Interest Rate Risk around Monetary Policy Announcements and Asset Duration

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Abstract

This paper empirically examines the monetary policy announcement premium by focusing on interest rate risk and asset durations. First, the average returns of long-duration Treasury bonds are higher than short-duraiton bonds on monetary policy announcement days. Second, the average returns of long-duration equities are statistically indistinguishable from those of short-duration equities on announcement days, whereas on non-announcement days, long-duration equities yield lower returns. This term structure on announcement days is attributed to the resolution of discount rate risk, as measured by the decline in option-implied volatility of Eurodollar futures. Third, the elasticity of returns with respect to changes in interest rate risk is greater for long-duration assets than that for short-duration assets, a result that holds for both bonds and equities.

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1 Introduction

This paper studies the monetary policy announcement premium by focusing on interest rate risk and heterogeneity in asset duration. The monetary policy announcement premium refers to the empirical regularity that average asset returns are elevated on announcement days (Savor and Wilson, 2013).[1] Prior to announcements, investors are exposed to risk and consequently require higher expected returns. This study identifies the specific type of risk to which investors are exposed and the assets most affected. The main findings are: (i) the resolution of *interest rate risk* leads to higher returns, and (ii) asset duration is a key determinant of heterogeneity in risk exposures.

First, while the literature has primarily emphasized cash flow uncertainty as the main risk resolved by announcements (Ai and Bansal, 2018; Wachter and Zhu, 2022), this paper highlights interest rate risk as a key factor. Monetary policy announcements convey information about future interest rates, resulting in a significant reduction in option-implied interest rate volatility, as documented by Bauer et al. (2022).

Second, assets with different durations exhibit varying exposures to interest rate risk. When interest rates rise unexpectedly, long-duration assets decline in value more than short-duration assets, as future cash flows are discounted at higher rates. Conversely, interest rate reductions lead to larger gains for long-duration assets. Prior to announcements, investors who prefer early resolution of uncertainty assign lower valuations to long-duration assets. Short-duration assets are less sensitive to interest rate changes due to their near-term cash flows.

I develop a tractable asset pricing model in which a representative investor with recursive preferences allocates wealth between short- and long-duration assets under uncertainty. The model features two sources of risk: cash flow risk and discount rate risk, with the latter assumed to be uncertain prior to announcements–a key innovation of this paper. Long-duration assets are more exposed to discount rate risk, while short-duration assets are more sensitive to cash flow uncertainty, as monetary policy mainly affects short-term cash flows, but is neutral in the long run. Both risks are resolved upon the announcement.

There are two theoretical predictions that apply to both bonds and equities. The first concerns

[1] Savor and Wilson (2013) find that the return on the S&P 500 Index is higher on FOMC days (25.5 bps) than on non-FOMC days (2.7 bps).

the average returns of short- and long-duration assets. For bonds, long-duration bonds are expected to yield higher average returns than short-duration bonds on announcement days because returns on long-duration bonds are more sensitive to changes in the discount rate; they provide claims on consumption further in the future.

In contrast to bonds, the relative expected returns of short- and long-duration equities are theoretically ambiguous due to the uncertainty in equity cash flows. Short-duration equities are more exposed to cash flow risk from monetary policy announcements, which are non-neutral in the short run but neutral in the long run. This greater sensitivity to cash flow risk may offset the lower exposure to discount rate risk compared to long-duration equities.

The second theoretical prediction concerns the contemporaneous relationship between changes in interest rate risk and asset returns on announcement days. Specifically, returns on long-duration assets are more sensitive to changes in interest rate risk than those on short-duration assets. The intuition is as follows: consider two announcements. When interest rate risk decreases, long-duration assets yield higher returns than short-duration assets. Conversely, when interest rate risk increases, the price of long-duration assets drops more. In contrast, the value of short-duration assets remains unaffected in both cases.

I empirically test the theoretical predictions using measures of asset duration and interest rate risk. Bond duration is measured using zero-coupon bond yield data (Liu and Wu, 2021), while equity duration is estimated from firm-level cash flows (Weber, 2018) or proxied with the book-to-market ratio (Hansen et al., 2008). Interest rate risk is measured by the option-implied volatility of Eurodollar futures (Bauer et al., 2022). The analysis focuses on U.S. Treasury bonds and publicly traded U.S. firms.

First, I test the theoretical predictions for average returns and find that longer-duration bonds have higher expected returns. For example, five-year Treasury bonds yield 4.8 basis points on average, while twenty-year bonds yield 10.0 basis points on monetary policy announcement days. This supports the prediction that long-duration bond returns are more sensitive to discount rate risk.

In contrast to bonds, equities do not show a positive relationship between duration and expected returns. For instance, equities with durations of 13 and 22 years have average returns of 17.5 and 17.3 basis points, respectively, indicating no significant difference. This flat term structure contrasts with prior literature, which finds a downward-sloping term structure of average monthly equity returns (Lettau and Wachter, 2011; Weber, 2018), where long-duration equities yield *lower* average monthly returns than short-duration equities: the return on the longest-duration portfolio is 55 bps, while that on the shortest-duration portfolio is 233 bps.

To assess the importance of interest rate risk, I compare average returns across two subsamples where interest rate risk either increases or decreases beyond a threshold. For bonds, the long-minus-short-duration portfolio yields 33.9 basis points when the interest rate risk decreases and -32.3 basis points when it increases. For equities, the corresponding strategy yields 17.5 and -32.3 basis points, respectively. These results show that a downward-sloping term structure emerges when interest rate risk increases.

In the second empirical exercise, I demonstrate that the elasticity of returns to changes in interest rate risk increases with duration for both bonds and equities. For example, when interest rate risk decreases by 1% on FOMC days, the return on 10-year bonds increases by 6.8 basis points, while the return on 5-year bonds increases by 4.1 basis points.

To further assess the importance of interest rate risk, I examine the elasticity of returns to changes in the VIX across durations. A 1% decrease in the VIX increases returns by 0.1 basis points for 10-year bonds and 0.9 basis points for 5-year bonds. Both estimates are statistically indistinguishable from zero. This suggests that interest rate risk is a more significant driver of the announcement premium for long-duration bonds than aggregate market volatility as measured by the VIX.

For equities with a duration of 25 years, the elasticity of the return to interest rate risk is 12, meaning that the return increases by 12 basis points when interest rate risk decreases by 1% on announcement days. For equities with a duration of 7 years, the elasticity is lower, at 8, indicating a weaker response compared to long-duration equities.

The paper is organized as follows. Section 2 highlights the cross-sectional heterogeneity in exposure to monetary policy announcements. Section 3 presents a simple theory and outlines the testable theoretical predictions. Section 4 describes the data and variable construction. Section 5 empirically tests the theoretical predictions for bonds, while Section 6 conducts the corresponding analysis for equities. Section 7 concludes the paper.

Related Literature First, this paper contributes to the literature on the macro announcement premium. Savor and Wilson (2013) document that excess returns on stocks and bonds are elevated on macro announcement days. Numerous empirical studies have investigated this phenomenon.[2] On the theoretical side, models have been developed to explain the macroeconomic announcement premium.[3]

While this paper emphasizes interest rate risk, much of the existing literature focuses on cash flow risk. Empirically, Lucca and Moench (2015) and Hu et al. (2022) find that excess returns are higher when uncertainty about aggregate cash flows – proxied by declines in the VIX – falls more sharply on FOMC announcement days. Zhang and Zhao (2023) examines the contemporaneous relationship between reductions in the VIX and the announcement premium. In contrast, this paper considers interest rate risk rather than aggregate stock return uncertainty, as measured by the VIX. On the theoretical front, whereas models by Wachter and Zhu (2022) and Ai et al. (2022) primarily focus on cash flow risk, this paper introduces a framework that jointly incorporates both interest rate risk and cash flow risk.

Additionally, this paper highlights duration as a key source of cross-sectional heterogeneity in exposure to monetary policy announcements. While prior studies often test risk-based hypotheses by examining cross-sectional variation in asset sensitivities, such as the relationship between market beta and expected returns (Savor and Wilson, 2014; Wachter and Zhu, 2022), or the predictive power of option-implied variance reductions for excess returns (Ai et al., 2022), the specific role of duration has received limited attention. Theoretically, whereas previous work typically treats cross-sectional sensitivity to monetary policy as exogenous (Wachter and Zhu, 2022), this paper offers an interpretation of heterogeneity.

Second, this paper contributes to the literature emphasizing the role of monetary policy uncertainty in determining asset prices. While the effects of uncertainty have been extensively

[2] Lucca and Moench (2015) find that a high excess return is driven by a pre-announcement drift on FOMC announcement days. Other literature includes Brusa et al. (2020); Neuhierl and Weber (2018); Cieslak et al. (2019); Mueller et al. (2017); Indriawan et al. (2021); Wachter and Zhu (2022).

[3] Ai and Bansal (2018) provide a revealed preference theory for the announcement premium. Wachter and Zhu (2022) show a model based on rare disasters and the success of the CAPM model on announcement days. Ai et al. (2022) develop a model in which risk compensation is required because FOMC announcements reveal the Fed's private information about its interest rate target and future economic growth rate.

studied, prior research has primarily focused on aggregate price indices, with limited attention to cross-sectional heterogeneity.[4] This paper focuses on the cross-sectional heterogeneity in asset duration.

Third, this paper contributes to the literature on the term structure of asset returns. Lettau and Wachter (2011), Van Binsbergen and Koijen (2017), and Weber (2018) document a downward-sloping term structure of monthly average equity returns. This study extends that evidence by examining the term structure specifically on monetary policy announcement days, revealing that it differs markedly from the pattern observed in monthly average returns.

2 Cross-sectional Heterogeneity in Exposure to Monetary Policy Announcements

This section examines the cross-sectional heterogeneity in risk exposure to monetary policy announcements among S&P 500 firms. I calculate the time-series average daily returns on FOMC days for each firm over the sample period (1990/1–2019/12). Firms are then sorted into five groups, from the lowest to the highest average returns. Table 1 reports the mean and standard deviation of daily returns on both FOMC and non-FOMC days for each group. The results reveal substantial variation in FOMC day returns across the five groups, with the highest group averaging 64.1 basis points and the lowest group averaging 6.7 basis points. In contrast, returns on non-FOMC days are similar across all groups, indicating that heterogeneity in exposure is specific to monetary policy announcements.

Savor and Wilson (2013) find that the return on the S&P 500 Index is higher on FOMC days (25.5 bps) than on non-FOMC days (2.7 bps). While much of the literature focuses on aggregate stock returns, such as those of the S&P 500 Index, Table 1 shows that elevated returns are concentrated in a subset of firms rather than being uniformly distributed across all firms. Section 3 examines the

[4] Bundick et al. (2017) estimate that changes in short-term uncertainty positively impact the term premium on announcement days. Bauer et al. (2022) highlight that reductions in uncertainty influence asset prices in ways distinct from conventional policy surprises. Lakdawala et al. (2021) demonstrate that changes in uncertainty affect spillovers to global bond yields. Similarly, Kroencke et al. (2021) identify shifts in risk appetite on FOMC announcement days, showing a correlation with stock returns.

Table 1: Cross-sectional Heterogeneity in Average Daily Returns on FOMC and non-FOMC Days.

	S&P500	Group				
	Index	1	2	3	4	5
Mean on FOMC	25.5	6.7	19.4	28.5	39.7	64.1
Mean on Non-FOMC	2.7	5.2	5.4	5.5	6.0	7.2
SD on FOMC	108	194	204	234	263	329
SD on Non-FOMC	109	192	206	230	253	297

Note: Table 1 shows cross-sectional heterogeneity in average returns for S&P500 firms. Five hundred firms are sorted based on their time-series average returns on FOMC days. The firms are then assigned to five groups based on these averages, and the average daily returns on FOMC and non-FOMC days are calculated for each group. "Mean on FOMC" represents the time-series average return for each group on FOMC days. "Mean on Non-FOMC" represents the corresponding return on non-FOMC days. "SD" denotes the standard deviation. "S&P500 Index" represents the mean and standard deviation of the S&P500 Index. Returns are expressed in basis points. Groups "1" through "5" denote the portfolios from low to high. The sample period is from January 1990 to December 2019.

sources of this heterogeneity within a theoretical framework that explains firm-level differences.

3 Theory

This section develops a model to derive testable theoretical predictions regarding risk factors and expected returns on announcement days. The model builds on Ai and Bansal (2018) and introduces two key extensions: (i) investors are subject to discount factor risk in addition to the cash flow risk considered by Ai and Bansal (2018), and (ii) the framework incorporates cross-sectional heterogeneity, specifically allowing for variation in asset duraiton.

There is a representative investor operating in a four-period model. Periods 1 and 2 are designated as trading periods, while periods 2, 3, and 4 serve as consumption periods. The investor can trade two types of assets: short-duration assets, which provide claims to consumption in period 3, and long-duration assets, which provide claims to consumption in period 4.

An investor in period 1 faces two sources of risk: discount factor risk and the cash flow risk of short-duration equity. The economy can be in one of four states. The discount rate is high and cash flow is high with probability p_1 (state s_1), the discount rate is high and cash flow is low with probability p_2 (state s_2), the discount rate is low and cash flow is high with probability p_3 (state s_3), and the discount rate is low and cash flow is low with probability p_4 (state s_4). The investor does not know the state of the economy in period 1. While Ai and Bansal (2018) and Wachter and Zhu (2022) focus on uncertainty about cash flows, this paper extends their framework to include discount rate risk. At the start of period 2, an announcement reveals the true state, which is then known to agents in periods 2, 3, and 4.

In period 1, the asset market opens, with short-duration assets traded at price P_1^S and long-duration assets at P_1^L. After the announcement in period 2, a second asset market opens. In periods 3 and 4, the investor consumes the returns from these assets; consumption is financed solely by asset holdings. Aggregate consumption is exogenously given, and consumption in periods 2 and 4 does not depend on the realized state s.

The investor derives utility from consumption in periods 2, 3, and 4 and maximizes a recursive utility function:

$$\max_{\theta_1^S,\theta_1^L,\theta_2^S,\theta_2^L,S_1} \left\{ E_1 \left[\left(C_2(s)^{1-\frac{1}{\psi}} + \beta(s) C_3(s)^{1-\frac{1}{\psi}} + \beta^2(s) C_4(s)^{1-\frac{1}{\psi}} \right)^{\frac{1-\gamma}{1-\frac{1}{\psi}}} \right] \right\}^{\frac{1}{1-\gamma}},$$

such that

$$\begin{aligned}
e &= P_1^S \theta_1^S + P_1^L \theta_1^L + S_1, \\
S_1 &= C_2(s) + P_2^S(s)\theta_2^S(s) + P_2^L(s)\theta_2^L(s), \quad s \in \{s_1, s_2, s_3, s_4\} \\
C_3(s) &= X_3(s)(\theta_1^S + \theta_2^S(s)), \quad s \in \{s_1, s_2, s_3, s_4\}, \\
C_4(s) &= X_4(\theta_1^L + \theta_2^L(s)), \quad s \in \{s_1, s_2, s_3, s_4\},
\end{aligned}$$

where $C_t(s)$ is consumption in period t, θ^S and θ^L are portfolios of short and long-duration assets, and X_3 is the cash flow of short-duraiton assets, and X_4 is the cash flow of long-duration assets.

In states s_1 and s_2, the discount factor is high, $\beta(s) = \beta^h$. In states s_3 and s_4, the discount factor is low, $\beta(s) = \beta^l$. In states s_1 and s_3, the cash flow for short-duraiton assets is high, $X_3(s) = X_3^h$. In states s_2 and s_4, the cash flow for short-duraiton assets is low, $X_3(s) = X_3^l$. The cash flow for long-duration assets is assumed to be invariant across states.

There are two important considerations. First, the investor faces uncertainty about the discount factor, which reflects uncertainty about the risk-free short-term interest rate before a monetary policy announcement. Since the risk-free rate tends to be used to discount future cash flows, investors are uncertain about how to value these cash flows prior to the announcement.

Second, it is assumed that only the uncertainty about the return on short-duration assets is resolved by the announcement, while information about long-duration asset cash flows remains unrevealed. This does not mean long-term cash flows are constant in reality, but rather that monetary policy announcements do not provide information about distant future cash flows. This assumption is motivated by empirical evidence that the effect of monetary policy are typically transitory (Christiano et al., 2005; Ramey, 2016), making it reasonable to assume announcements affect short-term, but not long-term, expected returns.

3.1 Bond as a No Cash Flow Uncertainty Case

In this section, I present theoretical predictions for assets without cash flow uncertainty, which can be interpreted as bonds, since their cash flows remain constant across economic states, at least in nominal terms. In the model, this is represented by setting $p_3 = p_4 = 0$, so the cash flow is constant in period 3 for all possible states. Proposition 1 provides an analytical solution for the difference in average announcement premiums between short- and long-duration bonds.

Proposition 1. *The average announcement premium of a short-duration bond is lower than that of a long-duration bond,*

$$E_1\left[\frac{P_2^S(s)}{P_1^S}\right] < E_1\left[\frac{P_2^L(s)}{P_1^L}\right]$$

if and only if

$$(V(s_1) - V(s_2))\left(\beta^h C_3(s_2)^{-\frac{1}{\psi}} C_4^{-\frac{1}{\psi}} - \beta^l C_3(s_1)^{-\frac{1}{\psi}} C_4^{-\frac{1}{\psi}}\right)$$

is negative. Here, $V(s_i)$ is defined as

$$V(s_i) \equiv \left[C_2^{1-\frac{1}{\psi}} + \beta(s_i) C_3(s_i)^{1-\frac{1}{\psi}} + \beta^2(s_i) C_4^{1-\frac{1}{\psi}}\right]^{\frac{\frac{1}{\psi}-\gamma}{1-\frac{1}{\psi}}}.$$

Proof. See Appendix A.1. □

Those necessary and sufficient conditions for determining the average returns of short- and long-duration bonds can be further simplified when investors face minimal uncertainty about aggregate consumption ($C_3(s_1) \approx C_3(s_2)$). In this case, the condition reduces to a comparison between risk aversion and the intertemporal elasticity of substitution:

Corollary 1. *When $C_3(s_1) \approx C_3(s_2)$ holds, the average reutrn of long-duration bonds is higher than that of short-duration bods,*

$$E_1\left[\frac{P_2^S(s)}{P_1^S}\right] < E_1\left[\frac{P_2^L(s)}{P_1^L}\right],$$

if and only if $\gamma < \frac{1}{\psi}$.

Proof. See Appendix A.1.1. □

Intuitively, for bonds, the discount factor is the sole source of uncertainty. Long-duraiton maturity bonds are therefore more sensitive to monetary policy announcements. When $\gamma < \frac{1}{\psi}$, the investor places greater weight on unfavorable states and less on favorable ones. As long-duration bonds are exposed to monetary policy more, their prices increase more than those of short-duraiton bonds in response to the resolution of uncertainty.

3.2 Equity as a Cash Flow Uncertainty Case

This section presents theoretical predictions for equities, characterized by $p_3 > 0$ and $p_4 > 0$. In this setting, a central bank announcement reveals information about future cash flows.

In contrast to the bond case, the expected return on short-duration equities exceeds that of long-duration equities when the dispersion of cash flows across high and low states is sufficiently large.

Proposition 2. *If*

$$X_3^h - X_3^l > \overline{\sigma}$$

holds, the expected return on short duration assets is higher than long duraiton assets:

$$E_1\left[\frac{P_2^S(s)}{P_1^S}\right] > E_1\left[\frac{P_2^L(s)}{P_1^L}\right].$$

Here, $\overline{\sigma}$ is defined in Appendix A.2.

Proof. See Appendix A.2. □

Short-duration assets are exposed to cash flow risk. When the dispersion of cash flows exceeds a threshold, the expected return on short-duration equities is higher than that on long-duration equities. If cash flow dispersion is small, discount factor risk dominates, and the expected return on long-duration assets exceeds that of short-duration assets, as in the bond case. The relative importance of these risks is examined empirically in Section 6.

3.3 The Elasticity of Returns to the Resolution of Discount Rate Risk

The final theoretical prediction concerns the sensitivity of asset returns to the resolution of discount rate risk. When monetary policy announcements resolve a greater degree of discount rate risk, the returns of long-duration assets increase more than those of short-duration assets. This prediction holds for both bonds and equities.

Proposition 3. *When discount rate risk is more strongly resolved by monetary policy announcements, the returns of long-duration assets increase more than those of short-duration assets. This is expressed as*

$$\frac{\partial E_1\left[\frac{P_2^L(s)}{P_1^L}\right]}{\partial \sigma^\beta} > \frac{\partial E_1\left[\frac{P_2^S(s)}{P_1^S}\right]}{\partial \sigma^\beta},$$

where

$$\sigma^\beta \equiv \frac{\beta^h - \beta^l}{2}.$$

Proof. See Appendix A.3. □

Note that this prediction applies to both equities and bonds. When a greater degree of discount rate risk is resolved by an announcement, the expected return increases more for long-duration assets than for short-duration assets.

