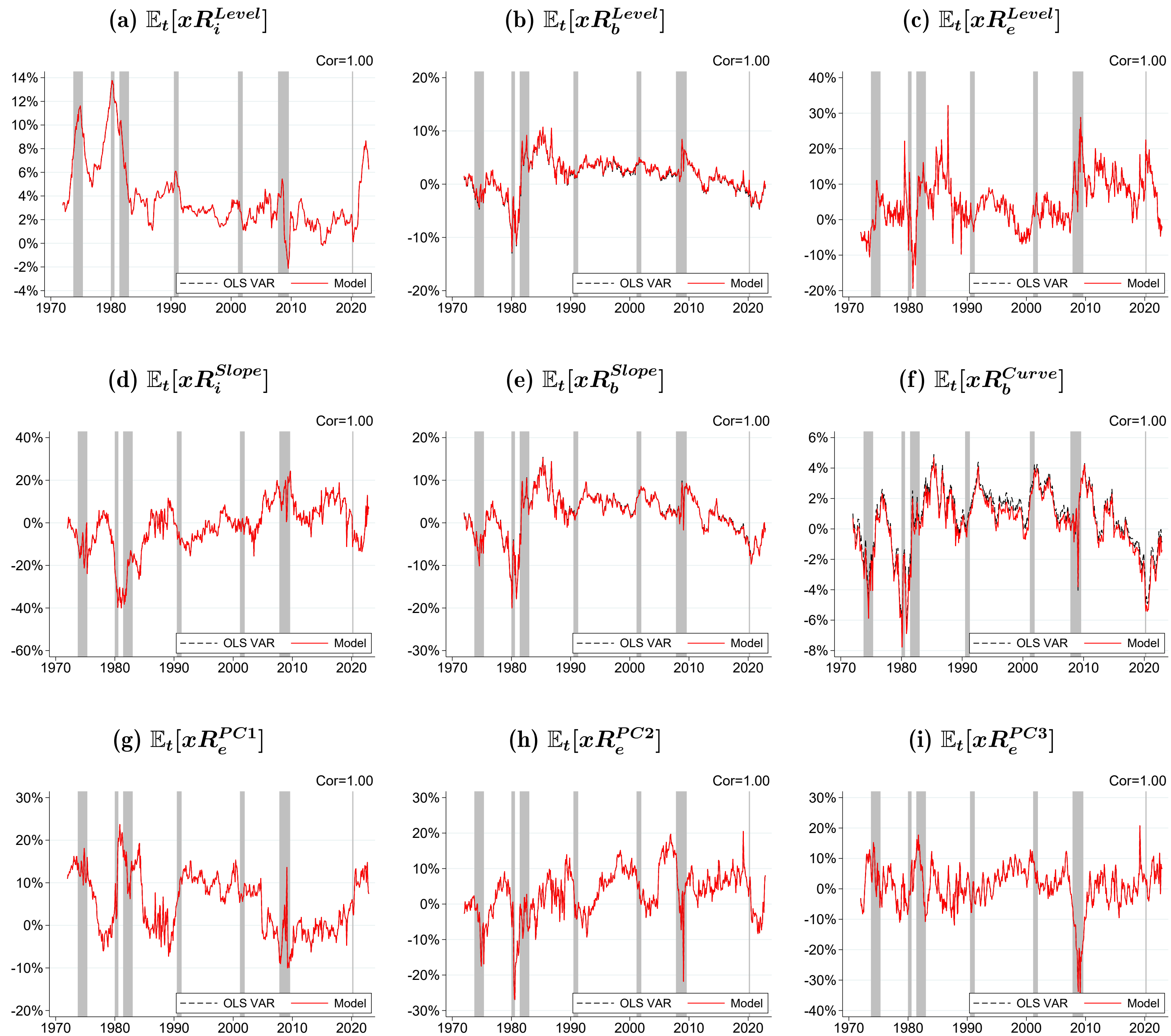


Figure 4
Model Fit: Conditional Risk Premia on Risk Factors

The graphs display time-series plots for the risk premia of the different risk factors, $\mathbb{E}_t[xR_j^*] = \mathbb{E}_t[xr_j^*] + 0.5 \cdot \sigma_j^2$, obtained from the unconstrained VAR (estimated by OLS) as well as from our no arbitrage model. Sections 2 and 3 provide further details about the term structure model and its empirical specification while Section 4.1 discusses the results from this figure.

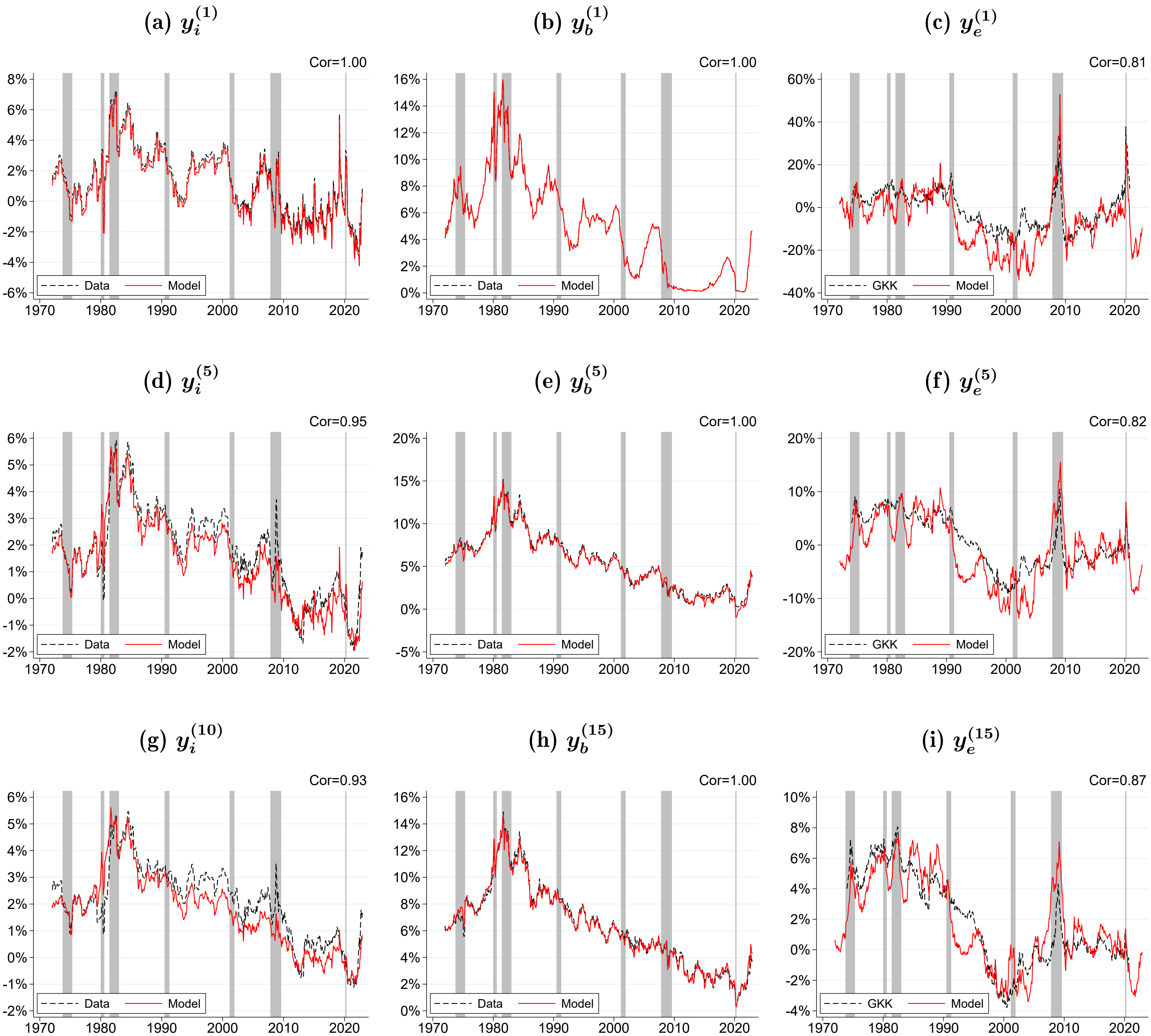


Figure 5
Model Fit: Inflation, Bond, and Dividend Strip Yields

The graphs display time-series plots for the yields on real bond, nominal bond, and dividend strips obtained from our no arbitrage term structure model together with the analogous yields from data external to the model. Sections 2 and 3 provide further details about the term structure model and its empirical specification while Section 4.2 discusses the results from this figure.

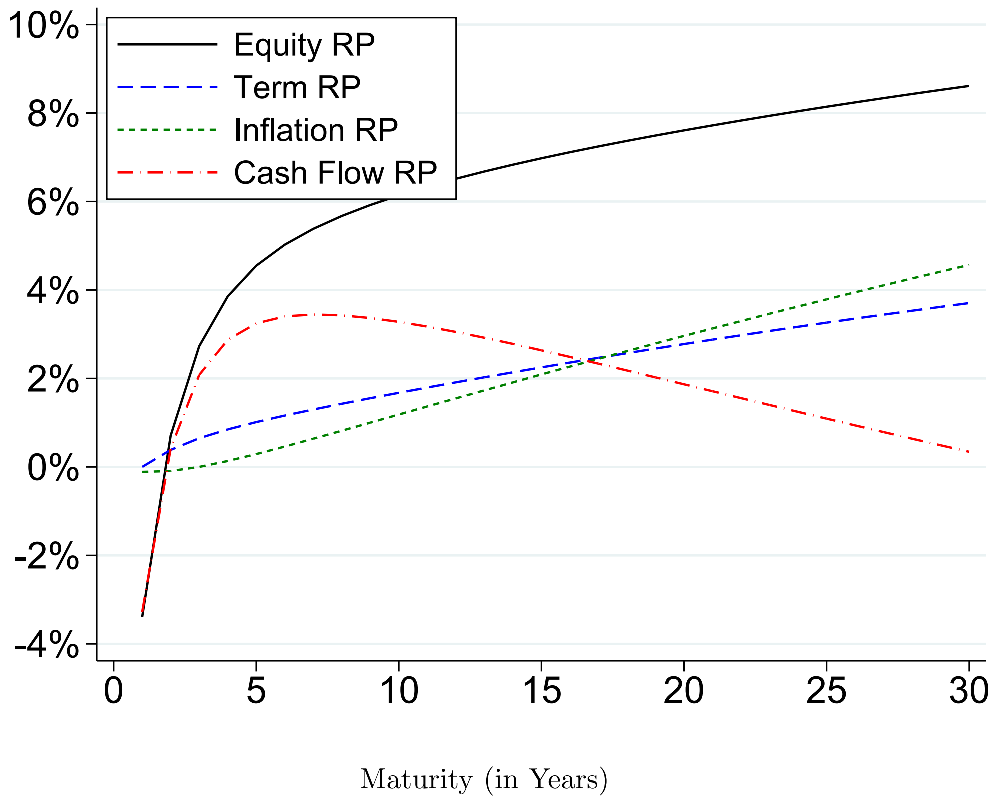


Figure 6
The Average Term Structure of Equity Risk Premia: Term RP, Inflation RP, and Cash Flow RP

This figure displays the average term structure of Equity RP and its components (the term, inflation, and cash flow RP from Equation 35). Sections 2 and 3 provide further details about the term structure model and its empirical specification while Section 5.1 discusses the results from this figure.

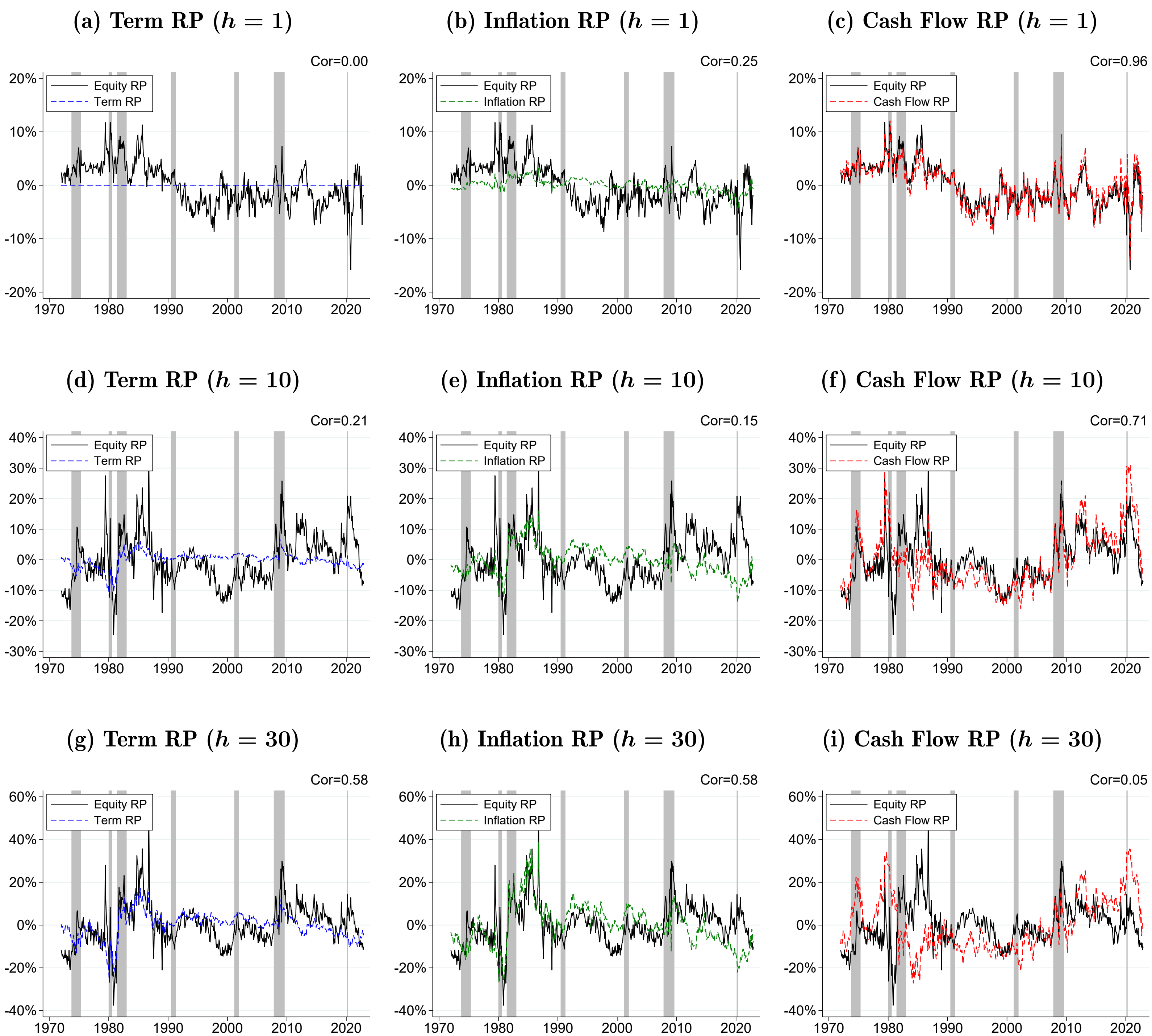
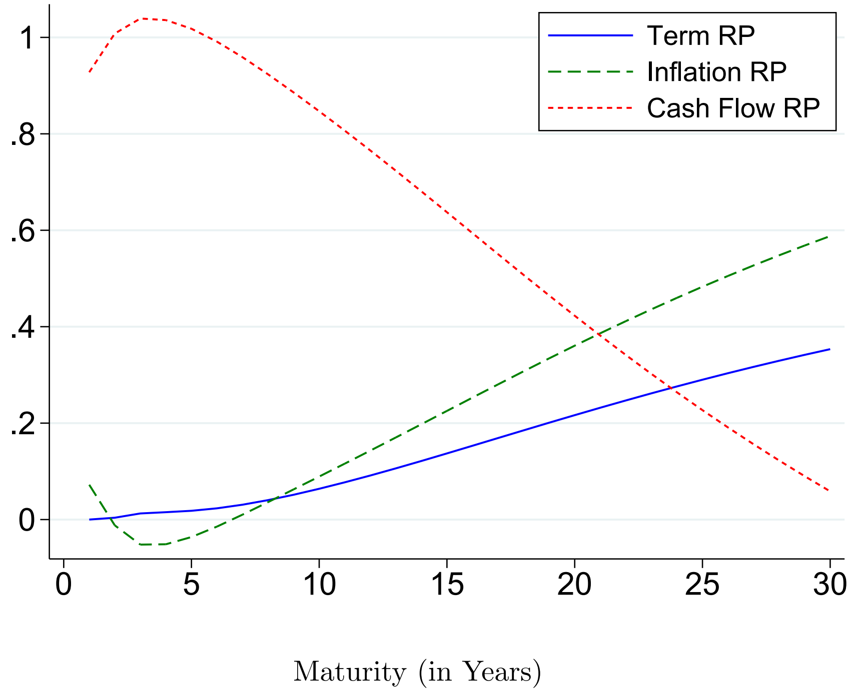