4 Data

This section details the construction of the main variables: bond and equity returns, equity duration, and interest rate risk. Bond returns are calculated using data on U.S. Treasury securities. The equity sample consists of firms incorporated in the United States and listed on the NYSE, Amex, or Nasdaq, excluding those in the financial sector. Balance sheet information is obtained from the Compustat database. Appendix B provides a detailed description of all data sources. The sample period extends from the first quarter of 1990 to the fourth quarter of 2019.

4.1 Returns of Equity and Bond

The daily return of asset on announcement days is calculated as $\frac{p_t}{p_{t-1}} - 1$, where p_t denotes the closing price on the announcement day and p_{t-1} is the closing price on the previous day. For equities, daily closing price data are obtained from CRSP.

For Treasury bonds, the returns are constructed using data from Liu and Wu (2021). This dataset provides daily zero-coupon yield of U.S. Treasury bonds for various maturities, $Y_t(n)$. The price of a bond with a maturity of n years, $p_t(n)$, is given by $p_t(n) = \frac{1}{(Y_t(n))^n}$, where $Y_t(n)$ is the annualized yield of a bond with a maturity of n years at time t.

4.2 The Duration of Assets

To analyze the heterogeneous exposure of assets with varying durations, it is necessary to measure asset duration. For bonds, duration is directly observable and is defined as the number of years to maturity; thus, a bond with n years to maturity is assigned a duration of n.

For equities, duration is not directly observable. Following Weber (2018), I construct equity duration based on the timing of expected cash flows, analogous to the Macaulay duration used for bonds. This approach reflects the weighted average time to maturity of cash flows, where the weights are determined by the ratio of discounted future cash flows to the current price:

$$\text{Duration}_{it} = \frac{\sum_{s=1}^{\infty} s \times \text{CF}_{i,t+s}/(1+r)^s}{P_{it}},$$

where Duration_{it} is the duration of firm i at time t, $\text{CF}_{i,t+s}$ is the cash flow at time $t+s$, P_{it} is the current equity price, and r is the discount rate. In contrast to bonds, equities lack observable finite maturities and predetermined cash flows. To account for this feature, the duration formula is decomposed into two components: a finite-horizon term of length T, and a residual term that captures the infinite-horizon component:

$$\text{Duration}_{it} = \frac{\sum_{s=1}^{T} s \times \text{CF}_{i,t+s}/(1+r)^s}{P_{it}} + \left(T + \frac{1+r}{r}\right) \frac{P_{i,t} - \sum_{s=1}^{T} \text{CF}_{i,t+s}/(1+r)^s}{P_{it}}. \quad (1)$$

A derivation of this equation can be found in Appendix C.1. Future cash flows are forecasted using the projected return on equity and growth in book equity, based on clean surplus accounting,

$$\begin{aligned} \text{CF}_{i,t+s} &= \text{E}_{i,t+s} - (\text{BV}_{i,t+s} - \text{BV}_{i,t+s-1}) \\ &= \text{BV}_{i,t+s-1} \left[\frac{\text{E}_{i,t+s}}{\text{BV}_{i,t+s-1}} - \frac{\text{BV}_{i,t+s} - \text{BV}_{i,t+s-1}}{\text{BV}_{i,t+s-1}} \right]. \end{aligned} \quad (2)$$

Return on equity, defined as $\frac{\text{E}_{i,t+s}}{\text{BV}_{i,t+s-1}}$, is the ratio of income before extraordinary items to the lagged book equity. Both return on equity and growth in book equity are modeled as autoregressive processes, with parameters estimated using pooled data from CRSP-Compustat firms. Further details on the estimation procedure are provided in Appendix C.

Table 2 presents summary statistics for key firm characteristics in Panel A. The average payoff horizon implied by stock prices is 18.0 years, with a standard deviation of 4.1 years, reflecting substantial heterogeneity across firms. On average, the public (19.8 years) and transportation (18.0 years) industries have longer durations, while the utilities (16.3 years) and wholesale (16.8 years) industries have shorter durations.

Panel B reports the cross-sectional correlations among key firm characteristics. The book-to-market ratio at time t is defined as the ratio of book equity to market equity, where book equity is calculated as total stockholders' equity plus deferred taxes and investment tax credits, minus the book value of preferred stock, and market equity is measured as total market capitalization.

Panel B reports a strong negative correlation between duration and the book-to-market ratio, with a correlation coefficient of -0.66. As demonstrated in Appendix C.2, there is a negative linear relationship between cash flow duration and the book-to-market ratio. Consistent with the literature, which employs the book-to-market ratio as an alternative proxy for duration (Lettau and Wachter, 2011; Hansen et al., 2008), I use the book-to-market ratio in robustness checks and find that the results remain consistent.

Table 2: Summary Statistics and Correlations for Firm Characteristics.

	Dur	BM	Size	Prof	Lev	Sales g	ME
	Panel A. Means and Standard Deviations						
Mean	18.0	0.78	5.8	0.01	0.21	1.66	2337
SD	4.1	1.0	2.1	0.05	0.22	20.6	9628
	Panel B. Correlations						
Dur		-0.66	-0.02	-0.09	-0.04	0.01	0.13
BM			-0.00	-0.08	-0.09	-0.05	-0.12
Size				0.19	0.24	-0.00	0.42
Prof					0.08	0.16	0.12
Lev						-0.00	0.06
Sales g							0.00

Note: Table 2 reports time series averages of quarterly cross-sectional means and standard deviations for firm characteristics in Panel A and correlations of these variables in Panel B. "Dur" is cash flow duration in years; "BM" is the book-to-market ratio; "Size" is the log of assets; "Prof" is profit divided by assets; "Lev" is the leverage ratio. "Sales g" is sales growth, represented as a percentage. "ME" is the market capitalization in millions. Financial statement data come from quarterly Compustat. The sample period is 1990Q1-2019Q4.

4.3 Interest Rate Risk Data

The measure of interest rate risk is constructed using the market-based conditional volatility of the future short-term interest rate, as proposed by Bauer et al. (2022). Specifically, they compute the standard deviation of Eurodollar (ED) futures one year ahead, conditional on current information, denoted as $\text{IRU}_t \equiv \sqrt{\text{Var}(\text{ED}_{t+\tau}|I_t)}$. This approach yields a model-free estimate of the conditional standard deviation by utilizing the information embedded in both futures and options prices.

Figure 1 presents a histogram of the two-day change in interest rate risk surrounding FOMC announcement days, measured as $\log(\text{IRU}_{t+1}) - \log(\text{IRU}_{t-1})$ when t is the FOMC day. The sample spans 1990 to 2019 and includes eight scheduled FOMC announcements per year, yielding 240 observations. The average change in the uncertainty measure is -0.021, with a t-statistic of -7.12, indicating that monetary policy announcements reduce the standard deviation of future interest rates by an average of 2.1%.

The standard deviation of the changes in interest rate risk is 0.047. The variation in the resolution of interest rate risk is related to a specific change in the Federal Reserve's forward guidance (Lakdawala et al., 2021). [5] In the subsequent analysis, I exploit the variation in changes in interest rate risk to estimate the elasticity of asset returns with respect to these changes. Conceptually, the empirical approach compares asset returns across announcement days that differ in the magnitude of the change in interest rate risk.

5 Empirical Analysis of Bonds

5.1 Average Return on FOMC days

This subsection empirically evaluates the theoretical prediction regarding the average returns of bonds on FOMC days. Proposition 1 predicts that long-duration bonds should exhibit higher returns than short-duration bonds. Figure 2-(a) presents the average returns on FOMC days across different

[5] For example, the largest decrease occurred in August 2011; monetary policy uncertainty decreases by 29%, shown in the left tail of the histogram in Figure 1. Before the meeting, the FOMC stated that interest rate would be kept low "... for an extended period". At the August meeting, the FOMC explicitly signaled that rates would remain low "at least through mid-2013" The market was able to interpret the statement with less uncertainty about future interest rate. The central bank's guidance played a crucial role in reducing interest rate risk.

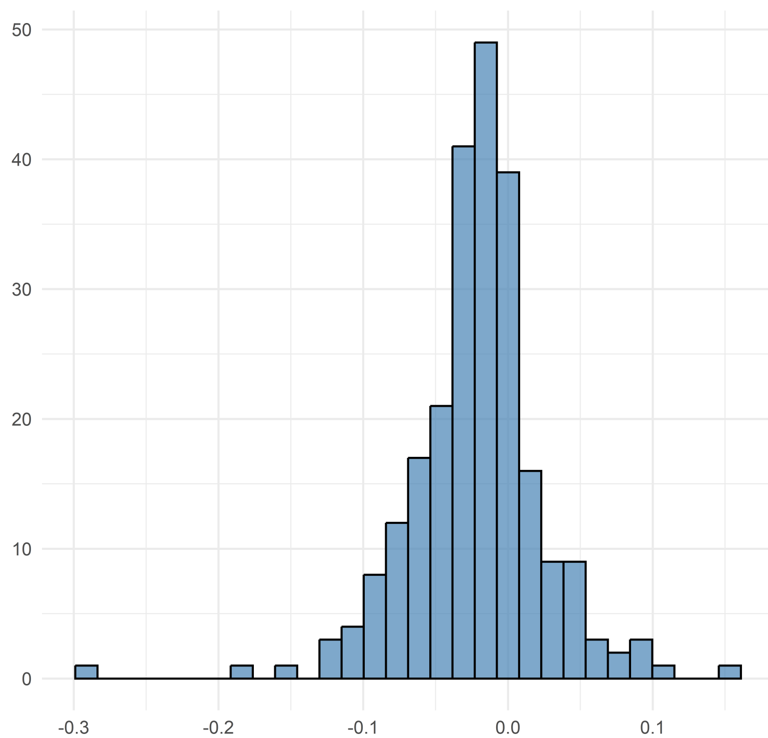


Figure 1: Histogram of Changes in Interest Rate Risk on FOMC days.

Note: Figure 1 shows a histogram of the two-day change in interest rate risk on FOMC days. Interest rate risk is measured using the risk-neutral standard deviation of the three-month interest rate at a one-year horizon, estimated from Eurodollar futures and options. The two-day change is calculated as the log of uncertainty at $t+1$ minus the log of uncertainty at $t-1$, where t represents FOMC announcement days. The sample period spans from January 1990 to December 2019, including 240 announcements, with eight announcements per year over thirty years. The data is obtained from Bauer et al. (2022).

maturities from 1990 to 2019, with 95% confidence intervals based on Newey-West standard errors. The results show a monotonic increase in returns with duration. For instance, the average return on a one-year Treasury bond is 0.62 basis points, while that on a twenty-nine-year Treasury bond is 10.22 basis points. These findings are consistent with Proposition 1.

Long-duration bonds exhibit larger standard errors. This is evident from the price formula, $p_t(n) = \frac{1}{(Y_t(n))^n}$, which implies that a given change in $Y_t(n)$ results in greater price variability for bonds with longer maturities. Consequently, the standard errors of returns increase with duration. This pattern is consistent with findings of Wachter and Zhu (2022).

Since this paper focuses on the relationship between bond returns and interest rate risk, Figure 2-(b) presents average returns for two subsamples, conditional on changes in interest rate risk. Specifically, the top 20% and bottom 20% of observations are selected based on changes in interest rate risk. The red line represents the top quintile, and the blue line represents the bottom quintile.

Figure 2(b) shows a clear difference in the term structure of returns between the two subsamples. When interest rate risk declines substantially, five-year bonds have a return of 29.5 basis points, and twenty-year bonds return 63.4 basis points. When the decline is modest, five-year and twenty-year bond returns are -22.0 and -54.3 basis points, respectively. This highlights that the magnitude of changes in interest rate risk is crucial for the term structure of bond returns on FOMC days.

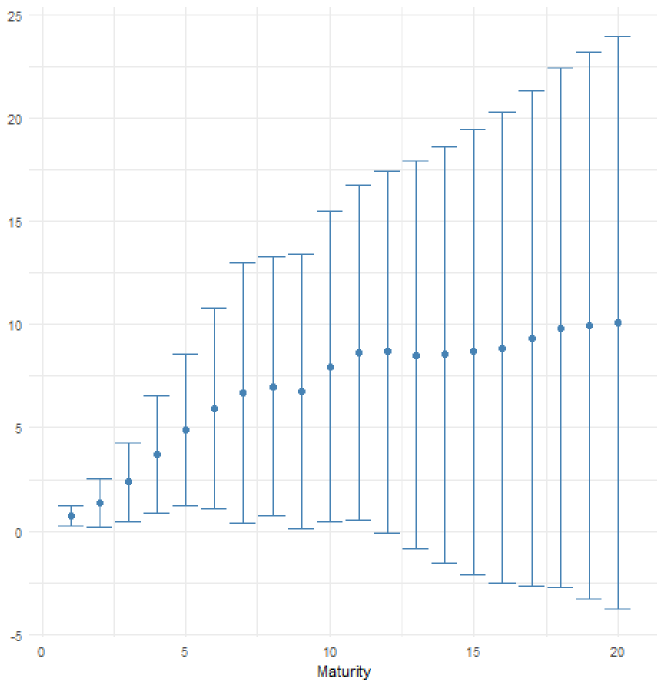
I also regress the returns of Treasury bonds with different maturities on risk factors. The empirical specification is

$$y_t^m = \alpha^m + \beta_s^m X_{s,t} + \epsilon_{it}, \tag{3}$$

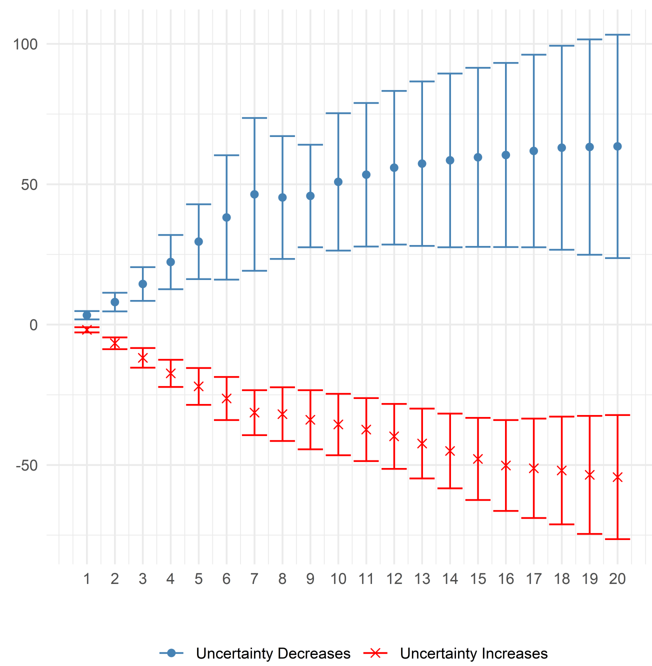
where y_t^m denotes the return on bonds with maturity m at time t; α^m is the model-specific pricing error; β_s^m is the time-series loading of bond returns on risk factor s; and $X_{s,t}$ is the risk factor. Bond returns and market excess returns are expressed in basis points.

Table 3 reports the average returns on FOMC and non-FOMC days for Treasury bonds with maturities of 1, 5, 10, 15, and 20 years. Panel A presents the results for FOMC days. On average, a long-short portfolio earns 9.6 basis points on FOMC announcement days. The table also reports CAPM alphas and betas; X^s denotes the market excess return. Risk-adjusted returns, as measured by CAPM alphas, increase monotonically with maturity, from 0.7 for one-year bonds to 11.1 for twenty-year bonds.

In contrast, returns on non-FOMC days are lower than those on FOMC days. For example, the



(a) All FOMC days



(b) Conditional on a Change in Uncertainty

Figure 2: Average Return on Treasury Bonds on FOMC Days.

Notes: Figure 2 shows the average returns on Treasury bonds with different maturities on FOMC days. The vertical axis represents bond returns, expressed in basis points, and the horizontal axis represents bond duration. Panel (a) includes all FOMC days from 1990 to 2019. Panel (b) conditions on changes in interest rate risk, with the red line representing the top 20% of changes and the blue line representing the bottom 20%. 95% confidence intervals are calculated using Newey-West standard errors. The full sample period spans from January 1990 to December 2021.

Table 3: Average Returns of Treasury Bonds with Duration.

	Maturity				
	1	5	10	15	20
	Panel A: FOMC days				
Average Return	0.7	5.0	8.2	9.0	10.3
	(0.26)	(1.60)	(3.64)	(5.41)	(6.73)
α_{capm}	0.7	4.4	7.7	8.8	11.1
	(0.34)	(1.91)	(3.55)	(5.16)	(7.15)
β_{capm}	0.00	0.02	0.02	0.01	-0.03
	(0.006)	(0.03)	(0.06)	(0.07)	(0.09)
	Panel B: Non-FOMC days				
Average Return	0.06	0.3	0.7	1.3	1.8
	(0.05)	(0.33)	(0.62)	(0.90)	(1.14)
α_{capm}	0.07	0.4	1.0	1.7	2.3
	(0.06)	(0.34)	(0.64)	(0.93)	(1.15)
β_{capm}	-0.01	-0.06	-0.11	-0.16	-0.20
	(0.002)	(0.008)	(0.016)	(0.023)	(0.032)

Note: Table 3 reports the returns of Treasury bonds on FOMC days, time-series factor loadings (β), and pricing errors (α) for different maturities. The return on a Treasury bond is defined as $\frac{p_t(n)}{p_{t-1}(n)}$, where $p_t(n)$ is the daily price of a Treasury bond with maturity n. Returns are stated in basis points. α_{CAPM} and β_{CAPM} are from the CAPM model. Newey-West standard errors are shown in parentheses. Maturity is in years.

average return for a one-year maturity bond is 0.06 basis points on non-FOMC days, compared to 0.7 basis points on FOMC days. This reflects the fact that interest rate risk is not substantially resolved on non-FOMC days. Moreover, the difference in average returns between short- and long-duration bonds is minimal on non-FOMC days, with a long-short portfolio earning only 1.7 basis points.

While this section examines the average returns of Treasury bonds on FOMC days, Appendix F presents results for other types of announcement days, such as GDP and inflation announcements.

5.2 Interest Rate Risk and Contemporaneous Regression.

This section empirically demonstrates that the returns on bonds with longer durations are more responsive to changes in interest rate risk than those with shorter durations. This hypothesis is derived from Proposition 3. I separately estimate the time-series regression

$$y_t^m = \beta_{iru}^m \Delta\text{IRU}_t + \epsilon_t, \tag{4}$$

where t indexes the tth FOMC announcement, and y_t^m is the return on Treasury bonds with duration m, expressed in percentage points. ΔIRU_t is the logarithm of tomorrow's interest rate risk minus yesterday's, when today is the tth FOMC day; i.e., $\log(\text{IRU}_{t+1}) - \log(\text{IRU}_{t-1})$. The coefficients β_{iru}^m are estimated separately using data on bonds with maturity m.

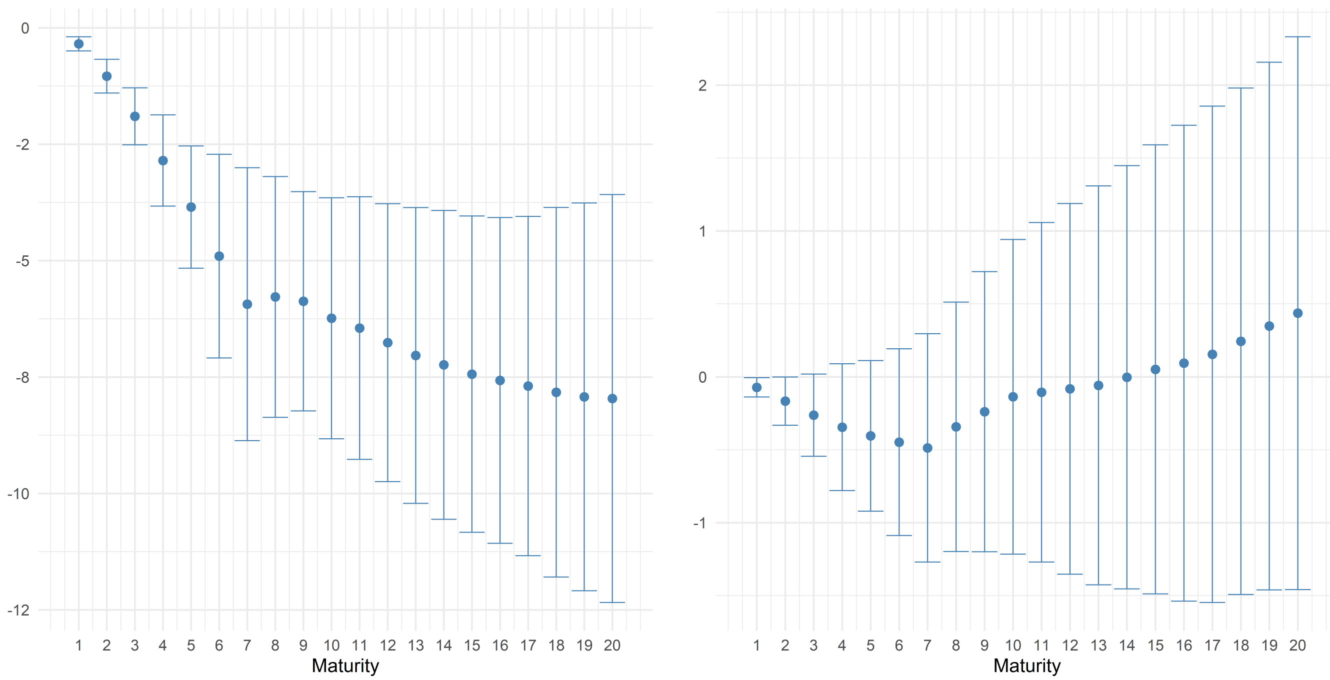
Figure 3-(a) shows the estimated values of β_{iru}^m as a function of m, with 95% confidence intervals of Newey-West standard errors. The coefficient decreases monotonically with duration, indicating that longer-duration bonds are more sensitive to changes in interest rate risk. For example, for a 10-year bond, β_{iru} is -6.8, implying that a 1% decrease in implied interest rate volatility increases the return by 6.8 basis points, while for a 5-year bond, the coefficient is -4.1. These results are consistent with Proposition 3.

In contrast to the interest rate risk emphasized in this paper, much of the literature focuses on cash flow uncertainty, often proxied by the VIX (Lucca and Moench, 2015; Hu et al., 2022). To assess whether the elevated returns on bonds are primarily attributable to a reduction in interest rate risk rather than aggregate cash flow uncertainty, I also examine the contemporaneous relationship between the VIX and Treasury bond returns. Specifically, I estimate

$$y_t^m = \beta_{vix}^m \Delta\text{VIX}_t + \epsilon_t, \tag{5}$$

where ΔVIX_t is defined as the logarithmic change in the VIX from the day before to the day after the tth FOMC announcement.

Figure 3-(b) shows that the estimated values of β_{vix}^m are not statistically different from zero and do not exhibit a clear pattern with duration. For example, the coefficient is -0.9 for a 5-year bond and -0.1 for a 10-year bond. This suggests that Treasury bonds are not significantly exposed to VIX-related risks; instead, interest rate risk is the primary driver of bond returns.



(a) interest rate risk

(b) VIX

Figure 3: The Elasticity of Return to Change in Uncertainty Conditional on Duraiton.

Note: Figure 3 shows the sensitivity of returns to changes in (a) interest rate risk and (b) the VIX for different maturities. I regress Treasury returns on changes in the uncertainty measure,

$$y_t^m = \beta^m \Delta \mathrm{Unc}_t + \epsilon_t, \tag{6}$$

where $\Delta\mathrm{Unc}_t$ represents changes in interest rate risk in Panel (a) and changes in the VIX in Panel (b). The vertical axis plots the coefficients β^m for each maturity m, along with their 95% confidence intervals.

To test whether returns on longer-duration bonds respond more strongly to the resolution of interest rate risk, I regress bond returns of varying durations on changes in interest rate risk. The empirical specification is given by

$$\text{Return}_{n,t} = \beta_1 \Delta UNC_t + \beta_2 \text{Duration}_{nt} + \beta_3 \Delta UNC_t \times \text{Duration}_{nt} + \gamma X_{it} + \epsilon_{it}, \quad (7)$$

where Return_{nt} is the return of bonds with duration n years at the tth FOMC expressed in basis points, ΔUNC_t is the measured change in IRU_t at the tth FOMC, and Duration_{nt} equals n as the bonds matures in n years. I use bonds with maturities ranging from one year to twenty-nine years, in one-year increments.

Control variables, X_{it}, include the two-day change in the VIX, monetary policy shocks (measured by high-frequency changes in federal funds futures; see Bernanke and Kuttner (2005)), and their interactions with duration. These controls account for the possibility that changes in interest rate risk may be correlated with changes in aggregate uncertainty or with the first moment of monetary policy, both of which could influence the sensitivity of returns across durations. The inclusion of the VIX reflects its widespread use as a proxy for uncertainty in the literature.

Table 4 presents the estimated results. Column (1) excludes control variables, while Column (2) includes them. The coefficient of interest, β_3, is estimated to be -0.24 in Column (1) and -0.26 in Column (2). The negative sign of the interaction term indicates that a 1% increase in interest rate risk reduces the return of bonds by 0.24–0.26 basis points more for each additional year of duration, relative to bonds with one year less duration.

I also conduct sensitivity analyses using alternative measures of interest rate risk for UNC_t in equation (7). In the baseline, discount factor risk is proxied by the standard deviation of one-year-ahead Eurodollar futures. Since discount factor risk is not directly observable, I also use basis point volatility (BP Vol)—the product of Black implied volatility and the futures price, calculated using at-the-money Eurodollar options—and the MOVE index, a weighted average of basis point volatility for one-month Treasury options across maturities.

Table 4 presents the results using alternative uncertainty measures. Columns (3) and (4) use BP vol, while columns (5) and (6) use MOVE. The estimated β_3 is significantly negative across all specifications. For instance, in column (3), a 1% increase in BP vol reduces bond returns by 0.17 basis points more for each additional year of duration. This confirms that return sensitivity

Table 4: The Elasticity of Return to Change in Uncertainty Conditional on Duration.

	(1)	(2)	(3)	(4)	(5)	(6)
IRU	-2.800	-1.887				
	(0.5495)	(0.5277)				
Duration × IRU	-0.2449	-0.2675				
	(0.1022)	(0.0850)				
BP vol			-2.045	-1.422		
			(0.4064)	(0.3988)		
Duration × BP vol			-0.1759	-0.1852		
			(0.0701)	(0.0623)		
MOVE					-1.470	-0.8990
					(0.4502)	(0.4596)
Duration × MOVE					-0.1256	-0.1605
					(0.0856)	(0.0796)
Controls		✓		✓		✓
R^2	0.10061	0.15016	0.08712	0.14093	0.04576	0.11597
Observations	7,047	7,018	7,047	7,018	7,047	7,018

Note: Table 4 reports coefficient estimates from pooled regressions of Treasury bond returns (in basis points) from 1990 to 2019. The main explanatory variables are the change in interest rate risk, duration, and their interaction. Standard errors are clustered by time. Columns (1) and (2) use interest rate risk, (3) and (4) use BP vol, and (5) and (6) use MOVE as uncertainty measures. Control variables include the two-day change in the VIX, monetary policy shocks, and their interactions with duration. The regression equation is

$$\text{Return}_{n,t} = \beta_1 \Delta UNC_t + \beta_2 \text{Duration}_{nt} + \beta_3 \Delta UNC_t \times \text{Duration}_{nt} + \gamma X_{it} + \epsilon_{it},$$

where Return_{nt} is the return of bonds with duration n years at the tth FOMC, ΔUNC_t is the measured change in uncertainty at the tth FOMC, and Duration_{nt} equals n as bonds matures in n years. Standard errors are clustered by the time dimension.

increases with duration, consistent with earlier findings. The results are robust to the choice of uncertainty measure, and columns (4) and (6) indicate that these effects are not driven by changes in the VIX or monetary policy shocks.

As an additional robustness check, I conduct time subsample analyses for the pre-crisis and post-crisis periods, employed an alternative dataset of zero-coupon Treasury returns from Gürkaynak et al. (2007), and estimate results using subsets of maturities rather than the full range from one to twenty-nine years. The results of these sensitivity analyses are reported in Appendix D.

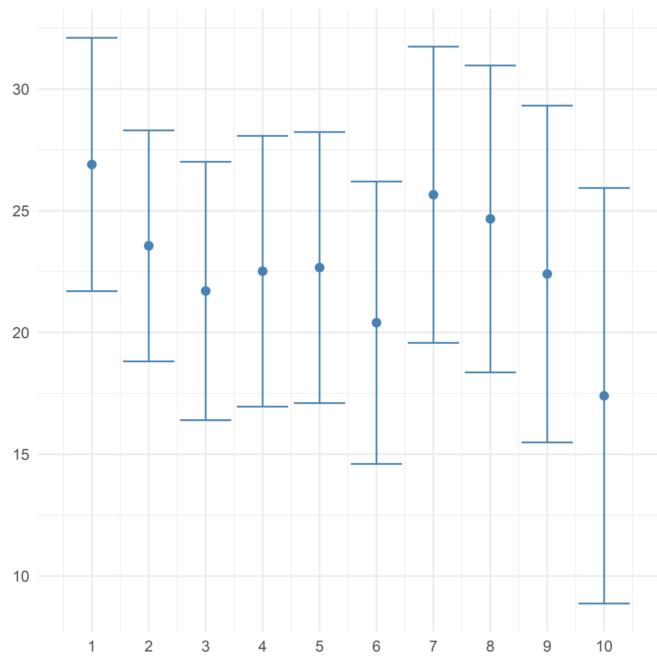
6 Empirical Analysis of Equities

6.1 Average Return on FOMC days

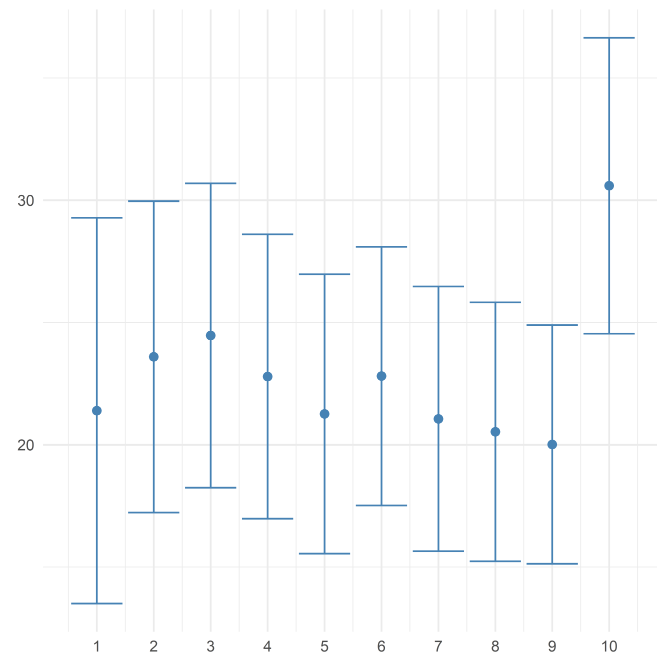
In this section, I empirically examine whether short- or long-duration equities earn higher returns on announcement days. Proposition 2 predicts that short-duration equities will exhibit higher returns than long-duration equities when the resolution of cash flow uncertainty is substantial. Conversely, if discount rate uncertainty is the primary risk resolved, the pattern aligns with the bond case: long-duration equities will have higher returns than short-duration equities.

Equities are sorted into ten deciles based on cash flow duration from the previous quarter, with portfolios rebalanced quarterly. Figure 4-(a) presents the average returns of these portfolios, expressed in basis points, along with 95% confidence intervals based on Newey-West standard errors, as a function of cash flow duration. The results indicate that average returns for short- and long-duration equities are statistically indistinguishable. Specifically, the shortest-duration portfolio has an average return of 26.9 basis points, the second-longest duration portfolio 22.4 basis points, and the longest-duration portfolio has 17.4 basis points. This empirical pattern stands in contrast to Treasury bonds, for which long-duration bonds exhibit higher returns.

Since cash flow duration is not directly observable, I conduct a sensitivity analysis using the book-to-market ratio as an alternative proxy for duration, following Lettau and Wachter (2007) and Hansen et al. (2008). Figure 4-(b) presents the average returns for portfolios sorted by the book-to-market ratio, with portfolios rebalanced quarterly. The results indicate that returns for portfolios with low and high book-to-market ratios are statistically indistinguishable.



(a) Cash Flow Duration



(b) Book-to-Market Ratio

Figure 4: Average Returns Conditional on Duration.

Note: Figure 4 plots the time-series average of portfolio returns on FOMC days. The horizontal axis represents portfolio duration, ranging from short (one) to long (ten). The vertical axis shows the average return on FOMC days for each portfolio. Equities are divided into ten groups based on duration, and the average return within each group is calculated. The portfolios are rebalanced every quarter. Figure 4(a) uses cash flow duration as defined by Weber (2018) to form the portfolios, while Figure 4(b) uses the book-to-market ratio. Newey-West standard errors are used.

The term structure of average returns on FOMC days stands in sharp contrast to that of average monthly returns. Weber (2018) documents a downward-sloping term structure for monthly equity returns. Figure 5-(a) corroborates this finding, showing that monthly average returns for portfolios sorted by cash flow duration decrease with duration: the shortest-duration portfolio yields 11.3 basis points, while the longest-duration portfolio yields only 0.3 basis points.[6]

Figure 5-(b) presents the monthly average returns of portfolios sorted by the book-to-market ratio, further demonstrating the downward-sloping term structure documented by Lettau and Wachter (2007). The shortest-duration portfolio yields 10.6 basis points, while the longest-duration portfolio yields 2.5 basis points.

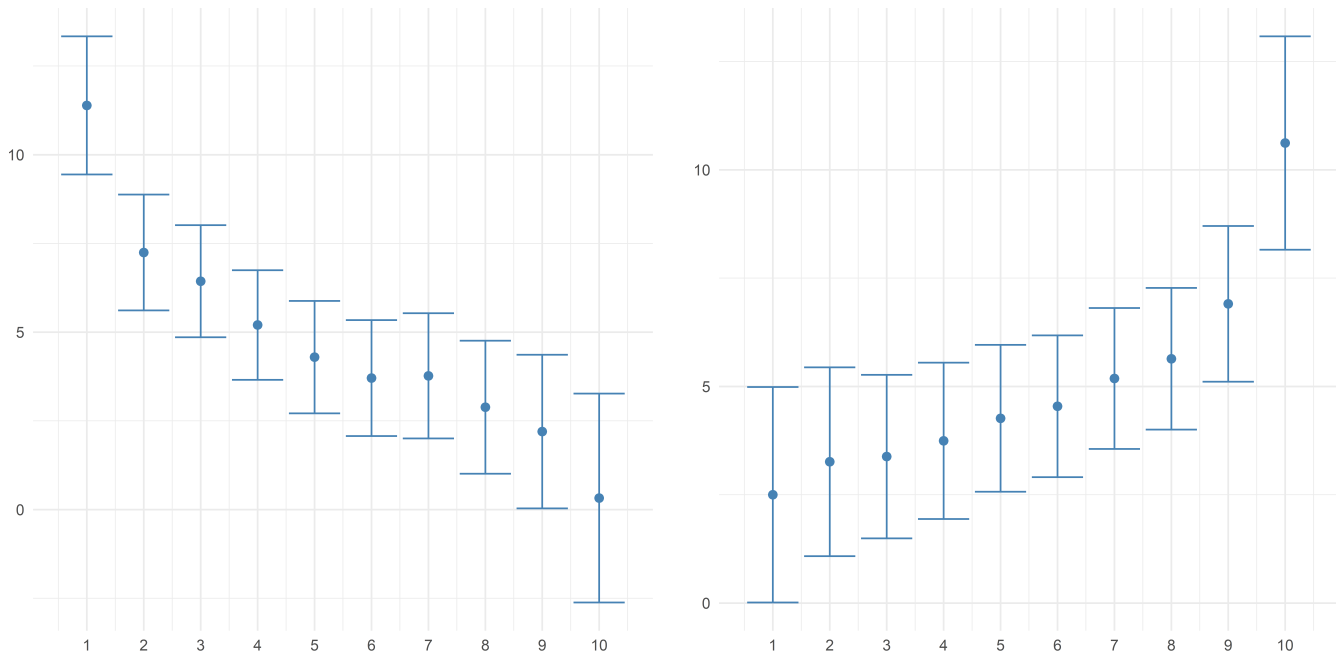
While the term structure of average monthly returns is downward sloping, this pattern does not persist for returns on FOMC days. The analysis suggests that the average return on long-duration equities is higher on FOMC days relative to non-FOMC days—implying an upward-sloping term structure—because the resolution of interest rate risk through monetary policy announcements disproportionately benefits long-duration equities.

To further investigate the relationship between average returns and interest rate risk, I conduct a subsample analysis focusing on announcements where the decline in interest rate risk exceeds a specified threshold. This threshold is set at the 80th percentile of the distribution of changes in interest rate risk.[7] For these selected announcements, I compute the time-series average of portfolio returns.

Figure 6 presents the average returns of portfolios on FOMC days for the full sample of announcements (blue) and for a subsample in which the increase in interest rate risk exceeds a specified threshold (red). The difference in the term structure between these samples is pronounced: when interest rate risk rises, the term structure becomes downward sloping. This pattern reflects the greater sensitivity of long-duration equities to discount factor uncertainty, causing investors to devalue these assets more when uncertainty increases. Overall, Figure 6 provides evidence that the resolution of interest rate risk is a key determinant of the term structure of equity returns on FOMC

[6] Monthly returns are calculated as the price difference between the beginning and end of the month, converted to daily returns by dividing the monthly return by the number of business days. Portfolios are formed by sorting equities into ten deciles based on duration from the previous quarter.

[7] The 80th percentile of $\log(\text{IRU}_{t+1}) - \log(\text{IRU}_{t-1})$ in the full sample is 0.004. Accordingly, I analyzed 48 announcements (20% of 240) with changes in interest rate risk greater than 0.4%.



(a) Cash Flow Duration (b) Book-to-Market Ratio

Figure 5: Monthly Average Returns Conditional on Duration.

Note: Figure 5 plots the time-series average of monthly returns for each portfolio. The horizontal axis represents the duration of portfolios, ranging from short (one) to long (ten). The vertical axis represents the average monthly return for each portfolio, expressed in basis points. Returns are converted from monthly to daily returns by dividing the monthly returns by the number of business days in the month. Equities are divided into ten groups based on (a) cash flow duration and (b) book-to-market ratio. The average return within each group is calculated. Standard errors are Newey-West standard error. 95% confidence intervals are shown. The portfolios are rebalanced every quarter.

days.

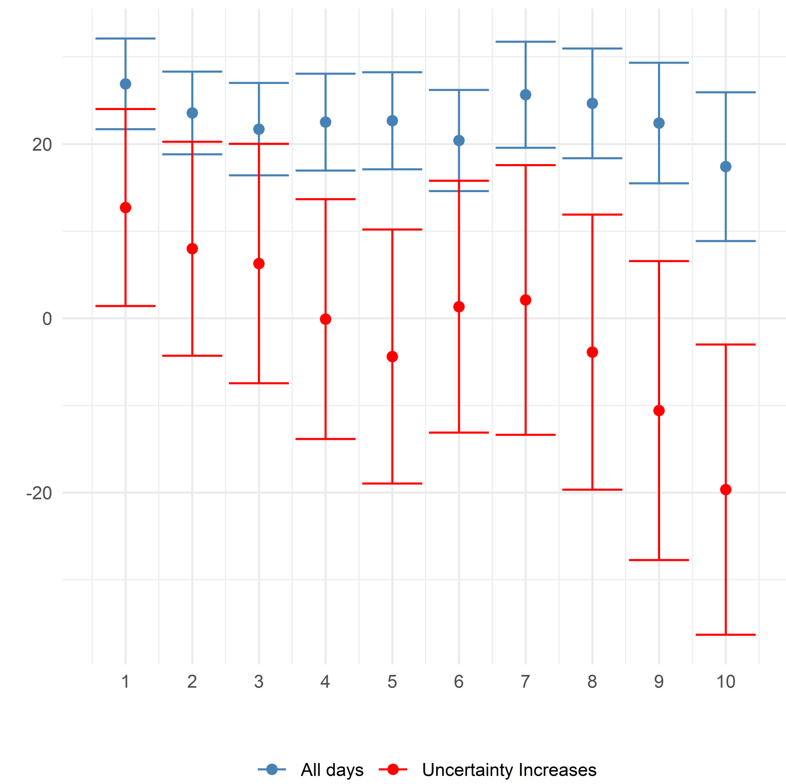


Figure 6: Average Returns Conditional on Duration and an Increase of Uncertainty.

Note: Figure 6 plots the time-series average of portfolio returns for all announcements and for a subsample of announcements. The blue points represent the average returns for all announcements from 1990 to 2019, while the red points represent the average returns for the subset of announcements where the change in interest rate risk $(\log(\text{IRU}t + 1) - \log(\text{IRU}t - 1))$ exceeds 0.004. The 80th percentile of the change in interest rate risk over the entire sample period is 0.004. The horizontal axis represents portfolio duration, ranging from short (one) to long (ten). The vertical axis represents the average return on FOMC days for each portfolio. The 95% confidence intervals, calculated using Newey-West standard errors, are shown. Portfolios are rebalanced every quarter.