Figure 7

Time Variation in the Term Structure of Equity Risk Premia: Term RP, Inflation RP, and Cash Flow RP

The graphs display time-series plots for the Equity RP components (the term, inflation, and cash flow RP from Equation 35). We consider three maturities (h =1, 10, and 30 years). Sections 2 and 3 provide further details about the term structure model and its empirical specification while Section 5.2 discusses the results from this figure.

(a) Fraction of Equity RP Variability Explained by its Components



(b) Fraction of Equity ΔRP Variability Explained by its Components

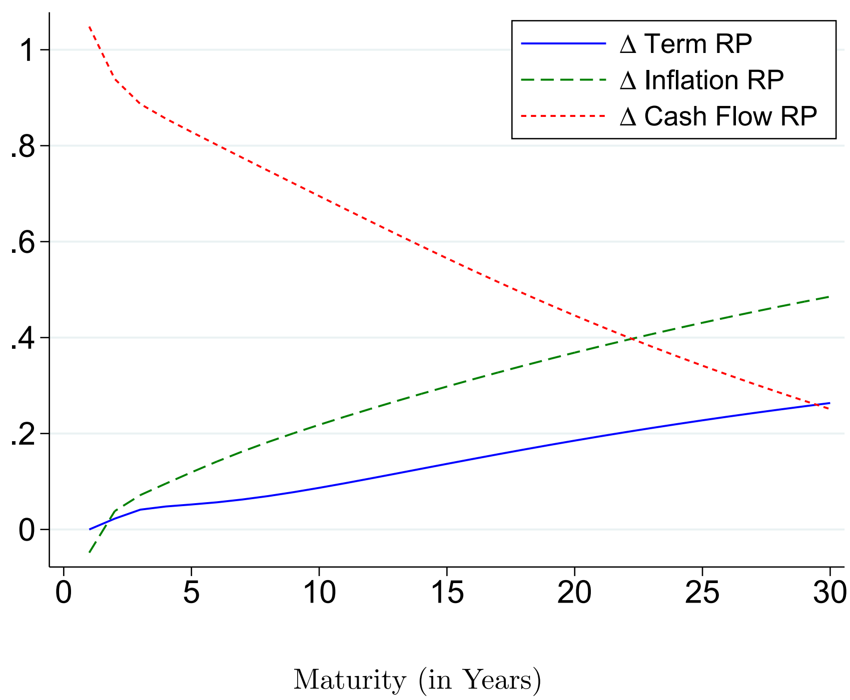


Figure 8

Fraction of Equity Premia Variability Explained by Term RP, Inflation RP, and Cash Flow RP

The graphs display term structure plots of the fraction of equity premia variability explained by each of the Equity RP components (the term, inflation, and cash flow RP from Equation 35). Similar for annual changes in RP (referred to as ΔRP). Sections 2 and 3 provide further details about the term structure model and its empirical specification while Section 5.2 discusses the results from this figure.

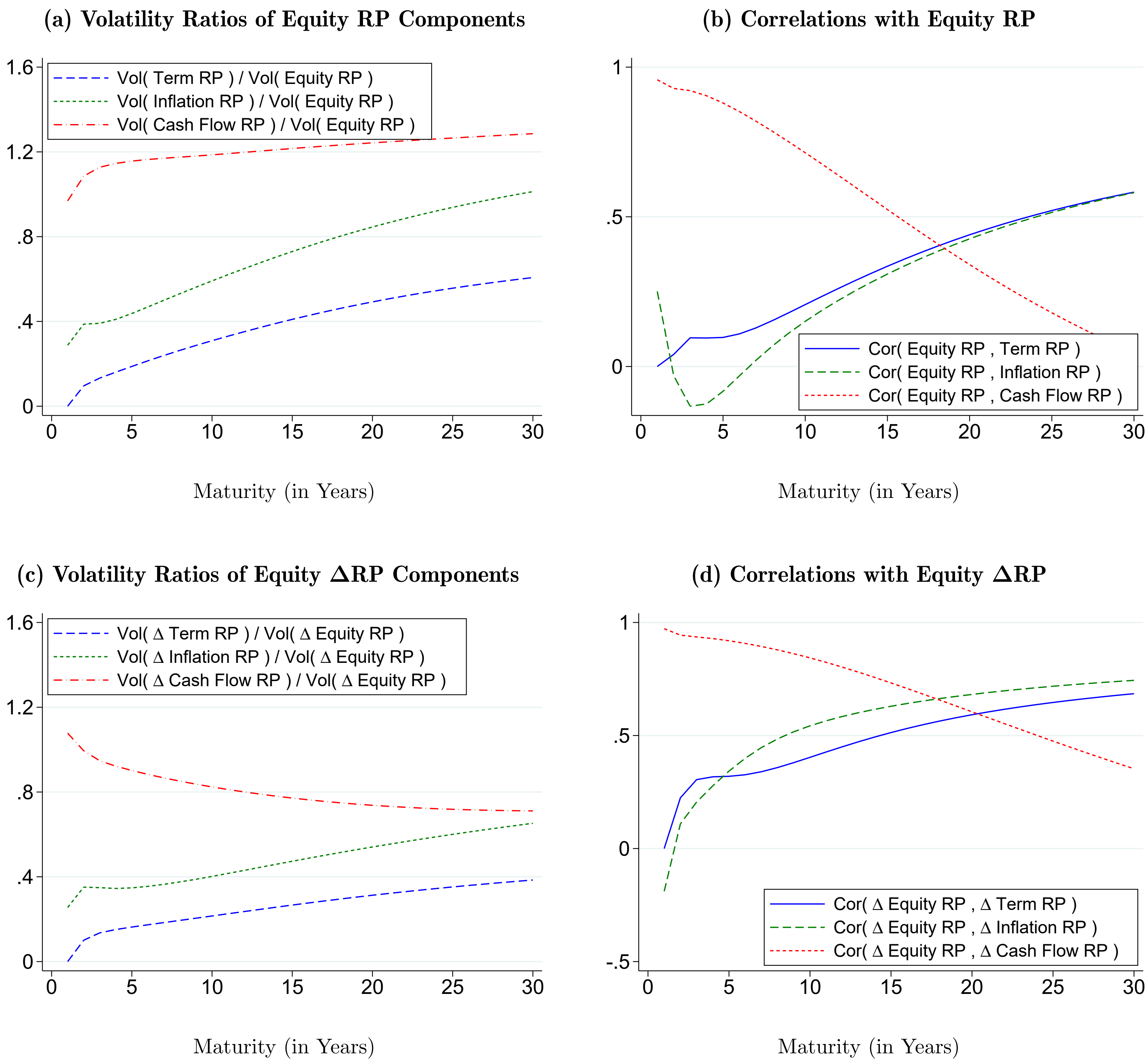
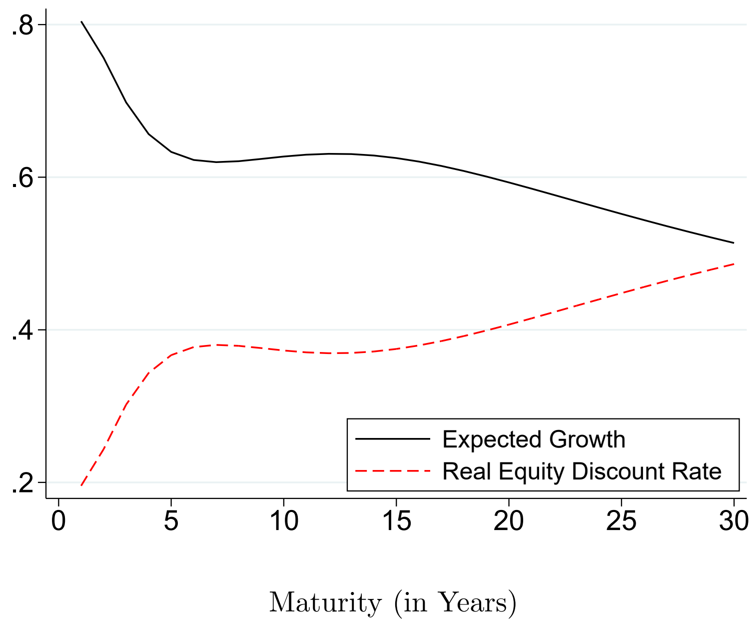


Figure 9
Equity RP Components: Volatility Ratios and Correlations with Equity RP

The graphs display term structure plots of the volatilities of equity RP components (over the equity RP volatility) as well as of the correlation of equity RP with each of its components (the term, inflation, and cash flow RP from Equation 35). Similar for annual changes in RP (referred to as ΔRP). Sections 2 and 3 provide further details about the term structure model and its empirical specification while Section 5.2 discusses the results from this figure.

(a) Fraction of Equity Yield Variability Explained by Growth and Discount Rate Components



(b) Fraction of Equity Yield Variability Explained by Growth and RP Components

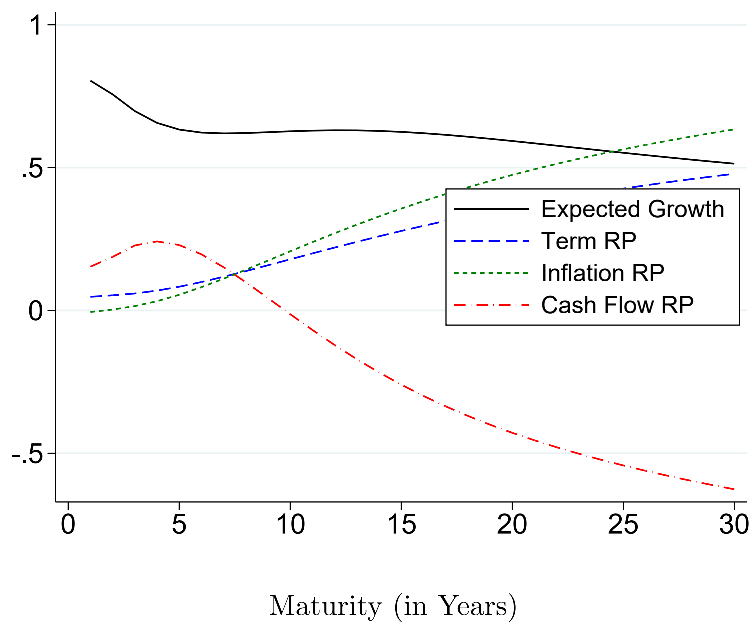


Figure 10
Fraction of Equity Yield Variability Explained by Expected Growth and Real Equity Discount Rate Components

The graphs display, based on Equation 39, term structure plots of the fraction of equity yield variability explained by expected growth and real equity discount rate components (the term, inflation, and cash flow RP components from Equation 41). Sections 2 and 3 provide further details about the term structure model and its empirical specification while Section 5.3 discusses the results from this figure.

Internet Appendix

From Bonds to Dividend Strips: Decomposing the Equity Premia Term Structure

By Spencer Andrews and Andrei S. Gonçalves

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A Derivations for our No Arbitrage Term Structure Model

A.1 Risk Premia Constraints under No Arbitrage

The no arbitrage condition $\mathbb{E}_t[e^{m_{t+1}+r^{(1)}_{b,t+1}}] = 1$ can be written as:

$$\mathbb{E}_t[m] \;+\; 0.5 \cdot \mathbb{V}ar_t[m] \;=\; -\,y^{(1)}_{b,t} \tag{IA.1}$$

and combining $\mathbb{E}_t[e^{m_{t+1}+r^{(1)}_{b,t+1}}] = 1$ and $\mathbb{E}_t[e^{m_{t+1}+r_{j,t+1}}] = 1$ with the VAR structure yields:

$$1^{'}_{xr_j}(\phi \;+\; \Phi z_t) \;+\; 0.5 \cdot 1^{'}_{xr_j}\Sigma 1_{xr_j} \;= 1^{'}_{xr_j}\Sigma\Omega^{'}\lambda_t \tag{IA.2}$$

where 1_{xr_j} is a selector vector such that $1^{'}_{xr_j} z_t = xr_{j,t}$.

Now, conjecture that $\lambda_t = \lambda + \Lambda z_t$. Then, we have:

$$1^{'}_{xr_j}\phi \;+\; 0.5 \cdot 1^{'}_{xr_j}\Sigma 1_{xr_j} \;+\; 1^{'}_{xr_j}\Phi z_t \;= 1^{'}_{xr_j}\Sigma\Omega^{'}\lambda \;+\; 1^{'}_{xr_j}\Sigma\Omega^{'}\Lambda z_t \tag{IA.3}$$

which implies the restrictions

$$1^{'}_{xr_j}\phi \;+\; 0.5 \cdot 1^{'}_{xr_j}\Sigma 1_{xr_j} \;= 1^{'}_{xr_j}\Sigma\Omega^{'}\lambda \tag{IA.4}$$

and

$$1^{'}_{xr_j}\Phi \;= 1^{'}_{xr_j}\Sigma\Omega^{'}\Lambda, \tag{IA.5}$$

thereby verifying the $\lambda_t = \lambda + \Lambda z_t$ conjecture.