I also estimate excess returns at the portfolio level using risk factor regressions. The empirical specification is

$$y_t^m = \alpha^m + \beta_s^m X_{s,t} + \epsilon_{it}, \tag{8}$$

where y_t^m denotes the excess return of portfolio m at time t, with $m \in \{1, \ldots, 10\}$ indexing portfolios sorted by duration. α^m is the model-specific pricing error, and β_s^m is the time-series loading on risk factors $X_{s,t}$. The risk factors used are the Fama and French three factors.

Panel A of Table 5 reports mean excess returns (OLS regression coefficients) and pricing errors from the three-factor model. The results do not reveal a clear upward or downward term structure. The three-factor model provides limited explanatory power for returns on FOMC days, as the average returns and pricing errors are similar across portfolios.

Panel B of Table 5 reports average monthly returns and pricing errors from the three-factor model. The results show that average monthly returns decrease monotonically with duration. The third row in Panel B indicates a strong positive relationship between duration and CAPM betas: high-duration stocks have a CAPM beta of 2.6, while low-duration stocks have a beta of 1.4. Consequently, pricing errors are negatively related to duration.

Sensitivity Analysis The cash flow duration measure described in Section 4.2 depends on six parameters: the persistence of return on equity (ROE) and sales growth, the long-run growth rates of sales and ROE, the discount rate, and the forecasting horizon. To assess the robustness of the results to these parameter choices, I conduct a sensitivity analysis by systematically varying each parameter, as detailed in Appendix E.2. The findings indicate that the results are robust to alternative parameter specifications.

6.2 Interest Rate Risk and Contemporaneous Regression.

This section estimates the elasticity of returns to changes in interest rate risk across durations, testing the prediction from Proposition 3 that long-duration equities are more sensitive to interest rate risk than short-duration equities.

I estimate the following regression separately for each portfolio to examine the sensitivity of returns to changes in interest rate risk:

$$y_t^m = \beta_{iru}^m \Delta \text{IRU}_t + \epsilon_t,$$

where y_t^m is the return of portfolio m at time t expressed in percentage points, and ΔIRU_t is the change in interest rate risk at time t. Portfolios are indexed by $m \in 1, \ldots, 10$ and are constructed by sorting stocks into ten deciles based on cash flow duration in the previous quarter.

Figure 7-(a) presents the estimated coefficients β_{iru}^m as a function of portfolio duration m, along with 95% confidence intervals based on OLS standard errors. The coefficients decrease

Table 5: Average Returns of Portfolios Sorted on Duration.

Portfolio	1	2	3	4	5	6	7	8	9	10
	Panel A: FOMC days									
Average returns	26.9	23.6	21.7	22.5	22.7	20.4	25.7	24.7	22.4	17.4
	(2.6)	(2.4)	(2.7)	(2.8)	(2.8)	(2.9)	(3.1)	(3.2)	(3.5)	(4.4)
CAPM α	26.1	22.5	20.1	20.9	20.4	17.6	22.5	21.5	18.1	11.9
	(2.7)	(2.5)	(2.8)	(2.9)	(2.9)	(3.0)	(3.1)	(3.2)	(3.5)	(3.4)
CAPM β	0.2	0.28	0.42	0.41	0.57	0.70	0.80	0.80	1.05	1.29
	(0.14)	(0.14)	(0.15)	(0.16)	(0.16)	(0.16)	(0.17)	(0.16)	(0.17)	(0.29)
FF3 α	26.0	20.8	19.6	20.6	19.9	18.1	23.1	22.5	19.1	13.3
	(2.6)	(2.5)	(2.7)	(2.8)	(2.8)	(2.8)	(3.0)	(3.1)	(3.4)	(3.0)
	Panel B: Average Monthly Returns									
Average returns	11.4	7.2	6.4	5.2	4.3	3.7	3.8	2.9	2.2	0.3
	(1.0)	(0.8)	(0.8)	(0.8)	(0.8)	(0.8)	(0.9)	(1.0)	(1.1)	(1.5)
CAPM α	10.5	6.4	5.6	4.4	3.4	2.7	2.6	1.6	0.5	-1.7
	(1.0)	(0.8)	(0.8)	(0.7)	(0.7)	(0.8)	(0.8)	(0.9)	(1.0)	(1.3)
CAPM β	1.4	1.4	1.3	1.3	1.5	1.6	1.8	2.1	2.6	3.0
	(0.25)	(0.23)	(0.22)	(0.21)	(0.21)	(0.21)	(0.23)	(0.23)	(0.27)	(0.37)
FF3 α	9.4	5.3	4.5	3.4	2.5	1.9	2.0	1.3	0.6	-1.2
	(1.0)	(0.8)	(0.8)	(0.8)	(0.8)	(0.8)	(0.9)	(0.9)	(1.0)	(1.4)
	Panel C: Property of Portfolios									
Duration	9.5	14.3	16.1	17.3	18.2	19.1	19.9	20.8	21.7	23.6

Note: The table shows the time-series average of the portfolio returns. "Average returns" refers to the average returns on the portfolios, expressed in basis points. "FF3 α" reports alphas from the three-factor model of Fama and French (1992). "1"-"10" represents the portfolio ordered from short to long duration. Panel A uses daily returns on FOMC days. Panel B uses monthly returns of portfolios. In Panel B, returns are converted to a daily scale by deviding monthly returns by the number of business days in the month. Panel C shows the average of cash flow duration of the portfolio in years. Standard errors in parenteses are Newey-West standard errors. The sample period is 1990/1-2019/12.

monotonically with duration: for the shortest-duration portfolio, the estimate is -5.3, while for the longest-duration portfolio, it is -9.85. This indicates that return sensitivity to interest rate risk increases in absolute value with duration, consistent with the theoretical prediction.

Figure 7-(b) presents the estimated coefficients β^m_{iru} for portfolios sorted by the book-to-market ratio. The coefficients increase monotonically with the book-to-market ratio: the lowest book-to-market portfolio has an estimate of -9.2, while the highest has -6.5.

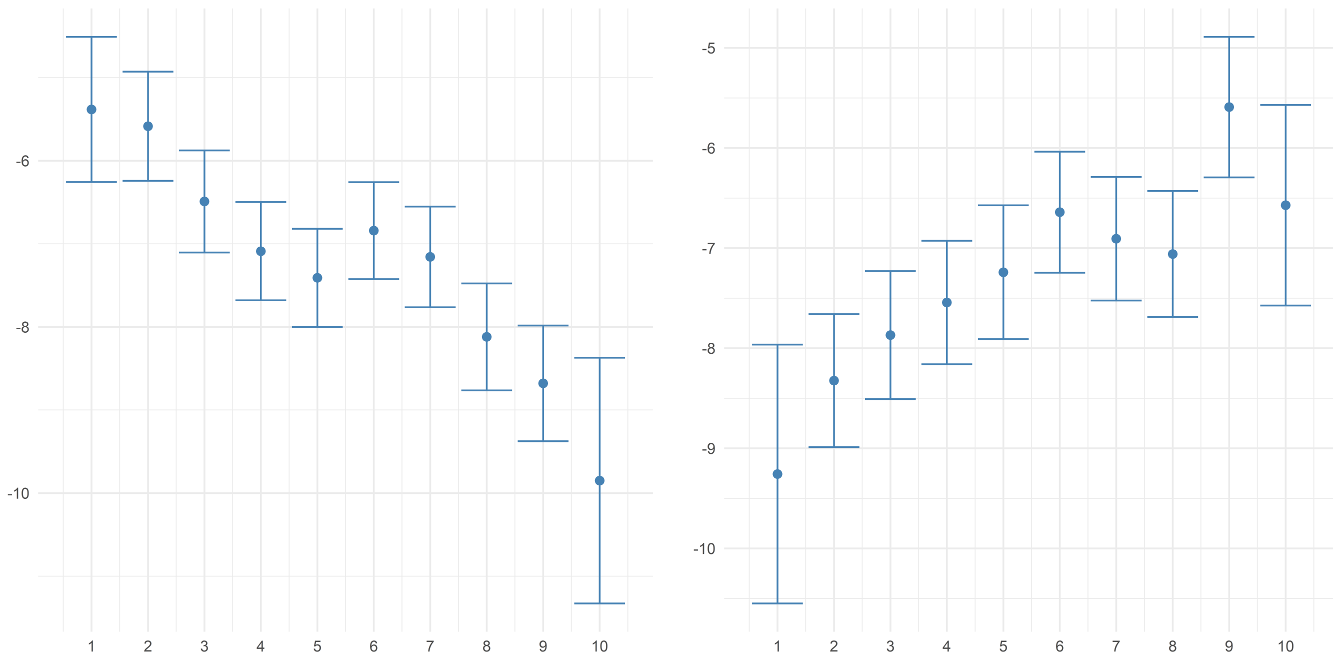
This monotonic relationship between the elasticity of returns to uncertainty and duration holds for both equities and bonds. Intuitively, conditional on the resolution of interest rate risk, assets with longer duration—regardless of cash flow risk—are more responsive. However, despite similar return sensitivities, the term structure of *average* returns differs: long-duration bonds have higher average returns than short-duration bonds, while for equities, average returns do not increase with duration. This difference reflects the presence of cash flow risk in equities but not in bonds.

I estimate the following regression to assess whether returns on longer-duration equities are more sensitive to the resolution of interest rate risk:

$$\text{Return}_{i,t} = \beta_1 \Delta IRU_t + \beta_2 \text{Duration}_{it} + \beta_3 \Delta IRU_t \times \text{Duration}_{it} + \gamma X_{it} + \epsilon_{it}, \qquad (9)$$

where i indexes firms, t indexes tth FOMC, Return_{it} denotes the stock return of firm i on the tth FOMC day (in basis points), ΔIRU_t is the change in interest rate risk associated with the tth FOMC, and Duration_{it} is the duration of firm i at time t. X_{it} denotes a vector of control variables, including (i) firm and year fixed effects, (ii) firm characteristics such as size, profitability, leverage, and sales growth, and (iii) interactions between these characteristics and ΔIRU_t. All balance sheet variables are measured using information from the previous quarter. Robust standard errors are clustered at the firm level.

Table 6 presents the regression results. Column (1) excludes control variables and fixed effects, Column (2) includes control variables, and Column (3) adds firm fixed effects. The coefficient of interest, β_3, is significantly negative across all specifications (e.g., -0.3 in Column (1)), indicating that a one-year increase in equity duration is associated with a 0.3 percentage point greater sensitivity of returns to changes in interest rate risk. Thus, the elasticity of returns with respect to interest rate risk increases in absolute value with duration.



(a) Cash Flow Duration

(b) Book-to-Market Ratio

Figure 7: The Elasticity of Returns to interest rate risk Conditional on Duration.

Note: Figure 7 shows the sensitivity of equity returns to changes in interest rate risk. I seperately regress the return of portfolios on changes in uncertainty measure:

$$y_t^m = \beta^m \Delta \text{IRU}_t + \epsilon_t,$$

where y_t^m is the return of portfolio m at time t expressed in basis points, and ΔIRU_t is the change in interest rate risk. Portfolios are indexed by $m \in \{1, \cdots, 10\}$. The portfolios are sorted based on cash flow duration in Figure (a) and on the book-to-market ratio in Figure (b). Interest rate risk data is taken from Bauer et al. (2022). The figure plots the coefficients β^m for each portfolio m, along with their two OLS standard error bands.

Table 6: The Elasticity of Returns to Interest Rate Risk Conditional on Duration.

	(1)	(2)	(3)
Duration × IRU	-0.3194	-0.3674	-0.3908
	(0.0570)	(0.0573)	(0.0549)
Profit × IRU		20.30	13.52
		(11.47)	(10.15)
Leverage × IRU		1.009	-0.3120
		(0.9006)	(0.8878)
Sales growth × IRU		-1.538	-1.652
		(0.7683)	(0.7817)
IRU	-1.591	5.210	5.205
	(0.9639)	(0.9060)	(0.9119)
R^2	0.00473	0.00547	0.02777
Observations	775,506	698,297	698,297
Controls		✓	✓
Firm fixed effects			✓
Year fixed effects			✓

Note: Table 6 reports the coefficient estimates from the pooled regression of equity returns over 240 FOMC event days. The explanatory variables include the change in the uncertainty measure, duration, their interaction, and control variables. Control variables consist of (i) firm and year fixed effects, (ii) size, profitability, leverage, and sales growth, and (iii) interactions between the variables in (ii) and the change in interest rate risk. Standard errors are clustered at the firm level. The dependent variable is equity returns measured in basis points. Column (2) includes the control variables in (ii) and (iii), while Column (3) adds firm and year fixed effects. The regression equation is

$$\text{Return}_{i,t} = \beta_1 \Delta IRU_t + \beta_2 \text{Duration}_{it} + \beta_3 \Delta IRU_t \times \text{Duration}_{it} + \gamma X_{it} + \epsilon_{it},$$

where i is the firm index, t is the tth FOMC, Return_{it} is the stock return of firm i at the tth FOMC, ΔIRU_t is the measured change in uncertainty caused by the tth FOMC, and Duration_{it} is the measured duration of firm i at the tth FOMC. Standard errors are clustered at firm level.

Sensitivity Analysis Table 7 reports the results of the sensitivity analysis using alternative measures of interest rate risk. Specifically, basis point volatility (BP Vol) and the MOVE index are employed as alternative proxies, as described in the previous section. Across all specifications, the estimated coefficients for the interaction between duration and the uncertainty measure remain significantly negative. The magnitude of these coefficients is consistent with previous estimates, ranging from -0.35 to -0.2.

As discussed in Section 6.1, the cash flow duration measure depends on several parameter choices. Appendix E.2 presents a sensitivity analysis with respect to these parameters. The results demonstrate that the main findings are robust to alternative parameter specifications.

7 Conclusion

This paper provides empirical evidence and a theoretical framework for understanding cross-sectional asset returns on FOMC announcement days. Specifically, it investigates the types of uncertainty resolved by FOMC announcements and the factors underlying the heterogeneity in stock returns. The findings are consistent with the literature emphasizing risk-based explanations for the elevated excess returns observed on announcement days. Distinct from prior work focusing on cash flow uncertainty, this analysis underscores the central role of interest rate risk in explaining these returns. To evaluate the importance of interest rate risk, the paper develops theoretical predictions relating announcement returns to asset duration and presents empirical results supporting these predictions.

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Table 7: The Elasticity of Returns to Interest Rate Risk Conditional on Duration.

	(1)	(2)	(3)	(4)	(5)	(6)
Duration × BP vol	-0.2308	-0.2597	-0.2867			
	(0.0521)	(0.0510)	(0.0495)			
Duration × MOVE				-0.2976	-0.3338	-0.3528
				(0.0476)	(0.0450)	(0.0443)
Duration	-1.654	-1.685	-3.044	-1.613	-1.639	-2.744
	(0.1621)	(0.1681)	(0.2623)	(0.1683)	(0.1721)	(0.2787)
BP vol	-1.900	2.368	2.945			
	(0.8656)	(0.6556)	(0.6661)			
MOVE				0.1215	3.620	4.198
				(0.7960)	(0.6268)	(0.6309)
R^2	0.00601	0.00653	0.02930	0.00504	0.00540	0.02837
Observations	775,506	698,297	698,297	775,506	698,297	698,297
Controls		✓	✓		✓	✓
Firm fixed effects			✓			✓
Year fixed effects			✓			✓

Note: Table 7 reports the coefficient estimates from the pooled regression of equity returns over 240 FOMC event days. The explanatory variables include the change in the uncertainty measure, duration, their interaction, and control variables. Basis point volatility (BP Vol) is defined as the product of Black IV and the futures price. MOVE is a weighted average of basis point volatility for one-month Treasury options across bond maturities. Control variables include (i) firm and year fixed effects, (ii) size, profitability, leverage, and sales growth, and (iii) interactions between the variables in (ii) and the change in interest rate risk. Standard errors are clustered at the firm level. Column (2) includes the control variables in (ii) and (iii), while Column (3) adds firm and year fixed effects.

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Appendix A Proof

A.1 Proposition 1

In the case of bonds, discount rate is high (β^h) with probability p (state s_1) and discount rate is low (β^l) with probability $1-p$ (state s_2). The cash flow of bond, $X_3(s)$, does not depend on s.

The announcement premium of long-maturity bonds and short-maturity bonds is given by

$$\begin{aligned}
&E_1\left[\frac{P_2^S(s)}{P_1^S}\right]-E_1\left[\frac{P_2^L(s)}{P_1^L}\right]\\
&=\frac{E\left[\left[C_2^{1-\frac{1}{\psi}}+\beta(s)C_3(s)^{1-\frac{1}{\psi}}+\beta^2(s)C_4^{1-\frac{1}{\psi}}\right]^{\frac{\frac{1}{\psi}-\gamma}{1-\frac{1}{\psi}}}\right]E\left[\beta(s)C_3(s)^{-\frac{1}{\psi}}X_3(s)\right]}{E\left[\left[C_2^{1-\frac{1}{\psi}}+\beta(s)C_3(s)^{1-\frac{1}{\psi}}+\beta^2(s)C_4^{1-\frac{1}{\psi}}\right]^{\frac{\frac{1}{\psi}-\gamma}{1-\frac{1}{\psi}}}\beta(s)C_3(s)^{-\frac{1}{\psi}}X_3(s)\right]}\\
&-\frac{E\left[\left[C_2^{1-\frac{1}{\psi}}+\beta(s)C_3(s)^{1-\frac{1}{\psi}}+\beta^2(s)C_4^{1-\frac{1}{\psi}}\right]^{\frac{\frac{1}{\psi}-\gamma}{1-\frac{1}{\psi}}}\right]E\left[\beta^2(s)C_4^{-\frac{1}{\psi}}X_4\right]}{E\left[\left[C_2^{1-\frac{1}{\psi}}+\beta(s)C_3(s)^{1-\frac{1}{\psi}}+\beta^2(s)C_4^{1-\frac{1}{\psi}}\right]^{\frac{\frac{1}{\psi}-\gamma}{1-\frac{1}{\psi}}}\beta^2(s)C_4^{-\frac{1}{\psi}}X_4\right]}. \qquad (10)
\end{aligned}$$

When (10) is positive, the expected return on short-duraiton assets is higher than long-duraiton. Conversely, when (10) is negative, the expected return on short-duraiton assets is lower than long-duraiton. The sing of (10) is equal to

$$\begin{aligned}
&E\left[\beta(s)C_3(s)^{-\frac{1}{\psi}}X_3(s)\right]E\left[\left[C_2^{1-\frac{1}{\psi}}+\beta(s)C_3(s)^{1-\frac{1}{\psi}}+\beta^2(s)C_4^{1-\frac{1}{\psi}}\right]^{\frac{\frac{1}{\psi}-\gamma}{1-\frac{1}{\psi}}}\beta^2(s)C_4^{-\frac{1}{\psi}}X_4\right]\\
&-E\left[\beta^2(s)C_4^{-\frac{1}{\psi}}X_4\right]E\left[\left[C_2^{1-\frac{1}{\psi}}+\beta(s)C_3(s)^{1-\frac{1}{\psi}}+\beta^2(s)C_4^{1-\frac{1}{\psi}}\right]^{\frac{\frac{1}{\psi}-\gamma}{1-\frac{1}{\psi}}}\beta(s)C_3(s)^{-\frac{1}{\psi}}X_3(s)\right] \qquad (11)
\end{aligned}$$

To abbreviate the notation,

$$V(s_i)\equiv\left[C_2^{1-\frac{1}{\psi}}+\beta(s_i)C_3(s_i)^{1-\frac{1}{\psi}}+\beta^2(s_i)C_4^{1-\frac{1}{\psi}}\right]^{\frac{\frac{1}{\psi}-\gamma}{1-\frac{1}{\psi}}} \qquad (12)$$

Equation (11) can be written as

$$
\begin{aligned}
&\left(p\beta^h C_3(s_1)^{-\frac{1}{\psi}} X_3 + (1-p)\beta^l C_3(s_2)^{-\frac{1}{\psi}} X_3\right) \\
&\times \left(pV(s_1)(\beta^h)^2 C_4^{-\frac{1}{\psi}} X_4 + (1-p)V(s_2)(\beta^l)^2 C_4^{-\frac{1}{\psi}} X_4\right) \\
&- \left(p\beta^h C_4^{-\frac{1}{\psi}} X_4 + (1-p)\beta^l C_4^{-\frac{1}{\psi}} X_4\right) \\
&\times \left(pV(s_1)(\beta^h)^2 C_3(s_1)^{-\frac{1}{\psi}} X_3 + (1-p)V(s_2)(\beta^l)^2 C_3(s_2)^{-\frac{1}{\psi}} X_3\right) \\
&= p(1-p)\beta^h\beta^l X_3 X_4 \left(V(s_1)-V(s_2)\right)\left(\beta^h C_3(s_2)^{-\frac{1}{\psi}} C_4^{-\frac{1}{\psi}} - \beta^l C_3(s_1)^{-\frac{1}{\psi}} C_4^{-\frac{1}{\psi}}\right). \qquad (13)
\end{aligned}
$$

Here,

$$p(1-p)\beta^h\beta^l X_3 X_4 \qquad (14)$$

is positive. Therefore, the sign of average returns of short minus long-duration bonds is equal to

$$\left(V(s_1)-V(s_2)\right)\left(\beta^h C_3(s_2)^{-\frac{1}{\psi}} C_4^{-\frac{1}{\psi}} - \beta^l C_3(s_1)^{-\frac{1}{\psi}} C_4^{-\frac{1}{\psi}}\right).$$

□

A.1.1 Corollary 1

From Proposition 1, the difference between the average returns of short and long-duration bonds is determined by

$$\left(V(s_1)-V(s_2)\right)\left(\beta^h C_3(s_2)^{-\frac{1}{\psi}} C_4^{-\frac{1}{\psi}} - \beta^l C_3(s_1)^{-\frac{1}{\psi}} C_4^{-\frac{1}{\psi}}\right). \qquad (15)$$

Under the assumption that consumption is approximately the same across the states ($C_3(s_1) \approx C_3(s_2)$), the second term:

$$\beta^h C_3(s_2)^{-\frac{1}{\psi}} C_4^{-\frac{1}{\psi}} - \beta^l C_3(s_1)^{-\frac{1}{\psi}} C_4^{-\frac{1}{\psi}}$$

is positive. Moreover, the first term in (15):

$$
\begin{aligned}
&V(s_1) - V(s_2) \\
&= \left[C_2^{1-\frac{1}{\psi}} + \beta^h C_3(s_1)^{1-\frac{1}{\psi}} + (\beta^h)^2 C_4^{1-\frac{1}{\psi}}\right]^{\frac{\frac{1}{\psi}-\gamma}{1-\frac{1}{\psi}}} - \left[C_2^{1-\frac{1}{\psi}} + \beta^l C_3(s_2)^{1-\frac{1}{\psi}} + (\beta^l)^2 C_4^{1-\frac{1}{\psi}}\right]^{\frac{\frac{1}{\psi}-\gamma}{1-\frac{1}{\psi}}},
\end{aligned}
$$

is negative if and only if $\frac{1}{\psi} < \gamma$ holds. Therefore, the average return of long-duration bonds is higher than that of short-duration bonds if and only if $\frac{1}{\psi} < \gamma$ holds.

□

A.2 Proposition 2

The sign of the expected return on short- minus long-duration bonds is given by

$$
\begin{aligned}
&E\left[\beta(s)C_3(s)^{-\frac{1}{\psi}}X_3(s)\right]E\left[\left[C_2^{1-\frac{1}{\psi}}+\beta(s)C_3(s)^{1-\frac{1}{\psi}}+\beta^2(s)C_4^{1-\frac{1}{\psi}}\right]^{\frac{\frac{1}{\psi}-\gamma}{1-\frac{1}{\psi}}}\beta^2(s)C_4^{-\frac{1}{\psi}}X_4\right]\\
&-E\left[\beta^2(s)C_4^{-\frac{1}{\psi}}X_4\right]E\left[\left[C_2^{1-\frac{1}{\psi}}+\beta(s)C_3(s)^{1-\frac{1}{\psi}}+\beta^2(s)C_4^{1-\frac{1}{\psi}}\right]^{\frac{\frac{1}{\psi}-\gamma}{1-\frac{1}{\psi}}}\beta(s)C_3(s)^{-\frac{1}{\psi}}X_3(s)\right]\\
&=(X_3^hC_3(s_1)^{-\frac{1}{\psi}}-X_3^lC_3(s_2)^{-\frac{1}{\psi}})p_1p_2(\beta^h)^3C_4^{-\frac{1}{\psi}}(V(s_2)-V(s_1))\\
&+(X_3^hC_3(s_3)^{-\frac{1}{\psi}}-X_3^lC_3(s_4)^{-\frac{1}{\psi}})p_3p_4(\beta^l)^3C_4^{-\frac{1}{\psi}}(V(s_4)-V(s_3))\\
&+(\beta^hC_3(s_3)^{-\frac{1}{\psi}}-\beta^lC_3(s_1)^{-\frac{1}{\psi}})p_1p_3X_3^h\beta^h\beta^lC_4^{-\frac{1}{\psi}}(V(s_1)-V(s_3))\\
&+(\beta^hC_3(s_4)^{-\frac{1}{\psi}}-\beta^lC_3(s_2)^{-\frac{1}{\psi}})p_2p_4X_3^l\beta^h\beta^lC_4^{-\frac{1}{\psi}}(V(s_2)-V(s_4))\\
&+p_1p_4\beta^h\beta^lC_4^{-\frac{1}{\psi}}(\beta^hX_3^lC_3(s_4)^{-\frac{1}{\psi}}-\beta^lX_3^hC_3(s_1)^{-\frac{1}{\psi}})(V(s_1)-V(s_4))\\
&+p_2p_3\beta^h\beta^lC_4^{-\frac{1}{\psi}}(\beta^hX_3^hC_3(s_3)^{-\frac{1}{\psi}}-\beta^lX_3^lC_3(s_2)^{-\frac{1}{\psi}})(V(s_2)-V(s_3)).
\end{aligned}
\tag{16}
$$

The cash flow of short-duration equities in high and low states is defined as

$$
\begin{aligned}
X_3^h &\equiv \overline{X}+\sigma\\
X_3^l &\equiv \overline{X}-\sigma,
\end{aligned}
$$

where σ is the dispersion of cash flow.

Equation (16) can be written as

$$
\begin{aligned}
&=((\overline{X}+\sigma)C_3(s_1)^{-\frac{1}{\psi}}-(\overline{X}-\sigma)C_3(s_2)^{-\frac{1}{\psi}})p_1p_2(\beta^h)^3C_4^{-\frac{1}{\psi}}(V(s_2)-V(s_1))\\
&+((\overline{X}+\sigma)C_3(s_3)^{-\frac{1}{\psi}}-(\overline{X}-\sigma)C_3(s_4)^{-\frac{1}{\psi}})p_3p_4(\beta^l)^3C_4^{-\frac{1}{\psi}}(V(s_4)-V(s_3))\\
&+(\beta^hC_3(s_3)^{-\frac{1}{\psi}}-\beta^lC_3(s_1)^{-\frac{1}{\psi}})p_1p_3(\overline{X}+\sigma)\beta^h\beta^lC_4^{-\frac{1}{\psi}}(V(s_1)-V(s_3))\\
&+(\beta^hC_3(s_4)^{-\frac{1}{\psi}}-\beta^lC_3(s_2)^{-\frac{1}{\psi}})p_2p_4(\overline{X}-\sigma)\beta^h\beta^lC_4^{-\frac{1}{\psi}}(V(s_2)-V(s_4))\\
&+p_1p_4\beta^h\beta^lC_4^{-\frac{1}{\psi}}(\beta^h(\overline{X}-\sigma)C_3(s_4)^{-\frac{1}{\psi}}-\beta^l(\overline{X}+\sigma)C_3(s_1)^{-\frac{1}{\psi}})(V(s_1)-V(s_4))\\
&+p_2p_3\beta^h\beta^lC_4^{-\frac{1}{\psi}}(\beta^h(\overline{X}+\sigma)C_3(s_3)^{-\frac{1}{\psi}}-\beta^l(\overline{X}-\sigma)C_3(s_2)^{-\frac{1}{\psi}})(V(s_2)-V(s_3))
\end{aligned}
$$

$$
\begin{aligned}
&= \frac{1}{16}\sigma\Big[(C_3(s_1)^{-\frac{1}{\psi}} + C_3(s_2)^{-\frac{1}{\psi}})(\beta^h)^3 C_4^{-\frac{1}{\psi}}(V(s_2) - V(s_1)) \\
&+ (C_3(s_3)^{-\frac{1}{\psi}} + C_3(s_4)^{-\frac{1}{\psi}})(\beta^l)^3 C_4^{-\frac{1}{\psi}}(V(s_4) - V(s_3)) \\
&+ (\beta^h C_3(s_3)^{-\frac{1}{\psi}} - \beta^l C_3(s_1)^{-\frac{1}{\psi}})\beta^h\beta^l C_4^{-\frac{1}{\psi}}(V(s_1) - V(s_3)) \\
&- (\beta^h C_3(s_4)^{-\frac{1}{\psi}} - \beta^l C_3(s_2)^{-\frac{1}{\psi}})\beta^h\beta^l C_4^{-\frac{1}{\psi}}(V(s_2) - V(s_4)) \\
&- \beta^h\beta^l C_4^{-\frac{1}{\psi}}(\beta^h C_3(s_4)^{-\frac{1}{\psi}} - \beta^l C_3(s_1)^{-\frac{1}{\psi}})(V(s_1) - V(s_4)) \\
&+ \beta^h\beta^l C_4^{-\frac{1}{\psi}}(\beta^h C_3(s_3)^{-\frac{1}{\psi}} - \beta^l C_3(s_2)^{-\frac{1}{\psi}})(V(s_2) - V(s_3))\Big] \\
&+ t.i.p. \qquad (17)
\end{aligned}
$$

To abbreviate the notation, I define terms independent of parameters σ in the equation (17).

$$
\begin{aligned}
t.i.p. \equiv\ & (\overline{X}C_3(s_1)^{-\frac{1}{\psi}} - \overline{X}C_3(s_2)^{-\frac{1}{\psi}})p_1p_2(\beta^h)^3 C_4^{-\frac{1}{\psi}}(V(s_2) - V(s_1)) \\
&+ (\overline{X}C_3(s_3)^{-\frac{1}{\psi}} - \overline{X}C_3(s_4)^{-\frac{1}{\psi}})p_3p_4(\beta^l)^3 C_4^{-\frac{1}{\psi}}(V(s_4) - V(s_3)) \\
&+ (\beta^h C_3(s_3)^{-\frac{1}{\psi}} - \beta^l C_3(s_1)^{-\frac{1}{\psi}})p_1p_3\overline{X}\beta^h\beta^l C_4^{-\frac{1}{\psi}}(V(s_1) - V(s_3)) \\
&+ (\beta^h C_3(s_4)^{-\frac{1}{\psi}} - \beta^l C_3(s_2)^{-\frac{1}{\psi}})p_2p_4\overline{X}\beta^h\beta^l C_4^{-\frac{1}{\psi}}(V(s_2) - V(s_4)) \\
&+ p_1p_4\beta^h\beta^l C_4^{-\frac{1}{\psi}}(\beta^h\overline{X}C_3(s_4)^{-\frac{1}{\psi}} + \beta^l\overline{X}C_3(s_1)^{-\frac{1}{\psi}})(V(s_1) - V(s_4)) \\
&+ p_2p_3\beta^h\beta^l C_4^{-\frac{1}{\psi}}(\beta^h\overline{X}C_3(s_3)^{-\frac{1}{\psi}} + \beta^l\overline{X}C_3(s_2)^{-\frac{1}{\psi}})(V(s_2) - V(s_3)). \qquad (18)
\end{aligned}
$$

I assumed that

$$C(s_2) = C(s_4) < C(s_1) = C(s_3).$$

This assumption implies that aggregate consumption is high when the cash flow of short-term equities is high. In constrast, the aggregate consumption is not affected by discount rate.

Then, the order of $V(s_i)$ is determined.

$$
\begin{aligned}
V(s_1) &< V(s_2) \\
V(s_3) &< V(s_4).
\end{aligned}
$$

In the equation (17), the coefficient on σ, defined as α^σ, is

$$\alpha^\sigma \equiv \frac{1}{16}\Big[(C_3(s_1)^{-\frac{1}{\psi}} + C_3(s_2)^{-\frac{1}{\psi}})(\beta^h)^3 C_4^{-\frac{1}{\psi}}(V(s_2) - V(s_1))$$

$$
\begin{aligned}
&+ (C_3(s_3)^{-\frac{1}{\psi}} + C_3(s_4)^{-\frac{1}{\psi}})(\beta^l)^3 C_4^{-\frac{1}{\psi}}(V(s_4) - V(s_3)) \\
&+ (\beta^h C_3(s_3)^{-\frac{1}{\psi}} - \beta^l C_3(s_1)^{-\frac{1}{\psi}}) p_1 p_3 \beta^h \beta^l C_4^{-\frac{1}{\psi}}(V(s_1) - V(s_3)) \\
&- (\beta^h C_3(s_4)^{-\frac{1}{\psi}} - \beta^l C_3(s_2)^{-\frac{1}{\psi}}) p_2 p_4 \beta^h \beta^l C_4^{-\frac{1}{\psi}}(V(s_2) - V(s_4)) \\
&- \beta^h \beta^l C_4^{-\frac{1}{\psi}}(\beta^h C_3(s_4)^{-\frac{1}{\psi}} + \beta^l C_3(s_1)^{-\frac{1}{\psi}})(V(s_1) - V(s_4)) \\
&+ \beta^h \beta^l C_4^{-\frac{1}{\psi}}(\beta^h C_3(s_3)^{-\frac{1}{\psi}} + \beta^l C_3(s_2)^{-\frac{1}{\psi}})(V(s_2) - V(s_3))\Big].
\end{aligned} \tag{19}
$$

In the lemma 1, I show that α^σ is positive. Therefore, when

$$
\sigma = \frac{X^h - X^l}{2} > \frac{-t.i.p}{\alpha^\sigma}
$$

is true, the expected return on short- minus long-duration equities is positive.

In proposition 2, $\overline{\sigma}$ is

$$
\overline{\sigma} \equiv 2\frac{-t.i.p}{\alpha^\sigma}. \tag{20}
$$

□

A.2.1 Lemma 1

Lemma 1. *The coefficient on σ,*

$$
\begin{aligned}
&(C_3(s_1)^{-\frac{1}{\psi}} + C_3(s_2)^{-\frac{1}{\psi}})(\beta^h)^3 C_4^{-\frac{1}{\psi}}(V(s_2) - V(s_1)) \\
&+ (C_3(s_3)^{-\frac{1}{\psi}} + C_3(s_4)^{-\frac{1}{\psi}})(\beta^l)^3 C_4^{-\frac{1}{\psi}}(V(s_4) - V(s_3)) \\
&+ (\beta^h C_3(s_3)^{-\frac{1}{\psi}} - \beta^l C_3(s_1)^{-\frac{1}{\psi}}) \beta^h \beta^l C_4^{-\frac{1}{\psi}}(V(s_1) - V(s_3)) \\
&- (\beta^h C_3(s_4)^{-\frac{1}{\psi}} - \beta^l C_3(s_2)^{-\frac{1}{\psi}}) \beta^h \beta^l C_4^{-\frac{1}{\psi}}(V(s_2) - V(s_4)) \\
&- \beta^h \beta^l C_4^{-\frac{1}{\psi}}(\beta^h C_3(s_4)^{-\frac{1}{\psi}} + \beta^l C_3(s_1)^{-\frac{1}{\psi}})(V(s_1) - V(s_4)) \\
&+ \beta^h \beta^l C_4^{-\frac{1}{\psi}}(\beta^h C_3(s_3)^{-\frac{1}{\psi}} + \beta^l C_3(s_2)^{-\frac{1}{\psi}})(V(s_2) - V(s_3)),
\end{aligned} \tag{21}
$$

is positive.

Proof. Since $V(s_1) < V(s_2)$ and $V(s_3) < V(s_4)$ are true, the first two terms in (21) are positive:

$$
(C_3(s_1)^{-\frac{1}{\psi}} + C_3(s_2)^{-\frac{1}{\psi}})(\beta^h)^3 C_4^{-\frac{1}{\psi}}(V(s_2) - V(s_1)) > 0.
$$

$$+ (C_3(s_3)^{-\frac{1}{\psi}} + C_3(s_4)^{-\frac{1}{\psi}})(\beta^l)^3 C_4^{-\frac{1}{\psi}}(V(s_4) - V(s_3)) > 0.$$

The remaining term (the sum of third to sixth terms in (21)) is

$$\begin{aligned}
&(\beta^h C_3(s_3)^{-\frac{1}{\psi}} - \beta^l C_3(s_1)^{-\frac{1}{\psi}})\beta^h\beta^l C_4^{-\frac{1}{\psi}}(V(s_1) - V(s_3)) \\
&- (\beta^h C_3(s_4)^{-\frac{1}{\psi}} - \beta^l C_3(s_2)^{-\frac{1}{\psi}})\beta^h\beta^l C_4^{-\frac{1}{\psi}}(V(s_2) - V(s_4)) \\
&- \beta^h\beta^l C_4^{-\frac{1}{\psi}}(\beta^h C_3(s_4)^{-\frac{1}{\psi}} + \beta^l C_3(s_1)^{-\frac{1}{\psi}})(V(s_1) - V(s_4)) \\
&+ \beta^h\beta^l C_4^{-\frac{1}{\psi}}(\beta^h C_3(s_3)^{-\frac{1}{\psi}} + \beta^l C_3(s_2)^{-\frac{1}{\psi}})(V(s_2) - V(s_3)) \\
&\geq (\beta^h C_3(s_3)^{-\frac{1}{\psi}} - \beta^l C_3(s_1)^{-\frac{1}{\psi}})\beta^h\beta^l C_4^{-\frac{1}{\psi}}(V(s_1) - V(s_4)) \\
&- (\beta^h C_3(s_4)^{-\frac{1}{\psi}} - \beta^l C_3(s_2)^{-\frac{1}{\psi}})\beta^h\beta^l C_4^{-\frac{1}{\psi}}(V(s_2) - V(s_4)) \\
&- \beta^h\beta^l C_4^{-\frac{1}{\psi}}(\beta^h C_3(s_4)^{-\frac{1}{\psi}} + \beta^l C_3(s_1)^{-\frac{1}{\psi}})(V(s_1) - V(s_4)) \\
&+ \beta^h\beta^l C_4^{-\frac{1}{\psi}}(\beta^h C_3(s_3)^{-\frac{1}{\psi}} + \beta^l C_3(s_2)^{-\frac{1}{\psi}})(V(s_2) - V(s_4)) \\
&= \beta^h\beta^l(V(s_1) - V(s_4))\left((\beta^h - \beta^l)C_3(s_1)^{-\frac{1}{\psi}} - (\beta^h C_3(s_4)^{-\frac{1}{\psi}} + \beta^l C_3(s_1)^{-\frac{1}{\psi}})\right) \\
&+ \beta^h\beta^l(V(s_2) - V(s_4))\left(\beta^h C_3(s_3)^{-\frac{1}{\psi}} + \beta^l C_3(s_2)^{-\frac{1}{\psi}} - (\beta^h - \beta^l)C_3(s_2)^{-\frac{1}{\psi}}\right) \\
&= \beta^h\beta^l(V(s_1) - V(s_4))\left(-(\beta^h C_3(s_4)^{-\frac{1}{\psi}} + \beta^l C_3(s_1)^{-\frac{1}{\psi}})\right) \\
&+ \beta^h\beta^l(V(s_2) - V(s_4))\left(\beta^h C_3(s_3)^{-\frac{1}{\psi}} + \beta^l C_3(s_2)^{-\frac{1}{\psi}}\right) \\
&+ \beta^h\beta^l(V(s_1) - V(s_4))\left((\beta^h - \beta^l)C_3(s_1)^{-\frac{1}{\psi}}\right) \\
&+ \beta^h\beta^l(V(s_2) - V(s_4))\left(-(\beta^h - \beta^l)C_3(s_2)^{-\frac{1}{\psi}}\right)
\end{aligned} \tag{22}$$

Here, the sum of firt and second terms in (22) is positive:

$$\begin{aligned}
&\beta^h\beta^l(V(s_1) - V(s_4))\left(-(\beta^h C_3(s_4)^{-\frac{1}{\psi}} + \beta^l C_3(s_1)^{-\frac{1}{\psi}})\right) \\
&+ \beta^h\beta^l(V(s_2) - V(s_4))\left(\beta^h C_3(s_3)^{-\frac{1}{\psi}} + \beta^l C_3(s_2)^{-\frac{1}{\psi}}\right) \\
&\geq \beta^h\beta^l(V(s_1) - V(s_4)) \\
&\times \left(-\beta^h C_3(s_2)^{-\frac{1}{\psi}} - \beta^l C_3(s_1)^{-\frac{1}{\psi}} + \beta^h C_3(s_1)^{-\frac{1}{\psi}} + \beta^l C_3(s_2)^{-\frac{1}{\psi}}\right) \\
&= \beta^h\beta^l(V(s_1) - V(s_4))(\beta^h - \beta^l)(C_3(s_1)^{-\frac{1}{\psi}} - C_3(s_2)^{-\frac{1}{\psi}}) \\
&\geq 0
\end{aligned} \tag{23}$$

The sum of third and fourth terms in (22) is positive:

$$
\begin{aligned}
&\beta^h\beta^l(V(s_1)-V(s_4))\left((\beta^h-\beta^l)C_3(s_1)^{-\frac{1}{\psi}}\right)\\
&+\beta^h\beta^l(V(s_2)-V(s_4))\left(-(\beta^h-\beta^l)C_3(s_2)^{-\frac{1}{\psi}}\right)\\
&\geq \beta^h\beta^l(V(s_1)-V(s_4))(\beta^h-\beta^l)(C_3(s_1)^{-\frac{1}{\psi}}-C_3(s_2)^{-\frac{1}{\psi}})\\
&\geq 0 \qquad (24)
\end{aligned}
$$

□

A.3 Proposition 3

As shown in equation (16), the difference between short- and long-duraiton assets is given by

$$
\begin{aligned}
&(X_3^hC_3(s_1)^{-\frac{1}{\psi}}-X_3^lC_3(s_2)^{-\frac{1}{\psi}})p_1p_2(\beta^h)^3C_4^{-\frac{1}{\psi}}(V(s_2)-V(s_1))\\
&+(X_3^hC_3(s_3)^{-\frac{1}{\psi}}-X_3^lC_3(s_4)^{-\frac{1}{\psi}})p_3p_4(\beta^l)^3C_4^{-\frac{1}{\psi}}(V(s_4)-V(s_3))\\
&+(\beta^hC_3(s_3)^{-\frac{1}{\psi}}-\beta^lC_3(s_1)^{-\frac{1}{\psi}})p_1p_3X_3^h\beta^h\beta^lC_4^{-\frac{1}{\psi}}(V(s_1)-V(s_3))\\
&+(\beta^hC_3(s_4)^{-\frac{1}{\psi}}-\beta^lC_3(s_2)^{-\frac{1}{\psi}})p_2p_4X_3^l\beta^h\beta^lC_4^{-\frac{1}{\psi}}(V(s_2)-V(s_4))\\
&+p_1p_4\beta^h\beta^lC_4^{-\frac{1}{\psi}}(\beta^hX_3^lC_3(s_4)^{-\frac{1}{\psi}}-\beta^lX_3^hC_3(s_1)^{-\frac{1}{\psi}})(V(s_1)-V(s_4))\\
&+p_2p_3\beta^h\beta^lC_4^{-\frac{1}{\psi}}(\beta^hX_3^hC_3(s_3)^{-\frac{1}{\psi}}-\beta^lX_3^lC_3(s_2)^{-\frac{1}{\psi}})(V(s_2)-V(s_3)) \qquad (25)
\end{aligned}
$$

The dispersion of discount rate in high and low states is given by

$$
\begin{aligned}
\beta^h &= \beta+\sigma^\beta\\
\beta^l &= \beta-\sigma^\beta
\end{aligned}
$$

What to be shown is that the derivative of equation (25) is negative.