A.2 Bond Strips

In this section, we derive all expressions related to bond strips.

A.2.1 Bond Strip Yields

The no arbitrage condition $e^{-h\cdot y_{b,t}^{(h)}} = \mathbb{E}_t[e^{m_{t+1}-(h-1)\cdot y_{b,t+1}^{(h-1)}}]$ implies:

$$\begin{aligned} h \cdot y_{b,t}^{(h)} &= -\mathbb{E}_t[m - (h-1)\cdot y_b^{(h-1)}] - 0.5 \cdot \mathbb{V}ar_t[m - (h-1)\cdot y_b^{(h-1)}] \\ &= y_{b,t}^{(1)} + (h-1)\cdot \mathbb{E}_t[y_b^{(h-1)}] - \frac{(h-1)}{2}\cdot \mathbb{V}ar_t[y_b^{(h-1)}] + (h-1)\cdot \mathbb{C}ov_t[m, y_b^{(h-1)}] \end{aligned} \tag{IA.6}$$

where the second equality uses $y_{b,t}^{(1)} = -\mathbb{E}_t[m] - 0.5 \cdot \mathbb{V}ar_t[m]$.

Now, conjecture that $y_{b,t}^{(h-1)} = a_{y_b}^{(h-1)} + b_{y_b}^{(h-1)'} z_t$ and substitute such conjecture into Equation IA.6 to get:

$$\begin{aligned} h \cdot y_{b,t}^{(h)} &= y_{b,t}^{(1)} + (h-1)\cdot \left[a^{(h-1)} + b^{(h-1)'}\left(\phi + \Phi z_t\right)\right] - \frac{(h-1)^2}{2}\cdot b^{(h-1)'}\Sigma b^{(h-1)} - (h-1)\cdot \lambda_t^{'}\Omega\Sigma b^{(h-1)} \\ &= (h-1)\cdot a^{(h-1)} + (h-1)\cdot b^{(h-1)'}\phi - \frac{(h-1)^2}{2}\cdot b^{(h-1)'}\Sigma b^{(h-1)} \\ &\quad + y_{b,t}^{(1)} + (h-1)\cdot b^{(h-1)'}\Phi z_t - (h-1)\cdot \lambda^{'}\Omega\Sigma b^{(h-1)} - (h-1)\cdot z_t^{'}\Lambda^{'}\Omega\Sigma b^{(h-1)} \\ &\Downarrow \end{aligned}$$

$$y_{b,t}^{(h)} = a_{y_b}^{(h)} \ + \ b_{y_b}^{(h)'} z_t \tag{IA.7}$$

which confirms the $y_{b,t}^{(h-1)} = a_{y_b}^{(h-1)} + b_{y_b}^{(h-1)'} z_t$ conjecture with boundary condition $a_{y_b}^{(0)} = b_{y_b}^{(0)} = 0$ and recursive parameters:

$$a_{y_b}^{(h)} = \tfrac{(h-1)}{h}\cdot \left[a_{y_b}^{(h-1)} + b_{y_b}^{(h-1)'}(\phi - \Sigma\Omega^{'}\lambda - 0.5\cdot (h-1)\cdot \Sigma b_{y_b}^{(h-1)})\right]$$

$$b_{y_b}^{(h)'} = \tfrac{1}{h}\cdot 1_{y_b}^{'} + \tfrac{(h-1)}{h}\cdot \left[b_{y_b}^{(h-1)'}(\Phi - \Sigma\Omega^{'}\Lambda)\right]$$

A.2.2 Bond Strip Returns and Risk Premia

Since $R_{b,t}^{(h)} = P_{b,t}^{(h-1)}/P_{b,t-1}^{(h)} = e^{h\cdot y_{b,t-1}^{(h)} - (h-1)\cdot y_{b,t}^{(h-1)}}$, we have $r_{b,t}^{(h)} = h\cdot y_{b,t-1}^{(h)} - (h-1)\cdot y_{b,t}^{(h-1)}$, which implies:

$$\mathbb{V}ar_t[r_b^{(h)}] = b_{\mathbb{V}_b}^{(h)'}\Sigma b_{\mathbb{V}_b}^{(h)} \tag{IA.8}$$

and

$$
\begin{aligned}
\mathbb{E}_t[xr_b^{(h)}] &= h \cdot y_{b,t}^{(h)} \; - \; (h-1) \cdot \mathbb{E}_t[y_b^{(h-1)}] \; - \; y_b^{(1)} \\
&= h \cdot y_{b,t}^{(h)} \; - \; (h-1) \cdot \left[a^{(h-1)} + b^{(h-1)'} \left(\phi + \Phi z_t \right) \right] \; - \; y_b^{(1)} \\
&= a_{\mathbb{E}_b}^{(h)} \; + \; b_{\mathbb{E}_b}^{(h)'} z_t
\end{aligned} \tag{IA.9}
$$

with recursive parameters:

$$a_{\mathbb{E}_b}^{(h)} = h \cdot a_{y_b}^{(h)} - (h-1) \cdot (a_{y_b}^{(h-1)} + b_{y_b}^{(h-1)'} \phi)$$

$$b_{\mathbb{E}_b}^{(h)'} = h \cdot b_{y_b}^{(h)'} - (h-1) \cdot b_{y_b}^{(h-1)'} \Phi - 1_{y_b}'$$

$$b_{\mathbb{V}_b}^{(h)'} = -(h-1) \cdot b_{y_b}^{(h-1)'}$$

Finally, we have:

$$
\begin{aligned}
\mathbb{E}_t[R_b^{(h)} - R_b^{(1)}] &= \mathbb{E}_t \left[e^{r_{b,t+1}^{(h)}} - e^{r_{b,t+1}^{(1)}} \right] \\
&= \mathbb{E}_t \left[e^{xr_{b,t+1}^{(h)}} - 1 \right] \cdot e^{y_{b,t}^{(1)}} \\
&= \left(e^{\mathbb{E}_t[xr_b^{(h)}] + 0.5 \cdot \mathbb{V}ar_t[r_b^{(h)}]} - 1 \right) \cdot e^{y_{b,t}^{(1)}}
\end{aligned} \tag{IA.10}
$$

A.3 Inflation Strips

In this section, we derive all expressions related to inflation strips.

A.3.1 Inflation Strip Yields

The no arbitrage condition $e^{-h \cdot y_{\pi,t}^{(h)}} = \mathbb{E}_t[e^{m_{t+1} - (h-1) \cdot y_{\pi,t+1}^{(h-1)} + \Delta\pi_{t+1}}]$ implies:

$$
\begin{aligned}
h \cdot y_{\pi,t}^{(h)} = & \; - \mathbb{E}_t[m] + (h-1) \cdot \mathbb{E}_t[y_i^{(h-1)}] - \mathbb{E}_t[\Delta\pi] - \frac{1}{2} \cdot \mathbb{V}ar_t[m] \\
& - \frac{1}{2} \cdot \mathbb{V}ar_t[\Delta\pi - (h-1) \cdot y_\pi^{(h-1)}] - \mathbb{C}ov_t[m, \Delta\pi - (h-1) \cdot y_\pi^{(h-1)}] \\
= & \; y_{b,t}^{(1)} + (h-1) \cdot \mathbb{E}_t[y_\pi^{(h-1)}] - \mathbb{E}_t[\Delta\pi] \\
& - \frac{1}{2} \cdot \mathbb{V}ar_t[\Delta\pi - (h-1) \cdot y_\pi^{(h-1)}] - \mathbb{C}ov_t[m, \Delta\pi - (h-1) \cdot y_\pi^{(h-1)}]
\end{aligned} \tag{IA.11}
$$

Now, conjecture that $y_{\pi,t}^{(h-1)} = a_{y_\pi}^{(h-1)} + b_{y_\pi}^{(h-1)'} z_t$ and substitute such conjecture into Equation IA.11 to get:

$$
\begin{aligned}
h \cdot y_{\pi,t}^{(h)} &= 1_{y_b}' z_t + (h-1) \cdot [a_{y_\pi}^{(h-1)} + b_{y_\pi}^{(h-1)'}(\phi + \Phi z_t)] - 1_\pi'(\phi + \Phi z_t) \\
&\quad - \frac{1}{2} \cdot (1_\pi - (h-1) \cdot b_{y_\pi}^{(h-1)})' \Sigma \frac{1}{2} (1_\pi - (h-1) \cdot b_{y_\pi}^{(h-1)}) \\
&\quad + \lambda_t' \Omega \Sigma (1_\pi - (h-1) \cdot b_{y_\pi}^{(h-1)}) \\
&= (h-1) \cdot [a_{y_\pi}^{(h-1)} + b_{y_\pi}^{(h-1)'} \phi] - 1_\pi' \phi \\
&\quad - \frac{1}{2} \cdot (1_\pi - (h-1) \cdot b_{y_\pi}^{(h-1)})' \Sigma (1_\pi - (h-1) \cdot b_{y_\pi}^{(h-1)}) \\
&\quad + (1_\pi - (h-1) \cdot b_{y_\pi}^{(h-1)})' \Sigma \Omega' \lambda \\
&\quad \{1_{y_b}' + (h-1) b_{y_\pi}^{(h-1)'} \Phi - 1_\pi' \Phi + (1_\pi - (h-1) \cdot b_{y_\pi}^{(h-1)})' \Sigma \Omega' \Lambda\} z_t \\
&\Downarrow \\
y_{\pi,t}^{(h)} &= a_{y_\pi}^{(h)} \ + \ b_{y_\pi}^{(h)'} z_t \qquad \text{(IA.12)}
\end{aligned}
$$

with boundary conditions $a_{y_\pi}^{(0)} = b_{y_\pi}^{(0)} = 0$, and recursive parameters:

$$
a_{y_\pi}^{(h)} = \tfrac{1}{h} \cdot \left[(h-1) \cdot a_{y_\pi}^{(h-1)} - (1_\pi - (h-1) \cdot b_{y_\pi}^{(h-1)})' (\phi - \Sigma \Omega' \lambda + 0.5 \cdot \Sigma (1_\pi - (h-1) \cdot b_{y_\pi}^{(h-1)}) \right]
$$

$$
b_{y_\pi}^{(h)'} = \tfrac{1}{h} \cdot \left[1_{y_b}' - (1_\pi - (h-1) \cdot b_{y_\pi}^{(h-1)})' (\Phi - \Sigma \Omega' \Lambda) \right]
$$

A.3.2 Inflation Strip Returns and Risk Premia

Since $R_{\pi,t}^{(h)} = P_{\pi,t}^{(h-1)} / P_{\pi,t-1}^{(h)} = e^{h \cdot y_{\pi,t-1}^{(h)} - (h-1) \cdot y_{\pi,t}^{(h-1)} + \Delta \pi_t}$, we have

$$
r_{\pi,t}^{(h)} \ = h \cdot y_{\pi,t-1}^{(h)} - (h-1) \cdot y_{\pi,t}^{(h-1)} + \Delta \pi_t \qquad \text{(IA.13)}
$$

which implies

$$
\mathbb{V}ar_t[r_\pi^{(h)}] \ = b_{\mathbb{V}_\pi}^{(h)'} \Sigma b_{\mathbb{V}_\pi}^{(h)} \qquad \text{(IA.14)}
$$

and

$$
\begin{aligned}
\mathbb{E}_t[xr_\pi^{(h)}] \ &= h \cdot y_{\pi,t}^{(h)} + \mathbb{E}_t[\Delta \pi - (h-1) \cdot y_\pi^{(h-1)}] - y_{b,t}^{(1)} \\
&= a_{\mathbb{E}_\pi}^{(h)} \ + \ b_{\mathbb{E}_\pi}^{(h)'} z_t \qquad \text{(IA.15)}
\end{aligned}
$$

with boundary conditions $a^{(0)}_{y_\pi} = b^{(0)}_{y_\pi} = 0$, and recursive parameters:

$a^{(h)}_{\mathbb{E}_\pi} = h \cdot a^{(h)}_{y_\pi} - (h-1) \cdot a^{(h-1)}_{y_\pi} + (1_\pi - (h-1) \cdot b^{(h-1)}_{y_\pi})' \phi$

$b^{(h)'}_{\mathbb{E}_\pi} = (1_\pi - (h-1) \cdot b^{(h-1)}_{y_\pi})' \Phi + (h \cdot b^{(h)}_{y_\pi})' - 1'_{y_b}$

$b^{(h)'}_{\mathbb{V}_\pi} = (1_\pi - (h-1) \cdot b^{(h-1)}_{y_\pi})'$

Finally, we have:

$$\begin{aligned} \mathbb{E}_t[R^{(h)}_\pi - R^{(1)}_b] &= \mathbb{E}_t\left[e^{r^{(h)}_{\pi,t+1}} - e^{r^{(1)}_{b,t+1}}\right] \\ &= \mathbb{E}_t\left[e^{xr^{(h)}_{\pi,t+1}} - 1\right] \cdot e^{y^{(1)}_{b,t}} \\ &= \left(e^{\mathbb{E}_t[xr^{(h)}_\pi] + 0.5 \cdot \mathbb{V}ar_t[r^{(h)}_\pi]} - 1\right) \cdot e^{y^{(1)}_{b,t}} \end{aligned} \tag{IA.16}$$

A.3.3 Inflation Strip Discount Rates

We can obtain each strip (log) discount rate from

$$\begin{aligned} dr^{(h)}_{\pi,t} &= \mathbb{E}_t[\frac{1}{h} \cdot r^{(h)}_{\pi,t\to t+h}] \\ &= y^{(h)}_{\pi,t} \ + \ \mathbb{E}_t[\frac{1}{h} \cdot \Delta\pi_{t\to t+h}] \\ &= y^{(h)}_{\pi,t} \ + \ \frac{1}{h} \cdot \sum_{j=1}^{h} \mathbb{E}_t[\Delta\pi_{t+j}] \end{aligned} \tag{IA.17}$$

where (conjecturing and verifying that $g^{(h)}_{\pi,t} = \frac{1}{h} \cdot \sum_{j=1}^{h} \mathbb{E}_t[\Delta\pi_{t+j}] = a^{(h)}_{g_\pi} + b^{(h)'}_{g_\pi} z_t$)

$$\begin{aligned} \frac{1}{h} \cdot \sum_{j=1}^{h} \mathbb{E}_t[\Delta\pi_{t+j}] &= \frac{1}{h} \cdot \mathbb{E}_t[\Delta\pi_{t+1}] \ + \ \frac{h-1}{h} \cdot \mathbb{E}_t\left[\frac{1}{h-1} \cdot \sum_{j=1}^{h-1} \mathbb{E}_{t+1}[\Delta\pi_{t+1+j}]\right] \\ &= \frac{1}{h} \cdot \mathbb{E}_t[\Delta\pi_{t+1}] \ + \ \frac{h-1}{h} \cdot \mathbb{E}_t[a^{(h-1)}_{g_\pi} + b^{(h-1)'}_{g_\pi} z_{t+1}] \\ &= \frac{1}{h} \cdot \mathbb{E}_t[1'_\pi z_{t+1}] \ + \ \frac{h-1}{h} \cdot \mathbb{E}_t[a^{(h-1)}_{g_\pi} + b^{(h-1)'}_{g_\pi} z_{t+1}] \\ &= a^{(h)}_{g_\pi} \ + \ b^{(h)'}_{g_\pi} z_t \end{aligned} \tag{IA.18}$$

with boundary conditions $a^{(0)}_{g_\pi} = b^{(0)'}_{g_\pi} = 0$, and recursive parameters:

$a^{(h)}_{g_\pi} = \frac{1}{h} \cdot 1'_\pi \phi + \frac{h-1}{h} \cdot (a^{(h-1)}_{g_\pi} + b^{(h-1)'}_{g_\pi} \phi)$

$b_{g_\pi}^{(h)'} = \frac{1}{h} \cdot 1_\pi' \Phi + \frac{h-1}{h} \cdot b_{g_\pi}^{(h-1)'} \Phi$

A.4 Dividend Strips (Log-Linear Approximation)

In this section, we derive all expressions related to dividend strips relying on the log-linear approximation of Gao and Martin (2021) (which is an improved version of the Campbell and Shiller (1989) log-linear approximation), $\Delta d_t \approx r_{e,t} + \frac{\rho_e}{1-\rho_e} \cdot y_{e,t} - \frac{1}{1-\rho_e} \cdot y_{e,t-1}$, where $\Delta d_t = log(D_t/D_{t-1})$ and $\rho_e = e^{-\overline{y}_e}$. These expressions are used in the robustness check of Section D.1. The expressions that do not rely on any approximation (used in our baseline analysis) are provided in Section A.5.