In the case of $C(s_1)\approx C(s_2)$ and $C(s_3)\approx C(s_4)$, the $V(s_1)\approx V(s_2)$ and $V(s_3)\approx V(s_4)$. The sum of first and second terms in equation (25) is approximately equal to zero.

The derivative of third term with respect to σ^β is given by

$$(C_3(s_3)^{-\frac{1}{\psi}}+C_3(s_1)^{-\frac{1}{\psi}})p_1p_3X_3^h(\beta^2-(\sigma^\beta)^2)C_4^{-\frac{1}{\psi}}(V(s_1)-V(s_3))$$

$$
\begin{aligned}
&+ (\beta^h C_3(s_3)^{-\frac{1}{\psi}} - \beta^l C_3(s_1)^{-\frac{1}{\psi}}) p_1 p_3 X_3^h (\beta^2 - (\sigma^\beta)^2) C_4^{-\frac{1}{\psi}} \left(\frac{\partial V(s_1)}{\partial \sigma^\beta} - \frac{\partial V(s_3)}{\partial \sigma^\beta} \right) \\
&+ (\beta^h C_3(s_3)^{-\frac{1}{\psi}} - \beta^l C_3(s_1)^{-\frac{1}{\psi}}) p_1 p_3 X_3^h (-2\sigma^\beta) C_4^{-\frac{1}{\psi}} (V(s_1) - V(s_3)) \\
&\approx p_1 p_3 X_3^h C_4^{-\frac{1}{\psi}} (V(s_1) - V(s_3)) \left((C_3(s_3)^{-\frac{1}{\psi}} + C_3(s_1)^{-\frac{1}{\psi}}) \beta^2 + (\beta^h C_3(s_3)^{-\frac{1}{\psi}} - \beta^l C_3(s_1)^{-\frac{1}{\psi}})(-2\sigma^\beta) \right) \\
&+ (\beta^h C_3(s_3)^{-\frac{1}{\psi}} - \beta^l C_3(s_1)^{-\frac{1}{\psi}}) p_1 p_3 X_3^h (\beta^2) C_4^{-\frac{1}{\psi}} \left(\frac{\partial V(s_1)}{\partial \sigma^\beta} - \frac{\partial V(s_3)}{\partial \sigma^\beta} \right)
\end{aligned} \tag{26}
$$

The approximation comes from the assumption that $(\sigma^\beta)^2 \approx 0$. Also, when $\sigma^\beta \ll \beta$ is true,

$$
(C_3(s_3)^{-\frac{1}{\psi}} + C_3(s_1)^{-\frac{1}{\psi}}) \beta^2 + (\beta^h C_3(s_3)^{-\frac{1}{\psi}} - \beta^l C_3(s_1)^{-\frac{1}{\psi}})(-2\sigma^\beta) > 0. \tag{27}
$$

Here,

$$
\begin{aligned}
&V(s_1) - V(s_3) < 0 \\
&\frac{\partial V(s_1)}{\partial \sigma^\beta} < 0 \\
&\frac{\partial V(s_3)}{\partial \sigma^\beta} > 0
\end{aligned}
$$

Therefore, (26) is negative.

Similarly, the derivative of fourth term with respect to σ^β is negative because

$$
\begin{aligned}
&V(s_2) - V(s_4) < 0 \\
&\frac{\partial V(s_2)}{\partial \sigma^\beta} < 0 \\
&\frac{\partial V(s_4)}{\partial \sigma^\beta} > 0
\end{aligned}
$$

The derivative of fifth term with respect to σ^β is given by

$$
\begin{aligned}
&p_1 p_4 (-2\sigma^\beta) C_4^{-\frac{1}{\psi}} (\beta^h X_3^l C_3(s_4)^{-\frac{1}{\psi}} - \beta^l X_3^h C_3(s_1)^{-\frac{1}{\psi}})(V(s_1) - V(s_4)) \\
&+ p_1 p_4 \beta^h \beta^l C_4^{-\frac{1}{\psi}} (X_3^l C_3(s_4)^{-\frac{1}{\psi}} + X_3^h C_3(s_1)^{-\frac{1}{\psi}})(V(s_1) - V(s_4)) \\
&+ p_1 p_4 \beta^h \beta^l C_4^{-\frac{1}{\psi}} (\beta^h X_3^l C_3(s_4)^{-\frac{1}{\psi}} - \beta^l X_3^h C_3(s_1)^{-\frac{1}{\psi}}) \left(\frac{V(s_1)}{\partial \sigma^\beta} - \frac{V(s_4)}{\partial \sigma^\beta} \right) \\
&= p_1 p_4 (V(s_1) - V(s_4)) C_4^{-\frac{1}{\psi}} \\
&\times (-2\sigma^\beta \beta^h X_3^l C_3(s_4)^{-\frac{1}{\psi}} + 2\sigma^\beta \beta^l X_3^h C_3(s_1)^{-\frac{1}{\psi}} + \beta^h \beta^l X_3^l C_3(s_4)^{-\frac{1}{\psi}} + \beta^h \beta^l X_3^h C_3(s_1)^{-\frac{1}{\psi}})
\end{aligned}
$$

$$+ p_1 p_4 \beta^h \beta^l C_4^{-\frac{1}{\psi}} (\beta^h X_3^l C_3(s_4)^{-\frac{1}{\psi}} - \beta^l X_3^h C_3(s_1)^{-\frac{1}{\psi}}) \left(\frac{V(s_1)}{\partial \sigma^\beta} - \frac{V(s_4)}{\partial \sigma^\beta} \right) \tag{28}$$

When $\sigma^\beta \ll \beta$ is true,

$$-2\sigma^\beta \beta^h X_3^l C_3(s_4)^{-\frac{1}{\psi}} + 2\sigma^\beta \beta^l X_3^h C_3(s_1)^{-\frac{1}{\psi}} + \beta^h \beta^l X_3^l C_3(s_4)^{-\frac{1}{\psi}} + \beta^h \beta^l X_3^h C_3(s_1)^{-\frac{1}{\psi}} > 0.$$

Also,

$$V(s_1) < V(s_4),$$

so (28) is negative. Similary, the derivative of sixth term with respect to σ^β is negative. Therefore, the derivative of equation (25) is negative.

□

Appendix B Data Sources and Descriptions

1. FOMC dates are obtained from the website of the Board of Governors of the Federal Reserve System.[8]

2. Daily SP 500 return is obtained from CRSP through WRDS. CRSP - Annual Update - Index/SP 500 Indexes - Index File on SP 500. Return on SP composite Index is item $sprtrn$.

3. Daily return on the Center for Research in Security Prices (CRSP) value-weighted NYSE / NASDAQ / AMEX is from CRSP-Annual Update - Stock-Version 2-Daily Stock Market Indexes.

4. VIX data is from Chicago Board Options Exchange through WRDS. I use "CBOE S&P500 Volatility Index - Close" (item is vix).

5. Monetary policy uncertainty measure is from Daily market-based data in Bauer et al. (2022) is from Michael Bauer's web page.

6. Daily stock returns of individual firms are from CRSP.

[8] https://www.federalreserve.gov/monetarypolicy/fomc_historical_year.htm

7. Firm characteristics are from Compustat. I use Compustat - North America - Fundamental Quarterly.

8. Daily Treasury data is from Liu and Wu (2021). I obtain data from Liu's website.

Appendix C Constructin of Duration Measure

This subsection outlines the procedure for constructing cash flow duration, following the methodologies of Dechow et al. (2004) and Weber (2018). This measure represents the weighted average time to cash flow maturity:

$$\text{Duration}_{it} = \frac{\sum_{s=1}^{T} s \times \text{CF}_{i,t+s}/(1+r)^s}{P_{it}},$$

where Duration_{it} is the duration of firm i at time t, $\text{CF}_{i,t+s}$ is the cash flow at time $t+s$, P_{it} is the price of current equity, r is the risk-free rate. A risk-free rate is common across time and firms.

Equities do nothave a well-defined finite maturity (T), so the duration formula is divided into a finite-period component and an infinite terminal value:

$$\text{Duration}_{it} = \frac{\sum_{s=1}^{T} s \times \text{CF}_{i,t+s}/(1+r)^s}{P_{it}} + (T + \frac{1+r}{r}) \times \frac{P_{it} - \sum_{s=1}^{T} \text{CF}_{i.t+s}/(1+r)^s}{P_{it}}. \quad (29)$$

Since future cash flows are uncertain, they are decomposed into two terms and are approximated using an AR(1) process:

$$\begin{aligned} \text{CF}_{i,t+s} &= \text{E}_{i,t+s} - (\text{BV}_{i,t+s} - \text{BV}_{i,t+s-1}) \\ &= \text{BV}_{i,t+s-1} \left[\frac{\text{E}_{i,t+s}}{\text{BV}_{i,t+s-1}} - \frac{\text{BV}_{i,t+s} - \text{BV}_{i,t+s-1}}{\text{BV}_{i,t+s-1}} \right]. \end{aligned} \quad (30)$$

Future return on equity $\left(\frac{\text{E}_{i,t+s}}{\text{BV}_{i,t+s-1}}\right)$ and growth in book equity $\left(\frac{\text{BV}_{i,t+s} - \text{BV}_{i,t+s-1}}{\text{BV}_{i,t+s-1}}\right)$ follows AR(1) with mean reversion.

$$\begin{aligned} \frac{\text{E}_{i,t+s}}{\text{BV}_{i,t+s-1}} &= (1-\rho_1)\overline{\frac{\text{E}}{\text{BV}}} + \rho_1 \frac{\text{E}_{i,t+s-1}}{\text{BV}_{i,t+s-2}}, \\ \frac{\text{BV}_{i,t+s} - \text{BV}_{i,t+s-1}}{\text{BV}_{i,t+s-1}} &= (1-\rho_2)\overline{\text{BVG}} + \rho_2 \frac{\text{BV}_{i,t+s-1} - \text{BV}_{i,t+s-2}}{\text{BV}_{i,t+s-2}}, \end{aligned}$$

where $\overline{\frac{\text{E}}{\text{BV}}}$ is average cost of equity and $\overline{\text{BVG}}$ is average growth in book equity.[9] After estimating each equation, the return on equity has an AR(1) coefficient of 0.67, while the growth in book equity has an AR(1) coefficient of 0.18.

Given these parameters, the procedure to calculate one-period-ahead cash flow is as follows:

1. Compute $\frac{\text{BV}_{i,t+s+1}-\text{BV}_{i,t+s}}{\text{BV}_{i,t+s}}$ with AR(1) process.

2. Compute $\frac{\text{E}_{i,t+s+1}}{\text{BV}_{i,t+s}}$ with AR(1) process.

3. Compute $\text{CF}_{i,t+1}$ with equation (30).

4. Update $\text{BV}_{i,t+1}$ with

$$\text{BV}_{i,t+1} = \left(1 + \frac{\text{BV}_{i,t+s} - \text{BV}_{i,t+s-1}}{\text{BV}_{i,t+s-1}}\right)\text{BV}_{i,t+s-1}.$$

This is a recursive procedure, where $n-$period ahead cash flows are calculated in the same manner. Duration is then measured using these future cash flows and the equation (29).

I use quarterly Compustat as a dataset. BV is an item *ceqq* (common/ordinary equity) minus item *pstkq* (Preferred/Preference Stock). Return on equity is an item *ibq* (Income after all expenses) divided by lagged BV. P_{it} is an item *prccq* (equity price close) multiplied by an item *cshoq* (common shares outstanding).

C.1 Derive equation (1)

This section derives the equation (1). The cash flow duration is given by

$$\text{Duration}_{it} = \frac{\sum_{s=1}^{\infty} s \times \text{CF}_{i,t+s}/(1+r)^s}{P_{it}}.$$

This equation is decomposed into a finite term and an infinite term

$$\begin{aligned}\text{Duration}_{it} = & \frac{\sum_{s=t}^{T} s \times \text{CF}_{i,t+s}/(1+r)^s}{\sum_{s=t}^{T} \text{CF}_{i,t+s}/(1+r)^s} \frac{\sum_{s=t}^{T} \text{CF}_{i,t+s}/(1+r)^s}{P_{it}} \\ & + \frac{\sum_{s=T+1}^{\infty} s \times \text{CF}_{i,t+s}/(1+r)^s}{\sum_{s=T+1}^{\infty} \text{CF}_{i,t+s}/(1+r)^s} \frac{\sum_{s=T+1}^{\infty} \text{CF}_{i,t+s}/(1+r)^s}{P_{it}}. \qquad (31)\end{aligned}$$

[9] They are set to 0.03 and 0.015, respectively, with the risk-free rate fixed at 0.03 and the termination period, T, set to 60 quarters, as specified in Weber (2018)

I assume that the terminal cash flow stream is equal to the difference between the observed market capitalization in the stock price and the present discounted value of cash flow over the finite period,

$$\sum_{s=T+1}^{\infty} \mathrm{CF}_{i,t+s}/(1+r)^s = P_{i,t} - \sum_{s=t}^{\infty} \mathrm{CF}_{i,t+s}/(1+r)^s. \tag{32}$$

I also assume that after $t = T$, the cash flow is constant over time. Then, I have

$$\frac{\sum_{s=T+1}^{\infty} s \times \mathrm{CF}_{i,t+s}/(1+r)^s}{\sum_{s=T+1}^{\infty} \mathrm{CF}_{i,t+s}/(1+r)^s} = T + \frac{1+r}{r}.$$

By substituting this and equation (32) into equation (31), I obtain the equation (1).

C.2 Negative relationship between cash flow duration and book-to-market

In Section 6.2, I use the book-to-market ratio as an alternative measure of duration for robustness checks. In this subsection, a linear relationship between cash flow duration and the book-to-market ratio is established under certain assumptions.

The cash flow duration is defined as

$$\mathrm{Duration}_{it} = \frac{\sum_{s=1}^{T} s \times \mathrm{CF}_{i,t+s}/(1+r)^s}{P_{it}} + (T + \frac{1+r}{r}) \times \frac{P_{it} - \sum_{s=1}^{T} \mathrm{CF}_{i.t+s}/(1+r)^s}{P_{it}},$$

and with the accounting identity, net cash distribution is given by

$$\mathrm{CF}_{i,t+s} = \mathrm{BV}_{i,t+s-1}\left[\frac{\mathrm{E}_{i,t+s}}{\mathrm{BV}_{i,t+s-1}} - \frac{\mathrm{BV}_{i,t+s} - \mathrm{BV}_{i,t+s-1}}{\mathrm{BV}_{i,t+s-1}}\right].$$

If we assume that the growth in the book value of equity is zero for all finite periods ($\mathrm{BV}_{i,t+s-1} = \mathrm{BV}_{i,t+s}$) and the return on equity is constant over periods $\left(\frac{\mathrm{E}_{i,t+s}}{\mathrm{BV}_{i,t+s-1}} = \frac{\mathrm{E}_{i,t}}{\mathrm{BV}_{i,t-1}}\right)$, then $\mathrm{CF}_{i,t+s} = \mathrm{E}_{i,t}$ holds.

Under this assumption, cash flow duration can be written as

$$\mathrm{Duration}_{it} = T + \frac{1+r}{r} - T\frac{E_{i,t}}{rP_{i,t}}.$$

Also assume that the return on equity is always equal to the cost of capital, $\frac{E_{i,t}}{BV_{i,t-1}} = r$.Then, duration can be written as

$$\mathrm{Duration}_{it} = T + \frac{1+r}{r} - T\frac{BV_{i,t}}{P_{i,t}}.$$

In this special case, there exists a linear and negative relationship between duration and book-to-market ratio.

Appendix D Sensitivity Analysis for Bonds

This subsection shows sensitivity analysis for bond returns.

Alternative Measure for Zero-Coupon Bond In the baseline analysis, Treasury bond returns are sourced from Liu and Wu (2021), where the yield curve is estimated using a non-parametric kernel-smoothing method. I also incorporate an alternative dataset for zero-coupon Treasury bonds from Gürkaynak et al. (2007), which estimates the forward rate using a parametric approach.

The empirical specification is provided in equation (7), and the results are summarized in Table 8. The uncertainty measure is IRU in the first and second columns, BP vol in the third and fourth columns, and MOVE in the fifth and sixth columns. The findings align with the baseline results, showing a significantly negative interaction term between duration and the uncertainty measure across all specifications. Moreover, the estimated values, ranging from -0.14 to -0.21, are comparable to the baseline.

Different Time Subsample I also conduct subsample analysis by dividing the period into pre-crisis (1990-2007) and post-crisis (2008-2019). The empirical specification is the equation (7). The uncertainty measure is benchmark measure of interest rate risk, IRU_t. The result is shown in Table 9. The columns (1) and (2) use the pre-crisis period and columns (3) and (4) use the post-crisis period. The results are consistent across the subsamples. The interaction term if duration and uncertainty measure is significantly negative. The results are robust to the choice of uncertainty measures and subsamples.

Quantitatively, the coefficients for post-crisis period are smaller in absolute terms. During the post-crisis period, the nominal interest rate is close to zero, and inverstors face less uncertainty about future interest rate. The resolution of interest rate risk is less significant during the post-crisis period, and thus the response of return to the resolution of interest rate risk is smaller during the post-crisis period.

Different Maturity of Bonds In the baseline analysis, I use bonds with maturities ranging from one year to twenty-nine years, in one-year increments. This section examines the sensitivity to the choice of maturity. I analyze three alternative datasets: maturities from one year to five years,

Table 8: The Elasticity of Return to Change in Uncertainty Conditional on Duration: Alternative Measure for Zero-Coupon Bond.