A.4.1 Dividend Strip Yields

The no arbitrage condition $e^{-h \cdot y_{e,t}^{(h)}} = \mathbb{E}_t[e^{m_{t+1} - (h-1) \cdot y_{e,t+1}^{(h-1)} + \Delta d_{t+1}}]$ implies:

$$\begin{aligned}
h \cdot y_{e,t}^{(h)} =& -\mathbb{E}_t[m] + (h-1) \cdot \mathbb{E}_t[y_e^{(h-1)}] - \mathbb{E}_t[\Delta d] - \frac{1}{2} \cdot \mathbb{V}ar_t[m] \\
& - \frac{1}{2} \cdot \mathbb{V}ar_t[\Delta d - (h-1) \cdot y_e^{(h-1)}] - \mathbb{C}ov_t[m, \Delta d - (h-1) \cdot y_e^{(h-1)}] \\
=& \, y_{b,t}^{(1)} + (h-1) \cdot \mathbb{E}_t[y_e^{(h-1)}] - \mathbb{E}_t[\Delta d] \qquad \text{(IA.19)} \\
& - \frac{1}{2} \cdot \mathbb{V}ar_t[\Delta d - (h-1) \cdot y_e^{(h-1)}] - \mathbb{C}ov_t[m, \Delta d - (h-1) \cdot y_e^{(h-1)}]
\end{aligned}$$

Now, conjecture that $y_{e,t}^{(h-1)} = a_{y_e}^{(h-1)} + b_{y_e}^{(h-1)'} z_t$ and substitute such conjecture together with $\Delta d_t = [1_{xr_e} + \frac{\rho_e}{1-\rho_e} 1_{y_e}]' z_t + [1_{y_b} - \frac{1}{1-\rho_e} 1_{y_e}]' z_{t-1}$ into Equation IA.19 to get:

$$
\begin{aligned}
h \cdot y_{e,t}^{(h)} &= 1_{y_b}' z_t + (h-1) \cdot [a^{(h-1)} + b^{(h-1)'} (\phi + \Phi z_t)] - (1_{xr_e} + \frac{\rho_e}{1-\rho_e} 1_{y_e})' (\phi + \Phi z_t) - (1_{y_b} - \frac{1}{1-\rho_e} 1_{y_e}) z_t \\
&\quad - \frac{1}{2} \cdot (1_{xr_e} + \frac{\rho_e}{1-\rho_e} 1_{y_e} - (h-1) \cdot b_{y_e}^{(h-1)})' \Sigma (1_{xr_e} + \frac{\rho_e}{1-\rho_e} 1_{y_e} - (h-1) \cdot b_{y_e}^{(h-1)}) \\
&\quad + \lambda_t' \Omega \Sigma (1_{xr_e} + \frac{\rho_e}{1-\rho_e} 1_{y_e} - (h-1) \cdot b_{y_e}^{(h-1)}) \\
&= (h-1) \cdot [a^{(h-1)} + b^{(h-1)'} \phi] - (1_{xr_e} + \frac{\rho_e}{1-\rho_e} 1_{y_e})' \phi \\
&\quad - \frac{1}{2} (1_{xr_e} + \frac{\rho_e}{1-\rho_e} 1_{y_e} - (h-1) \cdot b_{y_e}^{(h-1)})' \Sigma (1_{xr_e} + \frac{\rho_e}{1-\rho_e} 1_{y_e} - (h-1) \cdot b_{y_e}^{(h-1)}) \\
&\quad + (1_{xr_e} + \frac{\rho_e}{1-\rho_e} 1_{y_e} - (h-1) \cdot b_{y_e}^{(h-1)})' \Sigma \Omega' \lambda \\
&\quad \{1_{y_b}' + (h-1) b_{y_e}^{(h-1)'} \Phi - (1_{xr_e} + \frac{\rho_e}{1-\rho_e} 1_{y_e})' \Phi - (1_{y_b} - \frac{1}{1-\rho_e} 1_{y_e}) \\
&\quad + (1_{xr_e} + \frac{\rho_e}{1-\rho_e} 1_{y_e} - (h-1) \cdot b_{y_e}^{(h-1)})' \Sigma \Omega' \Lambda \} z_t \\
&\Downarrow \\
y_{e,t}^{(h)} &= a_{y_e}^{(h)} \; + \; b_{y_e}^{(h)'} z_t
\end{aligned}
\tag{IA.20}
$$

with boundary conditions $a_{y_e}^{(0)} = b_{y_e}^{(0)} = 0$, and recursive parameters:

$$a_{y_e}^{(h)} = \frac{1}{h} \cdot \Big[(h-1) \cdot a_{y_e}^{(h-1)} - (1_{xr_e} + \frac{\rho_e}{1-\rho_e} 1_{y_e} - (h-1) \cdot b_{y_e}^{(h-1)})' (\phi - \Sigma \Omega' \lambda + 0.5 \cdot \Sigma (1_{xr_e} + \frac{\rho_e}{1-\rho_e} 1_{y_e} - (h-1) \cdot b_{y_e}^{(h-1)})) \Big]$$

$$b_{y_e}^{(h)'} = \frac{1}{h} \cdot \Big[\frac{1}{1-\rho_e} 1_{y_e}' - (1_{xr_e} + \frac{\rho_e}{1-\rho_e} 1_{y_e} - (h-1) \cdot b_{y_e}^{(h-1)})' (\Phi - \Sigma \Omega' \Lambda) \Big]$$

A.4.2 Dividend Strip Returns and Risk Premia

Since $R_{e,t}^{(h)} = P_{e,t}^{(h-1)} / P_{e,t-1}^{(h)} = e^{h \cdot y_{e,t-1}^{(h)} - (h-1) \cdot y_{e,t}^{(h-1)} + \Delta d_t}$, we have

$$
\begin{aligned}
r_{e,t}^{(h)} &= h \cdot y_{e,t-1}^{(h)} - (h-1) \cdot y_{e,t}^{(h-1)} + \Delta d_t \\
&= h \cdot y_{e,t-1}^{(h)} - (h-1) \cdot y_{e,t}^{(h-1)} + r_{e,t} + \frac{\rho_e}{1-\rho_e} \cdot y_{e,t} - \frac{1}{1-\rho_e} \cdot y_{e,t-1}
\end{aligned}
\tag{IA.21}
$$

which implies:

$$\mathbb{V}ar_t[r_e^{(h)}] \ = b_{\mathbb{V}_e}^{(h)'} \Sigma b_{\mathbb{V}_e}^{(h)} \tag{IA.22}$$

and

$$\begin{aligned}
\mathbb{E}_t[xr_e^{(h)}] \ &= h \cdot y_{e,t}^{(h)} - \frac{1}{1-\rho_e} \cdot y_{e,t} + \mathbb{E}_t[(h-1) \cdot y_e^{(h-1)} + r_e + \frac{\rho_e}{1-\rho_e} \cdot y_e] \\
&= a_{\mathbb{E}_e}^{(h)} \ + \ b_{\mathbb{E}_e}^{(h)'} z_t
\end{aligned} \tag{IA.23}$$

with boundary conditions $a_{y_e}^{(0)} = b_{y_e}^{(0)} = 0$, and recursive parameters:

$a_{\mathbb{E}_e}^{(h)} = h \cdot a_{y_e}^{(h)} - (h-1) \cdot a_{y_e}^{(h-1)} + (1_{xr_e} + \frac{\rho_e}{1-\rho_e} 1_{y_e} - (h-1) \cdot b_{y_e}^{(h-1)})' \phi$

$b_{\mathbb{E}_e}^{(h)'} = (1_{xr_e} + \frac{\rho_e}{1-\rho_e} 1_{y_e} - (h-1) \cdot b_{y_e}^{(h-1)})' \Phi + (h \cdot b_{y_e}^{(h)} - \frac{1}{1-\rho_e} 1_{y_e})'$

$b_{\mathbb{V}_e}^{(h)'} = (1_{xr_e} + \frac{\rho_e}{1-\rho_e} 1_{y_e} - (h-1) \cdot b_{y_e}^{(h-1)})'$

Finally, we have:

$$\begin{aligned}
\mathbb{E}_t[R_e^{(h)} - R_b^{(1)}] \ &= \mathbb{E}_t \left[e^{r_{e,t+1}^{(h)}} - e^{r_{b,t+1}^{(1)}} \right] \\
&= \mathbb{E}_t \left[e^{xr_{e,t+1}^{(h)}} - 1 \right] \cdot e^{y_{b,t}^{(1)}} \\
&= \ \left(e^{\mathbb{E}_t[xr_e^{(h)}] + 0.5 \cdot \mathbb{V}ar_t[r_e^{(h)}]} - 1 \right) \cdot e^{y_{b,t}^{(1)}}
\end{aligned} \tag{IA.24}$$

A.4.3 Dividend Strip Discount Rates

We can obtain each strip (log) discount rate from

$$\begin{aligned}
dr_{e,t}^{(h)} \ &= \mathbb{E}_t[\frac{1}{h} \cdot r_{e,t\to t+h}^{(h)}] \\
&= y_{e,t}^{(h)} \ + \ \mathbb{E}_t[\frac{1}{h} \cdot \Delta d_{t\to t+h}] \\
&= y_{e,t}^{(h)} \ + \ \frac{1}{h} \cdot \sum_{j=1}^{h} \mathbb{E}_t[\Delta d_{t+j}]
\end{aligned} \tag{IA.25}$$

where (conjecturing and verifying that $g^{(h)}_{e,t} = \frac{1}{h} \cdot \sum_{j=1}^{h} \mathbb{E}_t[\Delta d_{t+j}] = a^{(h)}_{g_e} + b^{(h)'}_{g_e} z_t$)

$$\begin{aligned}
\frac{1}{h} \cdot \sum_{j=1}^{h} \mathbb{E}_t[\Delta d_{t+j}] &= \frac{1}{h} \cdot \mathbb{E}_t[\Delta d_{t+1}] \ + \ \frac{h-1}{h} \mathbb{E}_t \left[\frac{1}{h-1} \cdot \sum_{j=1}^{h-1} \mathbb{E}_{t+1}[\Delta d_{t+1+j}] \right] \\
&= \frac{1}{h} \cdot \mathbb{E}_t[\Delta d_{t+1}] \ + \ \frac{h-1}{h} \cdot \mathbb{E}_t[a^{(h-1)}_g + b^{(h-1)'}_g z_{t+1}] \\
&= \frac{1}{h} \cdot \mathbb{E}_t[r_{e,t+1} + \frac{\rho_e}{1-\rho_e} \cdot y_{e,t+1} - \frac{1}{1-\rho_e} \cdot y_{e,t}] \ + \ \frac{h-1}{h} \cdot \mathbb{E}_t[a^{(h-1)}_g + b^{(h-1)'}_g z_{t+1}] \\
&= a^{(h)}_g \ + \ b^{(h)'}_g z_t \qquad \text{(IA.26)}
\end{aligned}$$

with boundary conditions $a^{(0)}_g = b^{(0)'}_g = 0$, and recursive parameters:

$$a^{(h)}_{g_e} = \tfrac{1}{h} \cdot (1_{xr_e} + \tfrac{\rho_e}{1-\rho_e} 1_{y_e})' \phi + \tfrac{h-1}{h} \cdot (a^{(h-1)}_{g_e} + b^{(h-1)'}_{g_e} \phi)$$

$$b^{(h)'}_{g_e} = \tfrac{1}{h} \cdot [(1_{xr_e} + \tfrac{\rho_e}{1-\rho_e} 1_{y_e})' \Phi + 1'_{y_b} - \tfrac{1}{1-\rho_e} 1'_{y_e}] + \tfrac{h-1}{h} \cdot b^{(h-1)'}_{g_e} \Phi$$

A.5 Dividend Strips (Exact Expressions)

In this section, we derive all expressions related to dividend strips using no approximation.

A.5.1 Dividend Strip Yields, Returns, and Risk Premia

Let $r_{e,t} = log(\frac{P_{e,t}+D_t}{P_{e,t-1}})$ represent the log return on a portfolio paying the cash flow D_t and define its dividend yield as $y_{e,t} = log(\frac{D_t}{P_{e,t}} + 1)$. In this case, the no arbitrage condition for the dividend strip is:

$$\begin{aligned}
\frac{P^{(h)}_{e,t}}{P_{e,t}} \equiv \ w^{(h)}_{e,t} &= \mathbb{E}_t \left[M_{t+1} \frac{P^{(h-1)}_{e,t+1}}{P_{e,t}} \right] \\
&= \mathbb{E}_t \left[w^{(h-1)}_{e,t+1} \cdot e^{m_{t+1} + r_{e,t+1} - y_{e,t+1}} \right] \qquad \text{(IA.27)}
\end{aligned}$$

with boundary condition $P^{(0)}_{e,t} = D_t$ so that $w^{(0)}_{e,t} = e^{y_{e,t}} - 1$.

The derivation below shows that, as long as $r_{e,t} \,\epsilon\, r_t$ and $y_{e,t} \,\epsilon\, s_t$, the no arbitrage condition in Equation IA.27 implies:

$$w^{(h)}_{e,t} = e^{a^{(h)}_{1,w_e} + b^{(h)'}_{1,w_e} z_t} \ - \ e^{a^{(h)}_{2,w_e} + b^{(h)'}_{2,w_e} z_t} \qquad \text{(IA.28)}$$

with boundary conditions $a_{1,w_e}^{(0)} = a_{2,w_e}^{(0)} = b_{2,w_e}^{(0)} = 0$ and $b_{1,w_e}^{(0)} = 1_{y_e}$, and recursive parameters:

$a_{k,w_e}^{(h)} = a_{k,w_e}^{(h-1)} + (b_{k,w_e}^{(h-1)} + 1_{xr_e} - 1_{y_e})'(\phi - \Sigma\Omega'\lambda + 0.5 \cdot \Sigma(b_{k,w_e}^{(h-1)} + 1_{xr_e} - 1_{y_e}))$

$b_{k,w_e}^{(h)'} = (b_{k,w_e}^{(h-1)} + 1_{xr_e} - 1_{y_e})'(\Phi - \Sigma\Omega'\Lambda)$

Using the strip weights in Equation IA.28, we can calculate strip realized returns and risk premia:

$$R_{e,t}^{(h)} = \frac{P_{e,t}^{(h-1)}}{P_{e,t-1}^{(h)}} = \frac{w_{e,t}^{(h-1)}}{w_{e,t-1}^{(h)}} \cdot e^{r_{e,t} - y_{e,t}} \tag{IA.29}$$

and

$$\begin{aligned} \mathbb{E}_t\left[R_e^{(h)} - R_b^{(1)}\right] &= \mathbb{E}_t\left[\frac{w_{e,t+1}^{(h-1)}}{w_{e,t}^{(h)}} \cdot e^{r_{e,t+1} - y_{e,t+1}}\right] - e^{y_{b,t}^{(1)}} \\ &= \frac{1}{w_{e,t}^{(h)}} \cdot \left[e^{a_{1,\mathbb{E}e}^{(h)} + b_{1,\mathbb{E}e}^{(h)'} z_t} - e^{a_{2,\mathbb{E}e}^{(h)} + b_{2,\mathbb{E}e}^{(h)'} z_t}\right] - e^{y_{b,t}^{(1)}} \end{aligned} \tag{IA.30}$$

with recursive parameters given by:

$\theta_{k,\mathbb{E}e}^{(h)} = b_{k,w_e}^{(h-1)} + 1_{xr_e} - 1_{y_e}$

$a_{k,\mathbb{E}e}^{(h)} = a_{k,w_e}^{(h-1)} + \theta_{k,\mathbb{E}e}^{(h)'}(\phi + 0.5 \cdot \Sigma\theta_{k,\mathbb{E}e}^{(h)})$

$b_{k,\mathbb{E}e}^{(h)'} = \theta_{k,\mathbb{E}e}^{(h)'}\Phi + 1_{y_b}'$

Since $D_t > 0$ implies $y_{e,t} > 0$ and $w_{e,t}^{(h)} > 0$, we can also define dividend strip yields, $y_{e,t}^{(h)}$, based on

$$y_{e,t}^{(h)} = \frac{1}{h} \cdot log\left(\frac{D_t}{P_{e,t}^{(h)}}\right) = \frac{1}{h} \cdot \left[log\left(e^{y_{e,t}} - 1\right) - log\left(w_{e,t}^{(h)}\right)\right] \tag{IA.31}$$

and solve for dividend strip (log) discount rates (see derivation below):

$$P_{e,t}^{(h)} = \mathbb{E}_t\left[D_{t+h}\right] \cdot e^{-h \cdot dr_{e,t}^{(h)}}$$

$$\Downarrow$$

$$\begin{aligned} dr_{e,t}^{(h)} &= \frac{1}{h} \cdot log\left(\mathbb{E}_t\left[\frac{D_{t+h}}{P_{e,t}^{(h)}}\right]\right) \\ &= \frac{1}{h} \cdot log\left(\frac{1}{w_{e,t}^{(h)}} \cdot \left[e^{a_{1,dr_e}^{(h)} + b_{1,dr_e}^{(h)\prime} z_t} \;-\; e^{a_{2,dr_e}^{(h)} + b_{2,dr_e}^{(h)\prime} z_t}\right]\right) \end{aligned} \tag{IA.32}$$

with boundary conditions $\theta_{1,dr_e}^{(1)} = 1_{xr_e}$, $\theta_{2,dr_e}^{(1)} = 1_{xr_e} - 1_{y_e}$, and $a_{k,dr_e}^{(0)} = 0$, and recursive parameters:

$$\begin{aligned} \theta_{k,dr_e}^{(h)\prime} &= \theta_{k,dr_e}^{(h-1)\prime}\Phi \;+\; 1_{xr_e} \;-\; 1_{y_e} \;+\; 1_{y_b} \\ a_{k,dr_e}^{(h)} &= a_{k,dr_e}^{(h-1)} \;+\; \theta_{k,dr_e}^{(h)\prime}\phi \;+\; 0.5 \cdot \theta_{k,dr_e}^{(h)\prime}\Sigma\theta_{k,dr_e}^{(h)} \\ b_{k,dr_e}^{(h)\prime} &= \theta_{k,dr_e}^{(h)\prime}\Phi \;+\; 1_{y_b} \end{aligned}$$

A.5.2 $w_{e,t}^{(h)}$ Derivation

Start by conjecturing that

$$\begin{aligned} w_{e,t}^{(h)} &= e^{x_{e,1,t}^{(h)}} \;-\; e^{x_{e,2,t}^{(h)}} \\ & e^{a_{1,w_e}^{(h)} + b_{1,w_e}^{(h)\prime} z_t} \;-\; e^{a_{2,w_e}^{(h)} + b_{2,w_e}^{(h)\prime} z_t} \end{aligned} \tag{IA.33}$$

In this case, the boundary condition $w_{e,t}^{(0)} = e^{y_{e,t}} - 1$ implies $a_{1,w_e}^{(0)} = a_{2,w_e}^{(0)} = b_{2,w_e}^{(0)} = 0$ and $b_{1,w_e}^{(0)} = 1_{y_e}$.

Moreover, substituting the $x_{e,k,t}^{(h)} = a_{k,w_e}^{(h)} + b_{k,w_e}^{(h)'} z_t$ conjecture in Equation IA.27 implies:

$$
\begin{aligned}
x_{e,k,t}^{(h)} &= \mathbb{E}_t[x_{e,k}^{(h-1)} + m + r_e - y_e] + \frac{\mathbb{V}ar_t[x_{e,k}^{(h-1)} + m + r_e - y_e]}{2} \\
&= -y_{b,t}^{(1)} + \mathbb{E}_t[x_{e,k}^{(h-1)} + r_e - y_e] + \frac{\mathbb{V}ar_t[x_{e,k}^{(h-1)} + r_e - y_e]}{2} + \mathbb{C}ov_t[m, x_{e,k}^{(h-1)} + r_e - y_e] \\
&= a_{k,w_e}^{(h-1)} + (b_{k,w_e}^{(h-1)} + 1_{xr_e} - 1_{y_e})'(\phi + \Phi z_t) \\
&\quad + \frac{1}{2}(b_{k,w_e}^{(h-1)} + 1_{xr_e} - 1_{y_e})'\Sigma(b_{k,w_e}^{(h-1)} + 1_{xr_e} - 1_{y_e}) - \lambda_t'\Omega\Sigma(b_{k,w_e}^{(h-1)} + 1_{xr_e} - 1_{y_e}) \\
&= a_{k,w_e}^{(h-1)} + (b_{k,w_e}^{(h-1)} + 1_{xr_e} - 1_{y_e})'\phi + \frac{1}{2}(b_{k,w_e}^{(h-1)} + 1_{xr_e} - 1_{y_e})'\Sigma(b_{k,w_e}^{(h-1)} + 1_{xr_e} - 1_{y_e}) \\
&\quad - (b_{k,w_e}^{(h-1)} + 1_{xr_e} - 1_{y_e})'\Sigma\Omega'\lambda \\
&\quad + [(b_{k,w_e}^{(h-1)} + 1_{xr_e} - 1_{y_e})'\Phi - (b_{k,w_e}^{(h-1)} + 1_{xr_e} - 1_{y_e})'\Sigma\Omega'\Lambda]z_t \\
&= a_{k,w_e}^{(h)} \; + \; b_{k,w_e}^{(h)'} z_t
\end{aligned} \tag{IA.34}
$$

with recursive parameters:

$$
\begin{aligned}
a_{k,w_e}^{(h)} &= a_{k,w_e}^{(h-1)} + (b_{k,w_e}^{(h-1)} + 1_{xr_e} - 1_{y_e})'(\phi - \Sigma\Omega'\lambda + 0.5 \cdot \Sigma(b_{k,w_e}^{(h-1)} + 1_{xr_e} - 1_{y_e})) \\
b_{k,w_e}^{(h)'} &= (b_{k,w_e}^{(h-1)} + 1_{xr_e} - 1_{y_e})'(\Phi - \Sigma\Omega'\Lambda)
\end{aligned}
$$

A.5.3 $dr_{e,t}^{(h)}$ Derivation

Start from

$$
\begin{aligned}
dr_{e,t}^{(h)} &= \frac{1}{h} \cdot log \left(\mathbb{E}_t \left[\frac{D_{t+h}}{P_{e,t}^{(h)}} \right] \right) \\
&= \frac{1}{h} \cdot log \left(\mathbb{E}_t \left[\frac{D_{t+h}}{P_{e,t+h}} \cdot \frac{P_{e,t+h}}{P_{e,t}} \cdot \frac{P_{e,t}}{P_{e,t}^{(h)}} \right] \right) \\
&= \frac{1}{h} \cdot log \left(\frac{1}{w_{e,t}^{(h)}} \cdot \mathbb{E}_t \left[(e^{y_{e,t+h}} - 1) \cdot e^{\Sigma_{\tau=1}^{h} \Delta p_{t+\tau}} \right] \right) \\
&= \frac{1}{h} \cdot log \left(\frac{1}{w_{e,t}^{(h)}} \cdot \mathbb{E}_t \left[e^{y_{e,t+h} + \Sigma_{\tau=1}^{h} (r_{e,t+\tau} - y_{e,t+\tau})} \right] - \mathbb{E}_t \left[e^{\Sigma_{\tau=1}^{h} (r_{e,t+\tau} - y_{e,t+\tau})} \right] \right) \qquad \text{(IA.35)}
\end{aligned}
$$

Now, note that a few steps of algebra yield:

$$
y_{e,t+h} + \sum_{\tau=1}^{h} (r_{e,t+\tau} - y_{e,t+\tau}) = \left(\sum_{\tau=1}^{h} \theta_{1,dr_e}^{(\tau)} \right) \cdot \phi + \left(\theta_{1,dr_e}^{(h)'} \Phi + 1_{y_b} \right) z_t + \sum_{\tau=1}^{h} \theta_{1,dr_e}^{(\tau)} \widetilde{z}_{t+h-\tau+1}
$$

$$
\sum_{\tau=1}^{h} (r_{e,t+\tau} - y_{e,t+\tau}) = \left(\sum_{\tau=1}^{h} \theta_{2,dr_e}^{(\tau)} \right) \cdot \phi + \left(\theta_{2,dr_e}^{(h)'} \Phi + 1_{y_b} \right) z_t + \sum_{\tau=1}^{h} \theta_{2,dr_e}^{(\tau)} \widetilde{z}_{t+h-\tau+1}
$$

and substituting these equations into Equation IA.35 implies

$$
dr_{e,t}^{(h)} = \frac{1}{h} \cdot log \left(\frac{1}{w_{e,t}^{(h)}} \cdot \left[e^{a_{1,dr_e}^{(h)} + b_{1,dr_e}^{(h)'} z_t} - e^{a_{2,dr_e}^{(h)} + b_{2,dr_e}^{(h)'} z_t} \right] \right) \qquad \text{(IA.36)}
$$

with boundary conditions $\theta_{1,dr_e}^{(1)} = 1_{xr_e}$, $\theta_{2,dr_e}^{(1)} = 1_{xr_e} - 1_{y_e}$, and $a_{k,dr_e}^{(0)} = 0$, and recursive parameters:

$$
\begin{aligned}
\theta_{k,dr_e}^{(h)'} &= \theta_{k,dr_e}^{(h-1)'} \Phi + 1_{xr_e} - 1_{y_e} + 1_{y_b} \\
a_{k,dr_e}^{(h)} &= a_{k,dr_e}^{(h-1)} + \theta_{k,dr_e}^{(h)'} \phi + 0.5 \cdot \theta_{k,dr_e}^{(h)'} \Sigma \theta_{k,dr_e}^{(h)} \\
b_{k,dr_e}^{(h)'} &= \theta_{k,dr_e}^{(h)'} \Phi + 1_{y_b}
\end{aligned}
$$

B The VAR and SDF Estimation Procedure

As discussed in Subsection 3.3, we estimate our no arbitrage term structure model relying on an adaptation of the regression-based method proposed by Adrian, Crump, and Moench (2013) to our particular empirical analysis. The procedure is based on three simple steps, which provide consistent estimates (for π, Π, Σ, λ, and Λ) while imposing the no arbitrage restrictions in Equations 12 and 13.

In Step 1, we obtain consistent estimates for π, Π, Σ through equation by equation OLS applied to the VAR system in Equation 6. These estimates are consistent but do not impose the no arbitrage restrictions in Equations 12 and 13, and thus do not allow us to directly recover λ and Λ and obtain our term structures of risk premia.

In Step 2, we start by defining $xr^{(adj)}_{j,t+1} = xr_{j,t+1} + 0.5 \cdot 1'_{xr_j}\Sigma 1_{xr_j}$ and noting that the no arbitrage conditions in Equations 10 and 11 imply:

$$\begin{aligned} xr^{(adj)}_{j,t+1} &= 1'_{xr_j}\Sigma\Omega'\lambda_t \;+\; \widetilde{xr}_{j,t+1} \\ &= 1'_{xr_j}\Sigma\Omega'\lambda \;+\; 1'_{xr_j}\Sigma\Omega'\Lambda z_t \;+\; \widetilde{xr}_{j,t+1} \\ &= \sum_{k=1}^{n^*_{xr}}\lambda_k \cdot \mathbb{C}ov[\widetilde{xr}^*_k, \widetilde{xr}_j] + \sum_{k=1}^{n^*_{xr}}\sum_{l=1}^{n_s}\Lambda_{k,l} \cdot \mathbb{C}ov[\widetilde{xr}^*_k, \widetilde{xr}_j] \cdot s_{l,t} + \widetilde{xr}_{j,t+1} \end{aligned} \tag{IA.37}$$

where λ_k is the element of λ associated with the risk price of $\widetilde{xr}^*_k$ (other elements of λ are zero) and $\Lambda_{k,l}$ is the element of Λ associated with the variation in the risk price of $\widetilde{xr}^*_k$ due to variation in $s_{l,t}$ (other elements of Λ are zero).