	(1)	(2)	(3)	(4)	(5)	(6)
IRU	-3.052	-2.069				
	(0.5141)	(0.4990)				
Duration × IRU	-0.1484	-0.2114				
	(0.0875)	(0.0819)				
BP vol			-2.303	-1.638		
			(0.3868)	(0.3702)		
Duration × BP vol			-0.1198	-0.1578		
			(0.0498)	(0.0489)		
MOVE					-1.556	-0.9002
					(0.4642)	(0.4857)
Duration × MOVE					-0.0867	-0.1460
					(0.0808)	(0.0784)
Controls		✓		✓		✓
R^2	0.07344	0.10340	0.07359	0.10399	0.03637	0.07745
Observations	7,047	7,018	7,047	7,018	7,047	7,018

Note: Table 8 reports the coefficient estimates of the pooled regression of Treasury returns. The explanatory variables are the change in interest rate risk, duration, and the interaction of the two. The standard errors are clustered at time. The independent variables are returns of Treasury bonds with different maturities represented in basis points. Columns (2) and (4) include a two day window change in VIX, monetary policy shock, the interaction of a change in VIX and duration, and the interaction of monetary policy shock and duration. The regression equation is

$$\text{Return}_{n,t} = \beta_1 \Delta IRU_t + \beta_2 \text{Duration}_{nt} + \beta_3 \Delta IRU_t \times \text{Duration}_{nt} + \gamma X_{it} + \epsilon_{it},$$

where Return_{nt} is the return of bonds with duration n years at the tth FOMC, ΔIRU_t is the measured change in interest rate risk at the tth FOMC, and Duration_{nt} is equal to n as bonds matures in n years. Standard error is clustered at time dimension.

Table 9: Bond Return Sensitivity to Interest Rate Risk: Different Time Subsample.

	(1)	(2)	(3)	(4)
IRU	-2.149	-1.010	-3.190	-2.350
	(0.5889)	(0.4584)	(0.8077)	(0.7801)
Duration $\times$ IRU	-0.3196	-0.3139	-0.2115	-0.2840
	(0.1146)	(0.1161)	(0.1474)	(0.0996)
Controls		✓		✓
R^2	0.10815	0.13756	0.10013	0.24261
Observations	4,321	4,292	2,726	2,726

Note: Table 9 reports the coefficient estimates of the pooled regression of Treasury returns for the subsamples of 1990-2019. The explanatory variables are the change in interest rate risk, duration, and the interaction of the two. The standard errors are clustered at time. The independent variables are returns of Treasury bonds with different maturities represented in basis points. Columns (1) and (2) use the period into pre-crisis (1990-2007). Columns (3) and (4) use post-crisis (2008-2019). Columns (2) and (4) include a two day window change in VIX, monetary policy shock, the interaction of a change in VIX and duration, and the interaction of monetary policy shock and duration. The regression equation is

$$\text{Return}_{n,t} = \beta_1 \Delta IRU_t + \beta_2 \text{Duration}_{nt} + \beta_3 \Delta IRU_t \times \text{Duration}_{nt} + \gamma X_{it} + \epsilon_{it},$$

where Return_{nt} is the return of bonds with duration n years at the tth FOMC, ΔIRU_t is the measured change in interest rate risk at the tth FOMC, and Duration_{nt} is equal to n as bonds matures in n years. Standard error is clustered at time dimension.

from one year to ten years, and from eleven years to twenty-one years, all in one-year increments. The empirical specification is provided in equation (7). The uncertainty measure is the benchmark measure of interest rate risk, IRU_t. The results are presented in Table 10. Columns (1) and (2) use maturities from one year to five years, columns (3) and (4) use maturities from one year to ten years, and columns (5) and (6) use maturities from eleven years to twenty-one years.

The results are consistent across maturities, showing a significantly negative interaction term between duration and the uncertainty measure. The estimates are larger in absolute magnitude for shorter-maturity bonds (columns (1) and (2)) and smaller for longer maturities (columns (5) and (6)). This suggests that monetary policy has a stronger influence on discount factors for shorter maturities, with the effect diminishing for longer ones. For instance, when investors discount a consumption claim twenty years into the future, the discount factor is far less impacted by monetary policy announcements.

Appendix E Sensitivity Analysis for Equities

E.1 Sensitivity for Different Time Subsample

E.1.1 Average Returns on Equities

Figure 8 presents the average returns of portfolios sorted by cash flow duration. Panels (a) and (c) use the sample from 1990 to 2007, while Panels (b) and (d) use the sample from 2007 to 2019. In Panels (a) and (b), the portfolios are sorted based on cash flow duration, whereas in Panels (c) and (d), the portfolios are sorted based on the book-to-market ratio. The average returns of short- and long-maturity portfolios are indistinguishable in both the pre- and post-crisis periods.

E.1.2 The Elasticity of Returns to interest rate risk

Table 11 estimates a regression of the form (9) using different time subsamples. The first and second column use the sample from 1990 to 2007, and the third and fourth column use the sample from 2007 to 2019. The results are similar across the two samples. The interaction term of interest rate risk and duration is negative and significant for both samples.

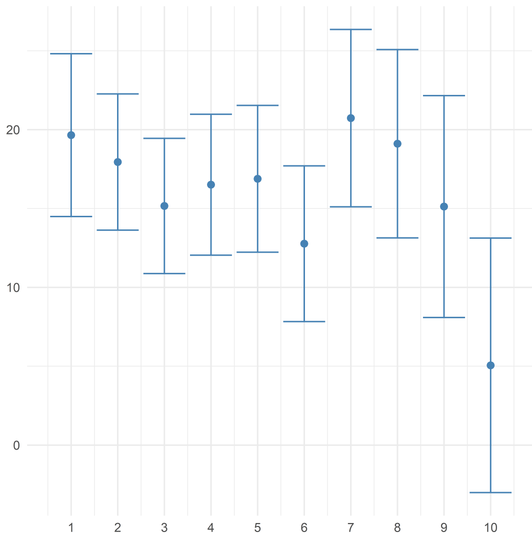
Table 10: The Elasticity of Return to Change in Uncertainty Conditional on Duration: Different Maturity of Bonds.

	(1)	(2)	(3)	(4)	(5)	(6)
IRU	0.5630	0.6244	0.0160	0.4067	-4.834	-3.414
	(0.1384)	(0.1507)	(0.2061)	(0.1974)	(1.190)	(1.182)
Duration $\times$ IRU	-0.8382	-0.6620	-0.7066	-0.6426	-0.1649	-0.2113
	(0.1430)	(0.1367)	(0.1484)	(0.1366)	(0.0986)	(0.0887)
Controls		✓		✓		✓
R^2	0.20908	0.40314	0.21159	0.31556	0.13206	0.19064
Observations	972	968	2,430	2,420	2,430	2,420

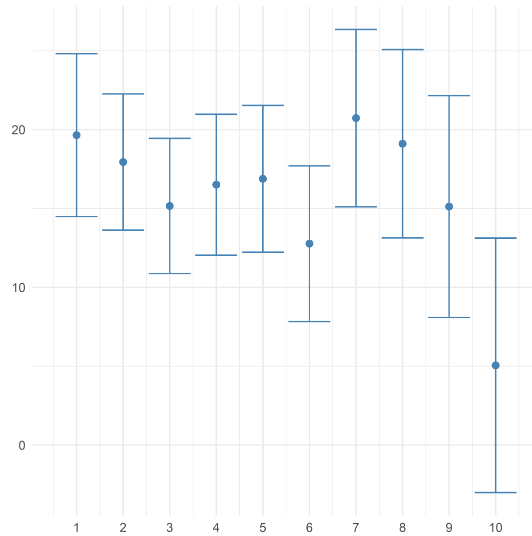
Note: Table 10 reports the coefficient estimates of the pooled regression of Treasury returns. The explanatory variables are the change in interest rate risk, duration, the interaction of the two, and control variables. The standard errors are clustered at time. The independent variables are returns of Treasury bonds with different maturities represented in basis points. Columns (1) and (2) use maturities from one year to five years, columns (3) and (4) use maturities from one year to ten years, and columns (5) and (6) use maturities from eleven years to twenty-one years. The regression equation is

$$\text{Return}_{n,t} = \beta_1 \Delta IRU_t + \beta_2 \text{Duration}_{nt} + \beta_3 \Delta IRU_t \times \text{Duration}_{nt} + \gamma X_{it} + \epsilon_{it},$$

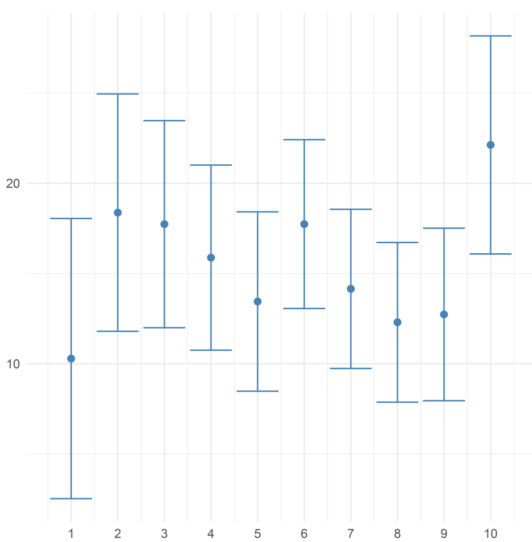
where Return_{nt} is the return of bonds with duration n years at the tth FOMC, ΔIRU_t is the measured change in interest rate risk at the tth FOMC, and Duration_{nt} is equal to n as bonds matures in n years. Standard error is clustered at time dimension.



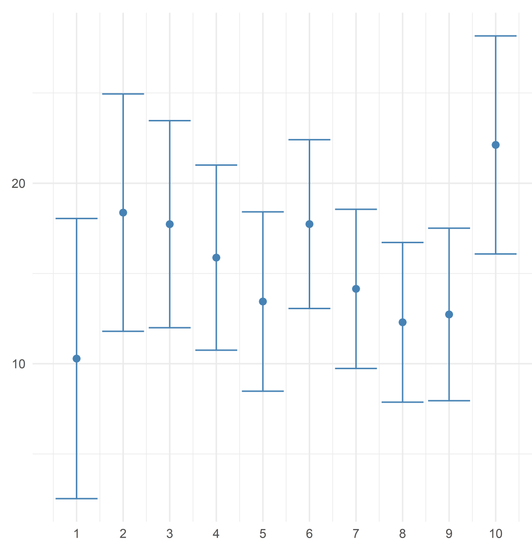
(a) Before 2009



(b) After 2008



(c) Before 2009 and By BM



(d) After 2008and By BM

Figure 8: Average Returns Conditional on Duration: Different Time Subsample.

Note: Figure 8 plots the time-series average of portfolio returns on FOMC days. The horizontal axis represents the duration of portfolios, ranging from short (one) to long (ten). The vertical axis represents the average return on FOMC days for each portfolio. Equities are divided into ten groups based on duration, and the average return within each group is calculated. The portfolios are rebalanced every quarter. Figure (a) and (c) uses sample 1990-2007. Figure (b) and (d) uses sample 2007-2019. Figure (a) and (b) forms portfolios based on cash flow duration. Figure (c) and (d) forms portfolios based on book-to-market ratio.

Table 11: The Elasticity of Returns to Interest Rate Risk Conditional on Duration.

	(1)	(2)	(3)	(4)
Duration × IRU	-0.2303	-0.2379	-0.6256	-0.6582
	(0.0451)	(0.0484)	(0.1279)	(0.0989)
Profit × IRU		10.21		1.810
		(4.750)		(19.73)
Leverage × IRU		0.1842		-5.376
		(1.002)		(1.636)
Sales growth × IRU		-0.3396		-4.742
		(0.7310)		(1.915)
IRU	0.7087	1.618	-2.987	6.362
	(0.8280)	(1.067)	(2.054)	(1.577)
R^2	0.00120	0.02392	0.01521	0.06516
Observations	530,068	466,974	245,438	231,323
Controls		✓		✓
Firm fixed effects		✓		✓
Year fixed effects		✓		✓

Note: Table 11 reports the coefficient estimates of the pooled regression of equity returns over 240 FOMC event days. The explanatory variables are the change in uncertainty measure, duration, the interaction of the two, and control variables. Control variables include (i) firm and year fixed effects and (ii) the interaction of firm characteristics and a change in interest rate risk. The standard errors are clustered at firm-level. The first and second column use the sample from 1990 to 2007, and the third and fourth column use the sample from 2007 to 2019. The regression equation is

$$\text{Return}_{i,t} = \beta_1 \Delta IRU_t + \beta_2 \text{Duration}_{it} + \beta_3 \Delta IRU_t \times \text{Duration}_{it} + \gamma X_{it} + \epsilon_{it},$$

where i is the index of the firm, t is the tth FOMC, Return_{it} is the stock return of firm i at the tth FOMC, ΔIRU_t is the measured change in uncertainty caused by the tth FOMC, and Duration_{it} is the measured duration of firm i at the tth FOMC. Standard errors are clustered at firm level.

E.2 Sensitivity for Parameters in Cash Flow Duration

To construct the cash flow duration, the parameters to be fed are the persistence in ROE (ρ_1), the persistence in sales growth (ρ_2), the long-run groth rate in sales ($\overline{BVG}$), the long-run growth rate in ROE ($\overline{\frac{E}{BV}}$), the discount rate (r), and the forecasting horizon (T). All variables are defined in Appendix C.

I conduct a sensitivity analysis by changing the parameters. I set the base case as $\rho_1 = 0.67$, $\rho_2 = 0.18$, $\overline{BVG} = 0.015$, $\overline{\frac{E}{BV}} = 0.03$, $r = 0.03$, and $T = 60$. I change one parameter at a time and keep the others constant. Specificaly, the perisistence in ROE is 0.55 and 0.75 (baseline is 0.67), the persistence in sales growth is 0.1 and 0.3 (baseline is 0.18), the long-run growth rate in sales is 0.01 and 0.02 (baseline is 0.015), the long-run growth rate in ROE is 0.02 and 0.04 (baseline is 0.03), the discount rate is 0.025 and 0.035 (baseline is 0.03), and the forecasting horizon is 12 years and 18 years (baseline is 15 years).

E.2.1 Average Returns on FOMC Days

I calculate the cash flow duration for each firm under twelve different values of a parameter. Then, I sort firms based on durations and estimate the average returns on FOMC days for each portfolio. Figures 9 and 10 show the average return as a function of cash flow duration under twelve different parameters. Each figure changes only one parameter while keeping the other parameters fixed at their baseline values.

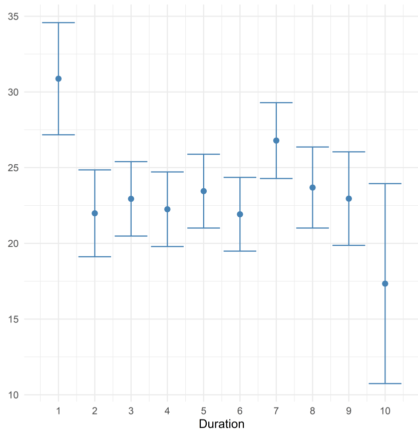
E.2.2 Interest Rate Uncertainry and Contemporaneous Relationship

This subsection shows a sensitivity analysis for the elasticity of equity returns to interest rate risk. After calculating cash flow duration under different value of parameters and sorting firms based on duration, I regress the return of portfolios on a change in interest rate risk. The equation is

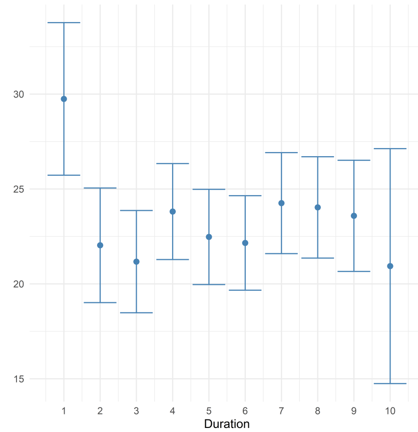
$$y_t^m = \beta^m \Delta \text{IRU}_t + \epsilon_t, \tag{33}$$

where ΔIRU_t is a change in interest rate risk and a portfolio is indexed by $m \in \{1, \cdots, 10\}$.

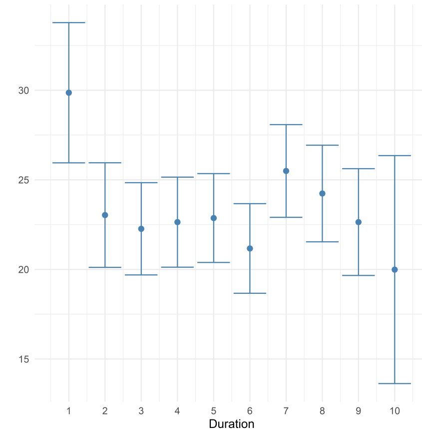
Figure 11 and 12 show the coefficients β^m for each portfolio m and its two standard error bands. The figures show that the elasticity of equity returns to interest rate risk increases with the duration



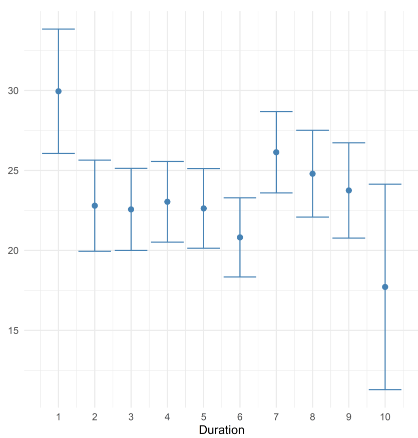
(a) $\rho_1 = 0.75$



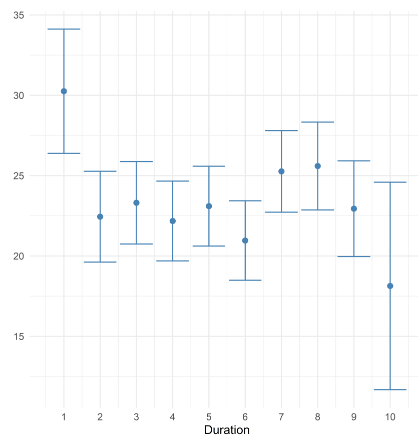
(b) $\rho_1 = 0.55$



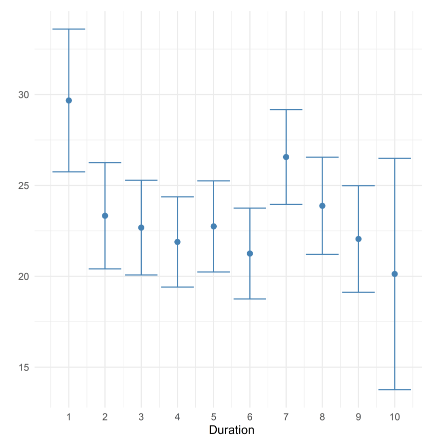
(c) $\rho_2 = 0.3$



(d) $\rho_2 = 0.1$



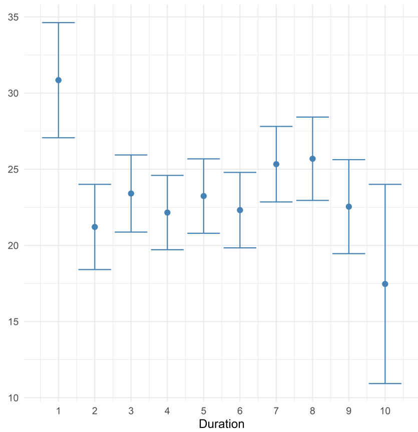
(e) $r = 0.02$



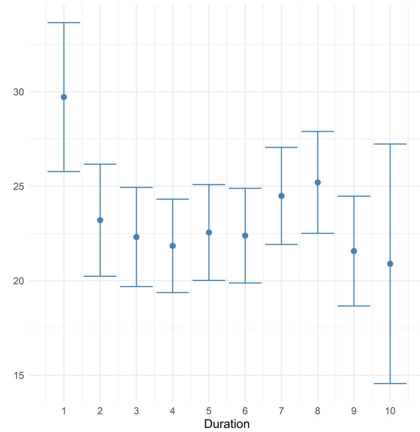
(f) $r = 0.01$

Figure 9: Sensitivity Analysis for Average Returns.

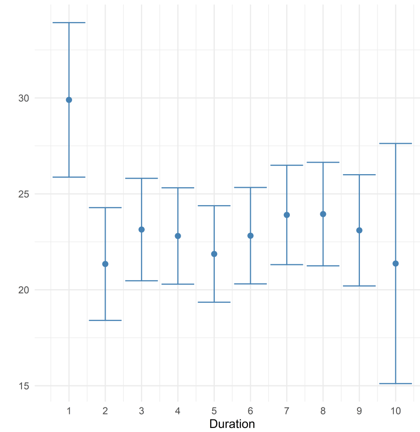
Note: Figure 9 plots the time-series average of portfolio returns on FOMC days under different parameters. The horizontal axis represents the duration of portfolio form short (one) to long (ten). The vertical axis represents the average return on FOMC days for each portfolio. I divide the equities into ten groups from low to high based on duration and calculate average returns within the groups. Each panel changes one parameter at a time and keeps the others constant.