So our Step 2 could be to use the initial consistent estimate of Σ from Step 1 and estimate λ and Λ from a panel OLS regression of $xr^{(adj)}_{j,t+1}$ (using all $r_j \in r$) on covariances with risk factors, $\mathbb{C}ov[\widetilde{xr}^*_k, \widetilde{xr}_j]$, as well as on the same covariances interacted with each state variable. However, we make two modifications to this approach to account for two important aspects of our empirical analysis. First, the $\{r^{(Anom)}_{e,t}\}$ set is an order of magnitude larger than the $\{r^{(Dur)}_{b,t}\}$ and $\{r^{(Dur)}_{\pi,t}\}$ sets. So, instead of including all $\{r^{(Anom)}_{e,t}\}$ returns on the left hand side of Equation IA.37, we include only $[xr^{(PC1)}_{e,t}, xr^{(PC2)}_{e,t}, xr^{(PC3)}_{e,t}]$, which are the three linear combinations of $\{r_{e,t}^{(Anom)}\}$ that explain the most variability in the long-short anomaly returns.[IA.1] Second, the $\widehat{r}_{\pi,t}^{(h)}$ returns in $\{r_{\pi,t}^{(Dur)}\}$ are not tradable, and thus we do not expect Equation IA.37 to perfectly hold for them. So, we use only the identifying assumption that shocks to $\widehat{r}_{\pi,t}^{(h)}$ have mean zero instead of the stronger assumption that they have mean zero and are orthogonal to the state vector, covariances, and their interactions.[IA.2] On a practical level, this means we first estimate $\overline{\lambda}_k = \lambda_k + \Lambda_k'\overline{s}$ values from the cross-sectional regression

$$\overline{xr}_{j,t+1}^{(adj)} = \sum_{k=1}^{n_{xr}^*} \overline{\lambda}_k \cdot \mathbb{C}ov[\widetilde{xr}_k^*, \widetilde{xr}_j] \tag{IA.38}$$

while including the average $\widehat{r}_{\pi,t}^{(h)}$ values among the set of $\overline{xr}_j$ considered. Then, we estimate Λ from the panel regression

$$xr_{j,t+1}^{(adj)} - \sum_{k=1}^{n_{xr}^*} \overline{\lambda}_k \cdot \mathbb{C}ov[\widetilde{xr}_k^*, \widetilde{xr}_j] = \sum_{k=1}^{n_{xr}^*} \sum_{l=1}^{n_s} \Lambda_{k,l} \cdot \mathbb{C}ov[\widetilde{xr}_k^*, \widetilde{xr}_j] \cdot (s_{l,t} - \overline{s}_l) + \widetilde{xr}_{j,t+1} \tag{IA.39}$$

while removing the $\widehat{r}_{\pi,t}^{(h)}$ values from the set of $xr_{j,t}$ considered. Then, we recover $\lambda_k = \overline{\lambda}_k - \Lambda_k'\overline{s}$.

Finally, our Step 3 directly imposes the no arbitrage conditions by updating our π_{xr} and Π_{xr} estimates to satisfy Equations 12 and 13 given our λ and Λ estimates obtained in Step 2. This allows us to update our π, Π, and Σ estimates accordingly, producing the final consistent estimates for π, Π, Σ, λ, and Λ that satisfy our no arbitrage conditions.[IA.3]

[IA.1] Letting $w^{(PCk)}$ represent the weights of PCk on all returns in $\{r_{e,t}^{(Anom)}\}$, note the PCk return adjusted for the Jensen's inequality is $xr_{e,t}^{(PCk)} + 0.5 \cdot \sum_{r_j \in \{r_{e,t}^{(Anom)}\}} w_j^{(PCk)} \cdot \mathbb{V}ar[xr_j]$ and not $xr_{e,t}^{(PCk)} + 0.5 \cdot \mathbb{V}ar[xr_e^{(PCk)}]$. The economic reason is that $xr_{e,t}^{(PCk)}$ is not the log excess return on a tradable portfolio. Instead, it is the weighted average of the log excess returns on the tradable portfolios in $\{r_{e,t}^{(Anom)}\}$.

[IA.2] Subsection D.8 considers an alternative specification that treats $\widehat{r}_{\pi,t}^{(h)}$ as tradable, thereby relying on the stronger assumption that $\widehat{r}_{\pi,t}^{(h)}$ shocks have mean zero and are orthogonal to the state vector, covariances, and their interactions. The results are similar to the ones we report in the main text.

[IA.3] Internet Appendix D.7 provides result (very similar to our baseline analysis) in which we consider a more involved estimation procedure. Specifically, we iterate on Steps 2 and 3 until Σ converges, always relying on the latest Σ estimate when estimating the panel regression in Step 2.

C Data Sources and Measurement (Variables in s_t and r_t)

As discussed in Subsection 3.2, we rely on a multivariate time series of overlapping monthly observations in which yields are in annual units and measured at the end of each month whereas flow variables (i.e., returns and inflation rate) have annual measurement (i.e., t and $t-1$ have a one year gap). The dataset covers from 01-1972 to 12-2022, with the initial date constrained by the availability of information on some equity signals as well as on the real and nominal bond yields described below.

C.1 Nominal Bonds

Our state vector contains the level and slope of nominal bond yields. We measure $y_{b,t}^{(Level)} = y_{b,t}^{(1)} = \widehat{y}_{b,t}^{(1)}$ and $y_{b,t}^{(Slope)} = \widehat{y}_{b,t}^{(15)} - \widehat{y}_{b,t}^{(1)}$, with hats indicating that these bond yields are obtained directly from external data instead of being implied from our model. We obtain $\{\widehat{y}_{b,t}^{(h)}\}_{h=1}^{h=30}$ from the the updated version of the interpolated bond yield dataset of Liu and Wu (2021).[IA.4] Maturities from 1 to 15 years are available over our entire sample period. However, maturities from 16 to 20 years are only available starting in 07-1981 and maturities from 21 to 30 years are only available starting on 11-1985. For these maturities, missing monthly yields are obtained by linear interpolation between $\widehat{y}_{b,t}^{(15)}$ and $\widehat{y}_{b,t}^{(30)}$, with the latter measured from the GS30 series of the Federal Reserve Economic Data (FRED). Note that only $\widehat{y}_{b,t}^{(1)}$ and $\widehat{y}_{b,t}^{(15)}$ are used in our model, and they do not require this extra linear interpolation step. However, we use $\widehat{y}_{b,t}^{(h)}$ for other hs in our preliminary analysis in Section 1.

We form our $\{r_{b,t}^{(Dur)}\} \subset r_t$ using the seven CRSP Fama bond portfolios (labeled $r_{b,t}^{(H1\text{to}H2)}$), which reflect Treasury bond portfolios with bond maturities between $H1$ and $H2$ years (the shortest duration portfolio has $H1 = 0$ and $H2 = 1$ and the longest duration portfolio has

[IA.4] We obtain the updated version of the interpolated bond yield dataset of Liu and Wu (2021) from https://sites.google.com/view/jingcynthiawu/yield-data. As shown in Liu and Wu (2021), their non-parametric kernel-smoothing interpolation offers some important advantage over the estimation of Gürkaynak, Sack, and Wright (2007), which relies on the parametric interpolation model of Svensson (1994) (an extension of Nelson and Siegel (1987)). However, Subsection D.5 repeats our analysis using the bond yields from Gürkaynak, Sack, and Wright (2007), with results that are similar to the ones we report in the main text.

$H1 = 10$ and $H2 = 30$). We then set $\widetilde{xr}_{b,t}^{(Level)} = \widetilde{xr}_{b,t}^{(5\text{to}10)}$ and $\widetilde{xr}_{b,t}^{(Slope)} = \widetilde{xr}_{b,t}^{(10\text{to}30)} - \widetilde{xr}_{b,t}^{(0\text{to}1)}$. Note that our $\{r_{b,t}^{(Dur)}\}$ is composed of tradable portfolios of Treasury bonds. This would not be the case if we constructed $\{r_{b,t}^{(Dur)}\}$ using nominal bond strip returns calculated from their yields (i.e., $\widehat{r}_{b,t}^{(h)} = h \cdot \widehat{y}_{b,t-1}^{(h)} - (h-1) \cdot \widehat{y}_{b,t}^{(h-1)}$). However, Subsection D.6 provides results (similar to the ones we report in the main text) in which $\{r_{b,t}^{(Dur)}\}$ is formed from $\widehat{r}_{b,t}^{(h)}$ with $h = 2, 3, ..., 15$, which are the maturities (beyond $h = 1$) for which the yield calculation does not require the extra linear interpolation step explained in the prior paragraph.

C.2 Real Bonds

Our state vector also contains the level and slope of real bond yields ($y_{\pi,t}^{(Level)}$ and $y_{\pi,t}^{(Slope)}$). However, their measurement is more complicated. In particular, we rely on three datasets:

1. yCM: This is the dataset from Chernov and Mueller (2012), which contains quarterly real bond yields from Q3-1971 to Q4-2002, with annual maturities of 1, 2, 3, 5, 7, and 10 years. It is based on a no arbitrage term structure model with five factors (three of which are latent). The model specification and estimation use information on macroeconomic activity (e.g., GDP and CPI growth), survey-based forecasts of inflation, nominal Treasury yields, and TIPS yields. We download the dataset from https://sites.google.com/site/mbchernov/home/published-papers.

2. yFED: This is the dataset from the Cleveland Fed, which contains monthly real bond yields starting in 01-1982, with annual maturities of 1 and 10 years. It is based on a model that uses nominal Treasury yields, inflation data, inflation swaps, and survey-based measures of inflation expectations. We download the dataset from https://www.clevelandfed.org/indicators-and-data/inflation-expectations.

3. yTIPS: This is the dataset from Gürkaynak, Sack, and Wright (2010), which contains real bond yields starting in 01-1999, with annual maturities of 2 to 20 years. It is based on a yield smoothing model applied to Treasury Inflation-Protected Securities (TIPS). They use the parametric interpolation model of Svensson (1994) (an extension of Nelson

and Siegel (1987)), analogously to what Gürkaynak, Sack, and Wright (2007) do for nominal bond yields. We download the dataset from https://www.federalreserve.gov/data/tips-yield-curve-and-inflation-compensation.htm.

Since the longest maturity we have over our full sample is 10 years, we set $y_{\pi,t}^{(Level)} = \widehat{y}_{\pi,t}^{(1)}$ and $y_{\pi,t}^{(Slope)} = \widehat{y}_{\pi,t}^{(10)} - \widehat{y}_{\pi,t}^{(1)}$. We obtain $\widehat{y}_{\pi,t}^{(h)}$ for $h = 1, 2, ..., 10$ over the period from 01-1972 to 12-2002 from the real yields available in yCM.[IA.5] For months after 12-2002, we obtain $\widehat{y}_{\pi,t}^{(1)}$ from yFED (the only available source in the three datasets), $\widehat{y}_{\pi,t}^{(10)}$ from yFED in 2003 and from yTIPS starting in 01-2004, and other $\widehat{y}_{\pi,t}^{(h)}$ values from yTIPS.[IA.6]

To form our $\{r_{\pi,t}^{(Dur)}\} \subset r_t$, we start from returns constructed from yields, $\widehat{r}_{\pi,t}^{(h)} = \Delta\pi_t + h \cdot \widehat{y}_{\pi,t-1}^{(h)} - (h-1) \cdot \widehat{y}_{\pi,t}^{(h-1)}$ for $h = 1, 2, ..., 10$. These $\widehat{r}_{\pi,t}^{(h)}$ returns are not tradable, and thus we use them in the estimation in a way that is robust to this fact (see Internet Appendix B for details). However, our approach limits our ability to extract information about the inflation risk premia dynamics from these $\widehat{r}_{\pi,t}^{(h)}$ returns. So, we add to $\{r_{\pi,t}^{(Dur)}\}$ log returns on gold obtained from Bloomberg ($r_{Gold,t}$) since gold is often viewed by market participants as a hedge for shocks to expected inflation.

As discussed in the Subsection 3.1, we use the level factor $\widetilde{xr}_{\pi,t}^{(Level)} = \widetilde{xr}_{\pi,t}^{(1)} = \widetilde{\Delta\pi}_t$ (see Footnote 13). We then set $\widetilde{xr}_{\pi,t}^{(Slope)} = \widetilde{xr}_{Gold,t} - \widetilde{xr}_{\pi,t}^{(1)} = \widetilde{xr}_{Gold,t} - \widetilde{\Delta\pi}_t$. This is in line with our interpretation that $r_{Gold,t}$ (at least partially) reflects shocks to expected inflation. Importantly, this approach ensures the $\widehat{r}_{\pi,t}^{(h)}$ artificial returns (which embed the measurement errors of the $\widehat{y}_{\pi,t}^{(h)}$ values) are not used as priced factors in the SDF.

[IA.5] For the real yields in yCM, we use the latest quarter available in months that are not at quarter ends. For instance, the real yields from 10-2002 and 11-2002 reflect the real yields from Q2-2002. Moreover, for maturities $h = 4, 6, 8, 9$ (which are not available in yCM), we use a linear interpolation between the real yields on the two closest maturities available.

[IA.6] We give a preference to real yields from yTIPS over yFED since they require fewer economic assumptions given that they are based on a yield smoothing model applied to TIPS. However, the prices of TIPS were unreliable in the early years of their availability due to limited maturities and liquidity (see the discussion in D'Amico, Kim, and Wei (2018) and Chernov and Mueller (2012)). In fact, Gürkaynak, Sack, and Wright (2010) only start applying the Svensson (1994) smoothing model in 01-2004 in yTIPS, relying on the restricted estimation from Nelson and Siegel (1987) in previous months. So, we only use yTIPS to obtain $\widehat{y}_{\pi,t}^{(10)}$ starting in 01-2004. For h values other than 1 and 10, we have no alternative other than to use yTIPS starting in 2003.

Given the difficulties in measuring yields and returns associated with real bonds, Subsection D.9 considers a specification that entirely removes $[\Delta\pi_t,\ y_{\pi,t}^{(Level)},\ y_{\pi,t}^{(Slope)}]$ from the state vector, $\{r_{\pi,t}^{(Dur)}\}$ from r_t, and $[\widetilde{xr}_{\pi,t}^{(Level)},\ \widetilde{xr}_{\pi,t}^{(Slope)}]$ from the SDF. That analysis leads to results that are similar to the ones we report in the main text. However, in that case we cannot separately identify the effect of term risk premia and inflation risk premia implicit in the bond risk premia. So, the results from that alternative specification are based on the decomposition in Equation 3 instead of Equation 35.

C.3 Equities

We have $y_{e,t} \in s_t$, $r_{e,t} \in r_t$, and $\widetilde{xr}_{e,t} \in \widetilde{xr}_t^*$. The aggregate annual equity return, $r_{e,t}$, and the aggregate annual dividend yield, $y_{e,t} = log(D_t/P_{e,t} + 1)$, are measured exactly as in Gonçalves (2021). In particular, annual dividends are based on the sum of dividends over a 12-month window with no compounding to avoid introducing properties of returns into dividends (see Binsbergen and Koijen (2010) and Chen (2009)). Moreover, dividends include M&A paid in cash (as suggested by Allen and Michaely (2003)). Both aspects serve to make $y_{e,t}$ more stationary (consistent with Koijen and Nieuwerburgh (2011), Sabbatucci (2022), and Gonçalves (2021)). However, Subsection D.2 considers an alternative specification that does not include M&A paid in cash in the dividend measurement, with results similar to the ones reported in the main text.

We also have $[y_{e,t}^{(PC1)},\ y_{e,t}^{(PC2)},\ y_{e,t}^{(PC3)}] \subset s_t$, $\{r_{e,t}^{(Anom)}\} \subset r_t$, and $[\widetilde{xr}_{e,t}^{(PC1)}, \widetilde{xr}_{e,t}^{(PC2)}, \widetilde{xr}_{e,t}^{(PC3)}] \subset \widetilde{xr}_t^*$. Following GKK, $\{r_{e,t}^{(Anom)}\}$ contains long and short value-weighted tercile portfolios associated with 51 common anomaly signals (so 102 portfolios in total). We obtain the stock-level signals from Jensen, Kelly, and Pedersen (2023), Chen and Zimmermann (2022), and CRSP+COMPUSTAT (in this order). The end result is that 15 signals are constructed from CRSP and COMPUSTAT directly, 2 signals come from Chen and Zimmermann (2022) (Industry Momentum and Short Interest), and the remaining 34 signals come from Jensen, Kelly, and Pedersen (2023).[IA.7] Following the exact methodology of GKK, we construct

[IA.7] The 15 signals we construct directly from CRSP and COMPUSTAT datasets are the Composite Issuance, principal component weights and apply those weights to stock-level returns and yields, which gives us $[y_{e,t}^{(PC1)},\ y_{e,t}^{(PC2)},\ y_{e,t}^{(PC3)}]$ and $[xr_{e,t}^{(PC1)}, xr_{e,t}^{(PC2)}, xr_{e,t}^{(PC3)}]$.

Our sample period goes from 01-1972 to 12-2022, which ensures nominal bond yields are at similar levels at the beginning and end of our sample period (see the discussion in Subsection 4.2). However, annual returns on some anomaly portfolios are not available as early as 01-1972. In particular, one anomaly has monthly portfolio returns starting in 07-1973 and two anomalies have monthly portfolio returns starting in 01-1973. Moreover, twenty anomalies have monthly portfolio returns starting in 07-1971 (which does not allow us to create annual returns as of 01-1972). We input monthly portfolio returns for missing months following the expectation-maximization algorithm suggested in McCracken and Ng (2016) (which is similar to the one in Stock and Watson (2002)). Specifically, we start by replacing missing monthly returns with the respective averages. Then, we estimate principal components and replace the originally missing monthly returns with the ones implied from the principal components. We repeat this process until the inputted monthly returns converge. For our inputted long and short monthly returns to be consistent with inputted long-short returns, we apply this process separately to long-short returns (obtaining $\widehat{xr}_t^{L-S}$) as well as to long and short returns (obtaining $\widehat{xr}_t^{Av} = 0.5 \cdot \widehat{xr}_t^{L} + 0.5 \cdot \widehat{xr}_t^{S}$). We then set $xr_t^L = \widehat{xr}_t^{Av} + 0.5 \cdot \widehat{xr}_t^{L-S}$ and $xr_t^S = \widehat{xr}_t^{Av} - 0.5 \cdot \widehat{xr}_t^{L-S}$ so that we have, by construction, $xr_t^L - xr_t^S = \widehat{xr}_t^{L-S}$. We impute yields on the portfolios associated with the three anomalies that start in 1973 following an analogous approach. Note that our findings are not driven by this imputation process since (as detailed in Subsection D.3) we obtain similar results using only portfolios sorted on the equity duration measure of Gonçalves (2021), which do not require any imputation.

Debt Issuance, Dividend/Price, Industry Momentum-Reversals, Industry Relative Reversals, Industry Relative Reversals (LV), Investment/Capital, Momentum-Reversals, Return on Assets (Q), Return on Market Equity, Share Repurchases, Share Volume, Value-Momentum, Value-Momentum-Prof, Value-Profitability.

D Supplementary Empirical Results

This section presents results from nine alternative empirical specifications for our no arbitrage term structure model. The core results are provided in Figures IA.1 to IA.3. In particular, Figure IA.1 shows that, for all nine alternative specifications, the term structures of inflation and term RP are upward sloping whereas the term structures of cash flow RP are hump-shaped, with relatively low RP at long dividend strip maturities. Moreover, Figure IA.2 shows that, for all nine alternative specifications, time variation in equity RP is driven by cash flow RP for short-maturity dividend strips and by term and inflation RP for long-maturity dividend strips. Finally, Figure IA.3 shows that the term structures of correlations between the different equity risk premia components is an important driver of the risk premia time variation results. In particular, term and inflation RP have a very weak correlation with equity RP at short dividend strip maturities, but a very strong correlation at long dividend strip maturities. Below, we describe the nine alternative specifications considered.

D.1 Dividend Strips Under Log-Linear Approximation

Our baseline analysis solves for dividend strip pricing information (e.g., returns and risk premia) using exact expressions that are highly non-linear even in logs (with derivations provided in Section A.5). While this approach is consistent with GKK, it could be that our main findings are due to the strong non-linearities of the solution (which can exacerbate any potential effect of model mispecification). To demonstrate that this is not the case, Figures IA.1(a) to IA.3(a) replicate our main results using an approximate solution based on the log-linear approximation of Gao and Martin (2021) (with derivations provided in Section A.4). In this case, $y_{e,t}^{(h)}$ is linear in z_t, leading to log-linear dividend strip risk premia.

D.2 Dividends that do Not Incorporate M&A Paid in Cash

Our baseline analysis measures the aggregate annual dividend yield, $y_{e,t}$, exactly as in Gonçalves (2021). As discussed in Section C.3, this implies our aggregate dividend measure incorporates M&A paid in cash (as suggested by Allen and Michaely (2003) and Sabbatucci (2022)). While this approach ensures D_t better reflects the aggregate dividends paid to investors and leads to a more stationary $y_{e,t}$ (consistent with Sabbatucci (2022) and Gonçalves (2021)), it deviates from the dividend measurement in GKK, which relies only on ordinary dividends. To demonstrate that our core findings are not driven by this difference in dividend measurement, Figures IA.1(b) to IA.3(b) replicate our main results with D_t measured from ordinary dividends only.

D.3 Replacing Anomalies with Equity Duration Portfolios

Our baseline analysis uses as equity test assets 102 long and short portfolios on 51 equity anomaly strategies. While this approach follows GKK, it differs from how we specify test assets for nominal and real bonds, which are based on bond portfolios that vary in cash flow duration. To demonstrate that our core findings are not driven by this difference in the specification of test assets, Figures IA.1(c) to IA.3(c) replicate our main results using as equity test assets tercile portfolios sorted on equity duration (we obtain similar results with quintiles), with the firm-year equity duration measure following Gonçalves (2021).[IA.8] This alternative specification also replaces the three PC-based equity factors in the SDF with a single equity duration factor (based on returns on the high-low duration portfolio).

[IA.8] Specifically, at June of each year t (with t from 1970 to 2022), we form three value-weighted portfolios by sorting stocks based on equity duration to construct our monthly portfolio returns over the subsequent twelve months. We then calculate annual log returns on a monthly frequency over our entire sample (from 01-1972 to 12-2022). We use NYSE breakpoints to define thresholds to assign stocks into portfolios, but form portfolios with all stocks in the sample. The low (high) duration portfolio is based on stocks with equity duration below the 30% (above the 70%) NYSE breakpoints. The mid duration portfolio contains all stocks that are not assigned to the high or low duration portfolios. The firm-year equity duration dataset from Gonçalves (2021) starts in 1973 (and is available under https://andreigoncalves.com/). To obtain equity duration from 1970 to 1972, we combine the first rolling window VAR estimated in Gonçalves (2021) with firm-level state variables evaluated as of June of 1970, 1971, and 1972. While this approach induces a small look-ahead bias in our equity duration measure since the first rolling window VAR estimated in Gonçalves (2021) uses data up to the fiscal year ending in calendar year 1972, this issue only affects equity duration from 1970 to 1972 and is not the driver of our results as it is not present in our baseline analysis.

D.4 Three Nominal and Real Bond Yields in State Vector

Our baseline analysis keeps two nominal bond yield state variables ($y_{b,t}^{(Level)}$ and $y_{b,t}^{(Slope)}$) and two real bond yield state variables ($y_{\pi,t}^{(Level)}$ and $y_{\pi,t}^{(Slope)}$). While it is well-known in the bond term structure literature that two bond yield factors capture much of the variability in bond yields, many papers use a third factor to capture some of the more nuanced movements in the bond yield term structure. So, Figures IA.1(d) to IA.3(d) replicate our main results using three nominal bond yield state variables ($\widehat{y}_{b,t}^{(1)}$, $\widehat{y}_{b,t}^{(5)}$, and $\widehat{y}_{b,t}^{(15)}$) and three real bond yield state variables ($\widehat{y}_{\pi,t}^{(1)}$, $\widehat{y}_{\pi,t}^{(5)}$, and $\widehat{y}_{\pi,t}^{(10)}$).

D.5 Nominal Bond Yields from Gürkaynak, Sack, and Wright (2007)

Our baseline analysis measures $\widehat{y}_{b,t}^{(h)}$ (used in $y_{b,t}^{(Level)}$ and $y_{b,t}^{(Slope)}$) based on the interpolated bond yield dataset of Liu and Wu (2021) (based on a non-parametric kernel-smoothing interpolation), which offers some important advantage over the estimation of Gürkaynak, Sack, and Wright (2007) that relies on the parametric interpolation model of Svensson (1994) (an extension of Nelson and Siegel (1987)). To demonstrate that our core findings are not sensitive to the choice $\widehat{y}_{b,t}^{(h)}$ measurement, Figures IA.1(e) to IA.3(e) replicate our main results while measuring $\widehat{y}_{b,t}^{(h)}$ using the interpolated bond yield dataset of Gürkaynak, Sack, and Wright (2007) (obtained from https://www.federalreserve.gov/data/nominal-yield-curve.htm).

D.6 Nominal Bond Returns Based on Yields

Our baseline analysis uses as nominal bond test assets seven CRSP Fama bond portfolios, which are tradable. An alternative approach would be to use artificial nominal bond strip returns given by $\widehat{r}_{b,t}^{(h)} = h \cdot \widehat{y}_{b,t-1}^{(h)} - (h-1) \cdot \widehat{y}_{b,t}^{(h-1)}$. While these returns are not tradable, they are often used in the literature to proxy for bond returns (e.g., Binsbergen (2025)). So, Figures IA.1(f) to IA.3(f) replicate our main results with $\widehat{r}_{b,t}^{(2)}$ to $\widehat{r}_{b,t}^{(15)}$ as the nominal bond test assets.

D.7 Estimation Based on Iterative Process Until Σ Converges

As detailed in Section B, we estimate our no arbitrage term structure model relying on an adaptation of the regression-based method proposed by Adrian, Crump, and Moench (2013) to our particular empirical analysis. The procedure is based on three simple steps, which provide consistent estimates (for π, Π, Σ, λ, and Λ) while imposing the no arbitrage restrictions in Equations 12 and 13. The first estimation step produces a consistent estimate of Σ, which is used in the second step to estimate λ and Λ, which in turn allow us to update Σ. Our baseline analysis only performs these three steps once to keep the estimation as simple as possible. However, we could iterate this process until the Σ estimate converges. Figures IA.1(g) to IA.3(g) replicate our main results doing that.

D.8 Estimation that Treats Real Bond Returns as Tradable

As detailed in Section B, when estimating our no arbitrage term structure model, we account for the fact that the real bond test assets based on $\widehat{r}_{\pi,t}^{(h)}$ are not tradable. To do that, we only use the identifying assumption that $\widehat{r}_{\pi,t}^{(h)}$ shocks have mean zero instead of the stronger assumption that they have mean zero and are orthogonal to the state vector, covariances, and their interactions. This approach implies that our estimation of λ and Λ separately relies on Equation IA.38 (which include $\widehat{r}_{\pi,t}^{(h)}$) and Equation IA.39 (which does not include $\widehat{r}_{\pi,t}^{(h)}$). Figures IA.1(h) to IA.3(h) replicate our main results while treating $\widehat{r}_{\pi,t}^{(h)}$ as tradable, and thus relying only on Equation IA.37 including all test assets jointly.

D.9 No Information on Real Bonds

As detailed in Section C.2, the data used for real bonds, which are needed to separately identify the term and inflation components of the bond RP, face some limitations (e.g., the real bond yields are based on a prior non-arbitrage model until 12-2002). To ensure our core findings are not due to these data limitations, Figures IA.1(i) to IA.3(i) replicate our main results while removing all information on the inflation rate and real bonds from s, xr, and

xr^*. Since in this case we cannot separately identity the term and inflation RP, the figures provide only information on the bond and cash flow RP.

References for Internet Appendix

Adrian, T., R. K. Crump, and E. Moench (2013). "Pricing the term structure with linear regressions". In: *Journal of Financial Economics* 110.1, pp. 110–138.

Allen, F. and R. Michaely (2003). "Payout Policy". In: *Handbook of the Economics of Finance*. Ed. by G. M. Constantinides, M. Harris, and R. M. Stulz. Vol. 1. A. Elsevier Science. Chap. 7, pp. 337–429.

Binsbergen, J. H. v. (2025). "Duration-Based Stock Valuation: Reassessing Stock Market Performance and Volatility". In: *Journal of Financial Economics* Forthcoming.

Binsbergen, J. H. v. and R. S. J. Koijen (2010). "Predictive Regressions: A Present-Value Approach". In: *Journal of Finance* 65.4, pp. 1439–1471.

Campbell, J. Y. and R. J. Shiller (1989). "The Dividend-Price Ratio and Expectations of Future Dividends and Discount Factors". In: *Review of Financial Studies* 1.3, pp. 195–228.

Chen, A. Y. and T. Zimmermann (2022). "Open Source Cross-Sectional Asset Pricing". In: *Critical Finance Review* 27.2, pp. 207–264.

Chen, L. (2009). "On the reversal of return and dividend growth predictability: A tale of two periods". In: *Journal of Financial Economics* 92, pp. 128–151.

Chernov, M. and P. Mueller (2012). "The Term Structure of Inflation Expectations". In: *Journal of Financial Economics* 106.2, pp. 367–394.

D'Amico, S., D. H. Kim, and M. Wei (2018). "Tips from TIPS: The Informational Content of Treasury Inflation-Protected Security Prices". In: *Journal of Financial and Quantitative Analysis* 53.1, pp. 395–436.

Gao, C. and I. Martin (2021). "Volatility, Valuation Ratios, and Bubbles: An Empirical Measure of Market Sentiment". In: *Journal of Finance* 76.6, pp. 3211–3254.

Gonçalves, A. S. (2021). "The Short Duration Premium". In: *Journal of Financial Economics* 141.3, pp. 919–945.

Gürkaynak, R. S., B. Sack, and J. H. Wright (Nov. 2007). "The U.S. Treasury yield curve: 1961 to the present". In: *Journal of Monetary Economics* 54.8, pp. 2291–2304.

Gürkaynak, R. S., B. Sack, and J. H. Wright (2010). "The TIPS Yield Curve and Inflation Compensation". In: *American Economic Journal: Macroeconomics* 2.1, pp. 70–92.

Jensen, T. I., B. T. Kelly, and L. H. Pedersen (2023). "Is There a Replication Crisis in Finance?" In: *Journal of Finance* 78.5. Forthcoming.

Koijen, R. S. J. and S. V. Nieuwerburgh (2011). "Predictability of Returns and Cash Flows". In: *Annual Review of Financial Economics* 3, pp. 467–491.

Liu, Y. and J. C. Wu (2021). "Reconstructing the Yield Curve". In: *Journal of Financial Economics* 142.3, pp. 1395–1425.

McCracken, M. W. and S. Ng (2016). "FRED-MD: A Monthly Database for Macroeconomic Research". In: *Journal of Business and Economic Statistics* 34.4, pp. 574–589.

Nelson, C. R. and A. F. Siegel (1987). "Parsimonious Modelling of Yield Curves". In: *Journal of Business* 60.4, pp. 473–489.

Sabbatucci, R. (2022). "Are Dividends and Stock Returns Predictable? New Evidence Using M&A Cash Flows". Working Paper.

Stock, J. H. and M. W. Watson (2002). "Macroeconomic Forecasting using Diffusion Indexes". In: *Journal of Business & Economic Statistics* 20.2, pp. 147–162.

Svensson, L. E. O. (1994). "Estimating and Interpreting Forward Interest Rates: Sweden 1992-1994". In: *NBER No. w4871*.

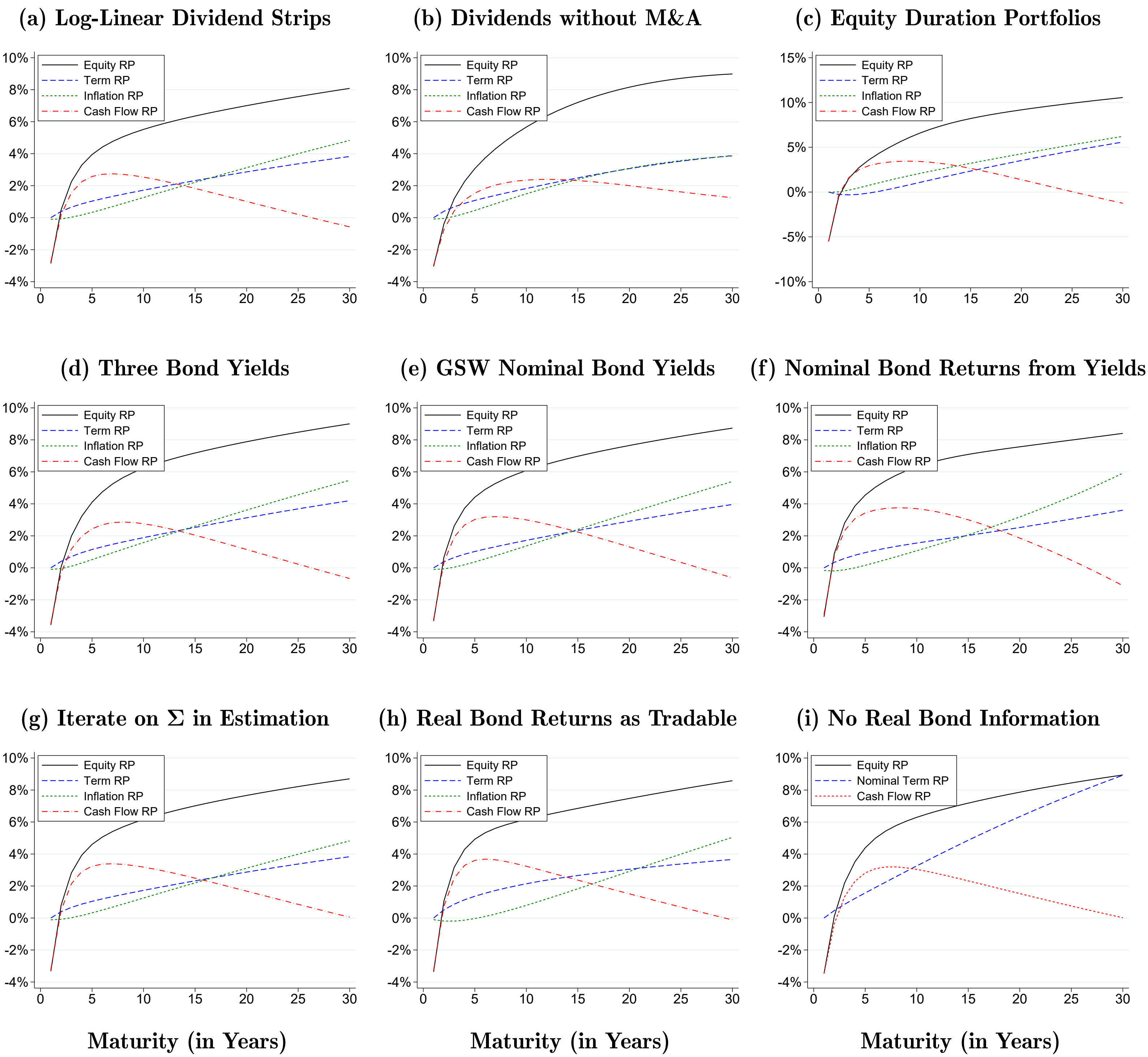

Figure IA.1
The Average Term Structure of Equity Risk Premia: Term RP, Inflation RP, and Cash Flow RP (Alternative Specifications)

The graphs in this figure replicate Figure 6 in the main text under alternative specifications for the no arbitrage term structure model. Specifically, the graphs display the average term structure of Equity RP and its components (the term, inflation, and cash flow RP from Equation 35). Sections 2 and 3 provide further details about the baseline term structure model and its empirical specification while Section D describes the alternative specifications we consider.

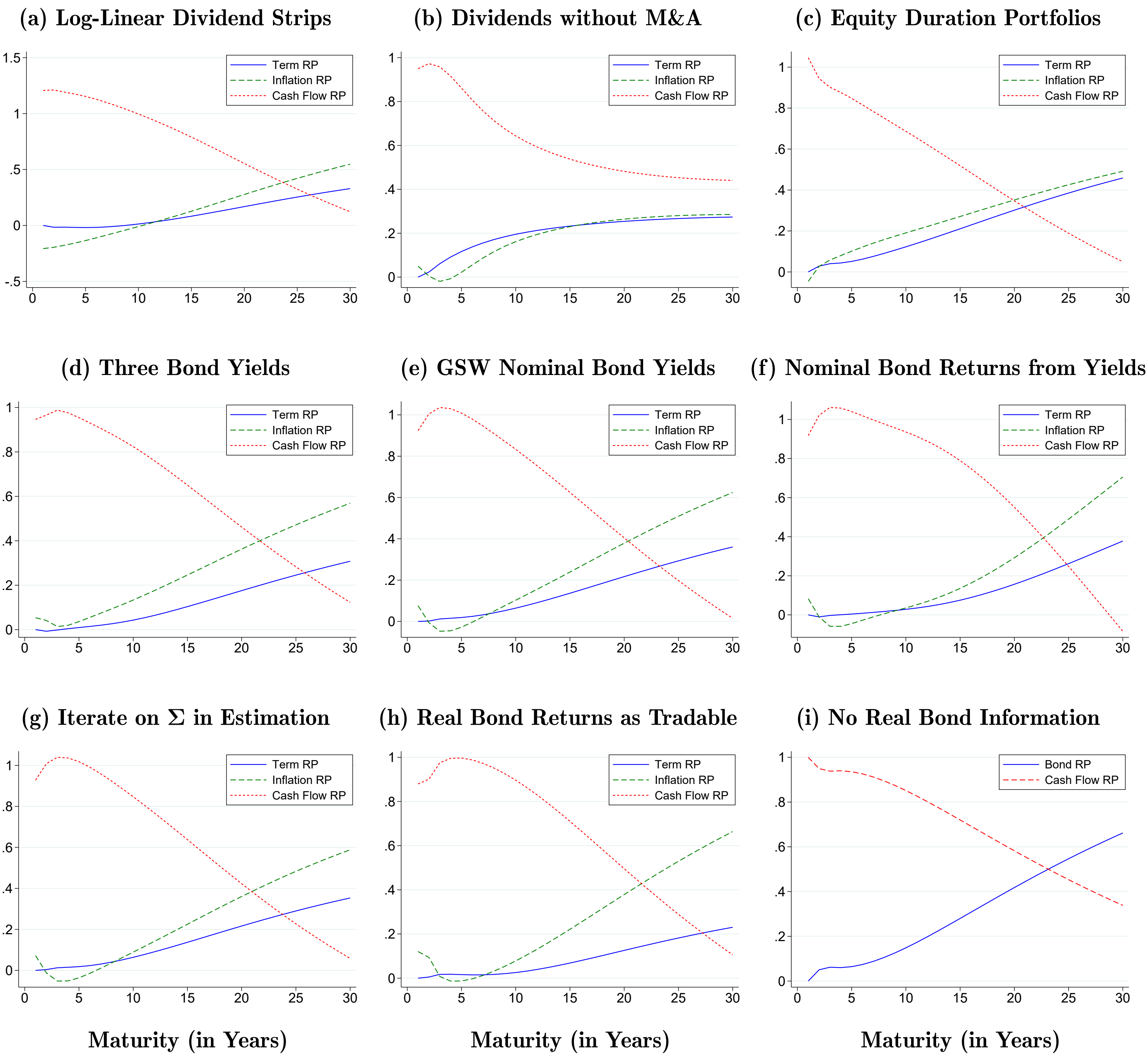

Figure IA.2
Fraction of Equity Premia Variability Explained by Term RP, Inflation RP, and Cash Flow RP (Alternative Specifications)

The graphs in this figure replicate Figure 8(a) in the main text under alternative specifications for the no arbitrage term structure model. Specifically, the graphs display term structure plots of the fraction of equity premia variability explained by each of the Equity RP components (the term, inflation, and cash flow RP from Equation 35). Sections 2 and 3 provide further details about the baseline term structure model and its empirical specification while Section D describes the alternative specifications we consider.

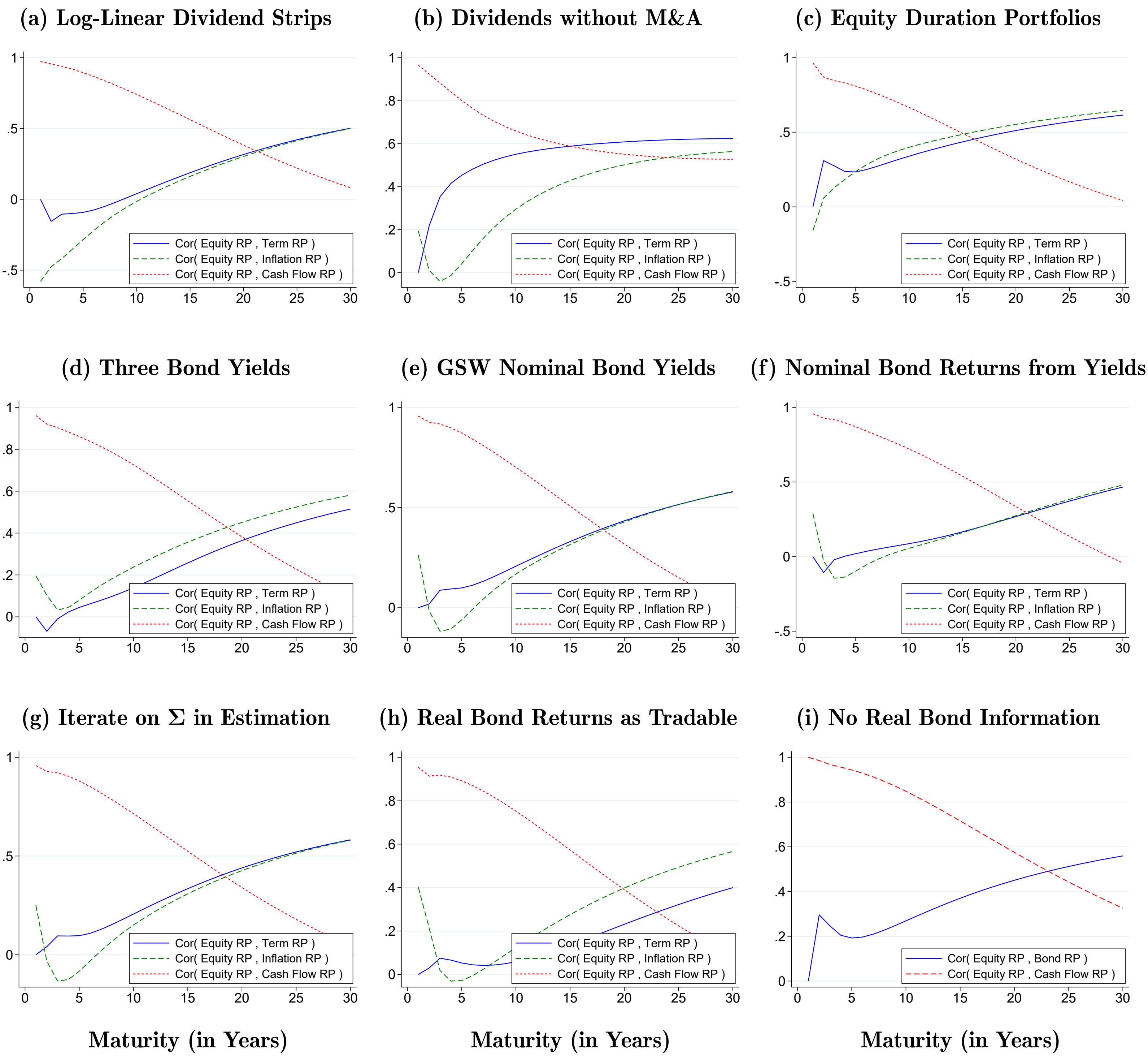

Figure IA.3
Correlations of Equity RP with Term RP, Inflation RP, and Cash Flow RP
(Alternative Specifications)

The graphs in this figure replicate Figure 9(b) in the main text under alternative specifications for the no arbitrage term structure model. Specifically, the graphs display term structure plots of the correlation of equity RP with each of its components (the term, inflation, and cash flow RP from Equation 35). Sections 2 and 3 provide further details about the baseline term structure model and its empirical specification while Section D describes the alternative specifications we consider.