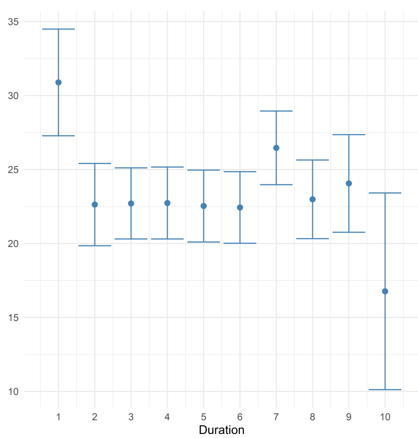
(a) $\overline{BVG} = 0.02$



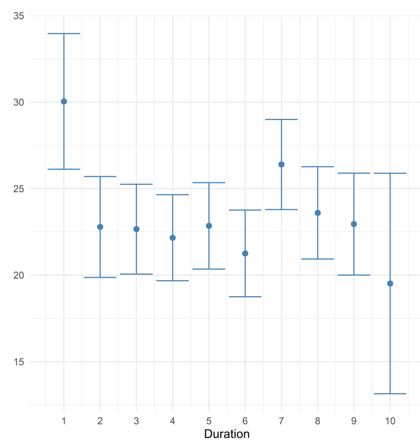
(b) $\overline{BVG} = 0.01$



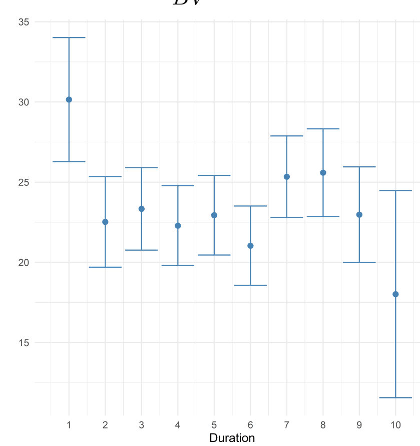
(c) $\overline{\frac{E}{BV}} = 0.04$



(d) $\overline{\frac{E}{BV}} = 0.02$



(e) $T = 18$ years



(f) $T = 12$ years

Figure 10: Sensitivity Analysis for Average Returns.

Note: Figure 10 plots the time-series average of portfolio returns on FOMC days under different parameters. The horizontal axis represents the duration of portfolio form short (one) to long (ten). The vertical axis represents the average return on FOMC days for each portfolio. I divide the equities into ten groups from low to high based on duration and calculate average returns within the groups. Each panel changes one parameter at a time and keeps the others constant.

in absolute terms. The result does not depend on the value of parameters that are assumed when calculating cash flow duration.

Appendix F Other Announcements

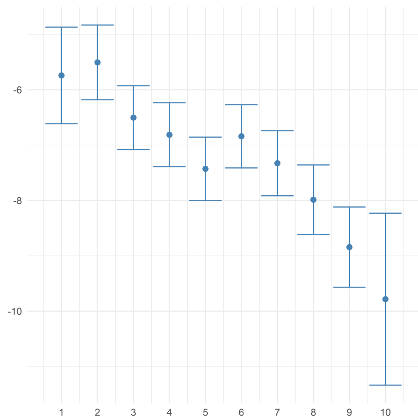
In this section, I examine the term structure of average returns on other major announcement days, specifically those related to GDP, CPI, and employment status.[10] The analysis covers the same sample period as the monetary policy announcement analysis (1990–2019). For each announcement type, I calculate the average returns of portfolios sorted by duration for both bonds and equities.

Figure 13 presents the average returns of Treasury bonds across different maturities on GDP, CPI, and employment status announcement days, measured in basis points. The results reveal distinct term structure slopes for each announcement type. On GDP announcement days, the term structure is upward sloping and steeper than on FOMC announcement days. For CPI announcements, the term structure remains upward sloping but is comparatively flatter. The term structure is flat on employment status announcement days. Statistical tests reported in Appendix F.1 confirm that the slope of the term structure is steepest for GDP announcements, followed by FOMC, CPI, and employment status announcements.

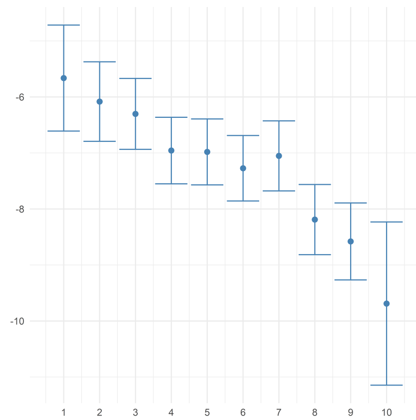
Each type of announcement conveys a different amount of information about discount factor risk. GDP announcements, occurring quarterly, are especially influential for central bank policy and thus provide the most information, resulting in a steeper term structure. CPI announcements also matter, but to a lesser extent. Employment status announcements, released monthly, are less closely linked to the risk-free rate and provide comparatively little information about discount factor risk.

Figure 14 presents the average returns of equities across different cash flow durations on GDP, CPI, and employment status announcement days. Consistent with Section 6.1, the term structure of returns on FOMC announcement days is flat, whereas the term structure of monthly average

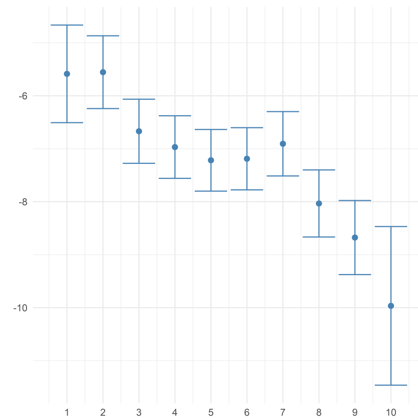
[10]For GDP announcements, I use the advance GDP releases by the Bureau of Economic Analysis, which are announced quarterly. CPI data are released monthly by the U.S. Bureau of Labor Statistics (BLS). The employment status report, also issued monthly by the BLS, includes metrics such as the unemployment rate, nonfarm payrolls, and labor force participation rate.



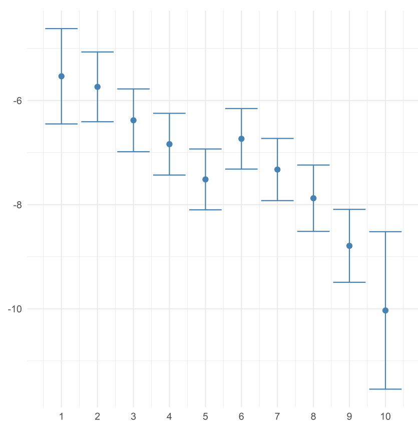
(a) $\rho_1 = 0.75$



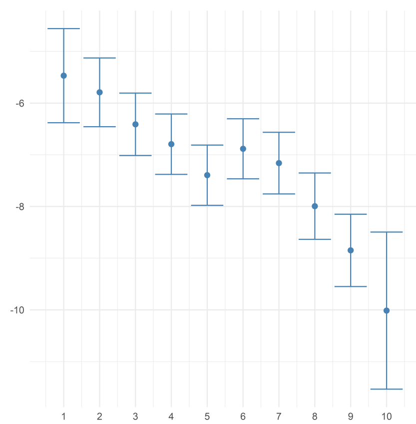
(b) $\rho_1 = 0.55$



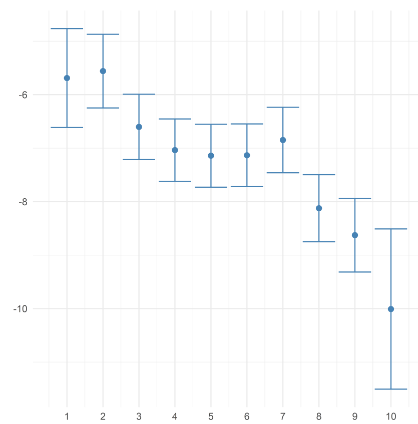
(c) $\rho_2 = 0.3$



(d) $\rho_2 = 0.1$



(e) $r = 0.02$



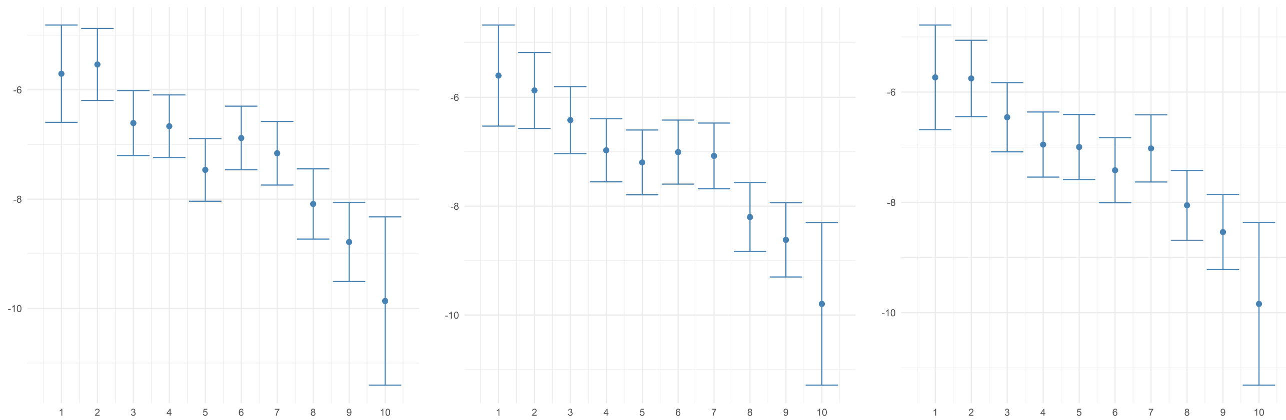
(f) $r = 0.01$

Figure 11: Sensitivity Analysis for the Elasticity to Interest Rate Risk.

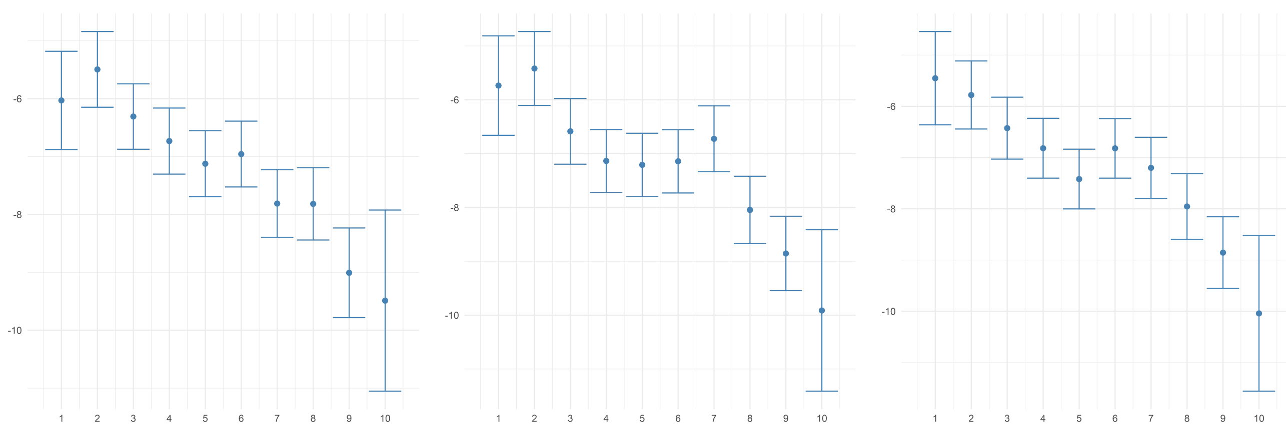
Note: Figure 11 the sensitivity of equity returns to a change in interest rate risk. I seperately regress the return of portfolios on a change in uncertainty measure,

$$y_t^m = \beta^m \Delta \text{IRU}_t + \epsilon_t, \tag{34}$$

where ΔIRU_t is a change in interest rate risk and a portfolio is indexed by $m \in \{1, \cdots, 10\}$. The portfolio is sorted based on cash flow duration in figure (a) and book-to-market ratio in figure (b). interest rate risk is taken from Bauer et al. (2022). The vertical plots the coefficients β^m for each portfolio m, and its two standard error bands. Each panel changes one parameter at a time and keeps the others constant.



(a) $\overline{BVG} = 0.02$ (b) $\overline{BVG} = 0.01$ (c) $\overline{\frac{E}{BV}} = 0.04$



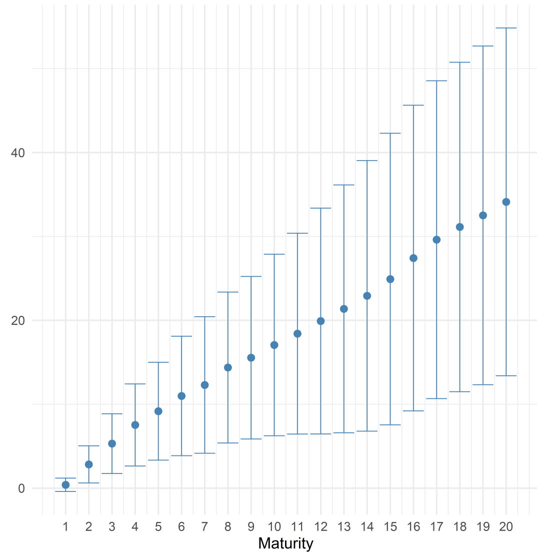
(d) $\overline{\frac{E}{BV}} = 0.02$ (e) $T = 18$ years (f) $T = 12$ years

Figure 12: Sensitivity Analysis for the Elasticity to Interest Rate Risk.

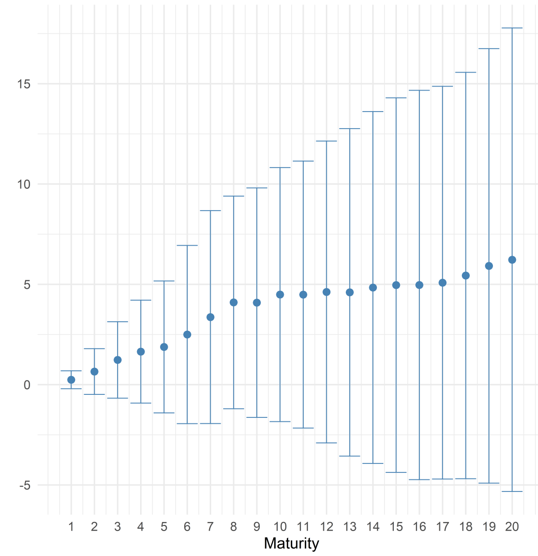
Note: Figure 12 the sensitivity of equity returns to a change in interest rate risk. I seperately regress the return of portfolios on a change in uncertainty measure,

$$y_t^m = \beta^m \Delta \text{IRU}_t + \epsilon_t, \tag{35}$$

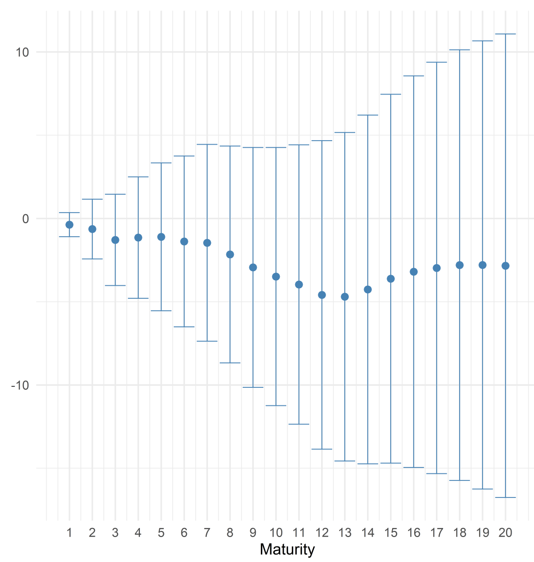
where ΔIRU_t is a change in interest rate risk and a portfolio is indexed by $m \in \{1, \cdots, 10\}$. The portfolio is sorted based on cash flow duration in figure (a) and book-to-market ratio in figure (b). interest rate risk is taken from Bauer et al. (2022). The vertical plots the coefficients β^m for each portfolio m, and its two standard error bands. Each panel changes one parameter at a time and keeps the others constant.



(a) GDP



(b) CPI



(c) Employment Status

Figure 13: Average Returns of Bonds on Other Announcement Days.

Notes: Figure 13 shows the average returns on Treasury bonds with different maturities on GDP, CPI, and employment status announcement dates. The vertical axis represents the average returns on Treasury bonds, expressed in basis points, while the horizontal axis represents the maturity of the bonds in years. The 95% confidence intervals are calculated. The sample period spans from 1990 to 2019.

returns is downward sloping. The figure shows that (i) the term structure of returns on GDP and employment status announcement days is also flat, mirroring the pattern observed for FOMC announcements, and (ii) the term structure on CPI announcement days is downward sloping. These results suggest that the resolution of discount rate risk is more pronounced on GDP and employment status announcement days, but less so on CPI announcement days.

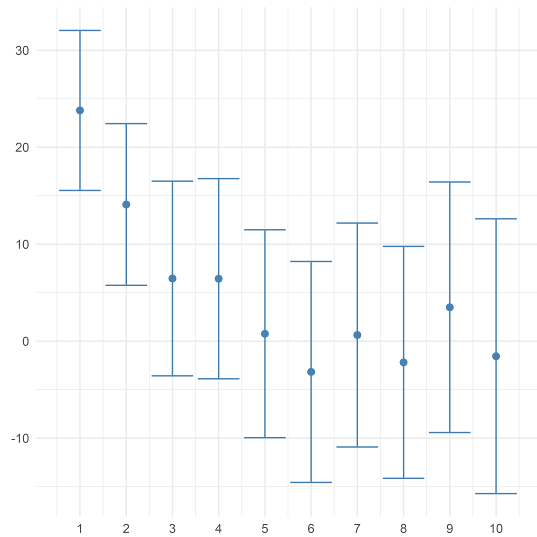
F.1 Bond Returns on Other Announcements

This section presents the statistical test of the slope of the term structure on other announcement days. The empirical specification is given by:

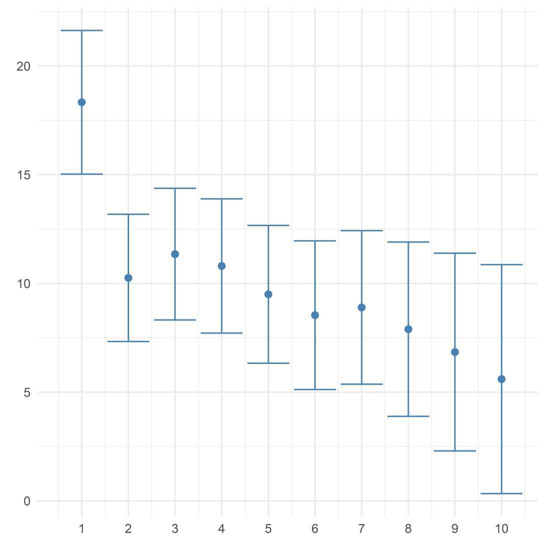
$$\begin{aligned} y_{m,t} &= m + D_{\{t=GDP\}} + D_{\{t=FOMC\}} + D_{\{t=CPI\}} + D_{\{t=EMP\}} \\ &\quad + m \times D_{\{t=GDP\}} + m \times D_{\{t=FOMC\}} + m \times D_{\{t=CPI\}} + m \times D_{\{t=EMP\}} + \epsilon_{mt}, \qquad (36) \end{aligned}$$

where $y_{m,t}$ represents the returns of bonds with maturity m at time t, m denotes the bond maturity, and $D_{t=GDP}$ is a dummy variable equal to one on GDP announcement days. Similarly, $D_{t=FOMC}$, $D_{t=CPI}$, and $D_{t=EMP}$ are dummy variables for FOMC, CPI, and employment status announcement days, respectively. The sample consists of daily data including those announcement and non-announcement days from January 1990 to December 2019. Bond maturities range from one year to twenty-nine years in one-year increments. Standard errors are clustered by the maturity dimension.

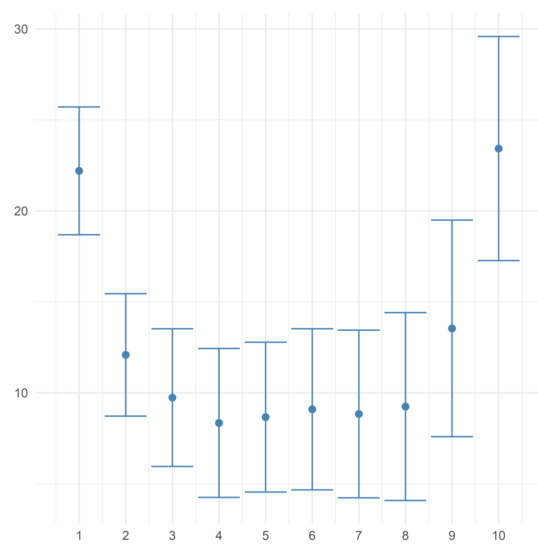
Table 12 presents the coefficient estimates from the pooled regression of Treasury returns. The coefficient on the interaction term between FOMC and duration is 0.2, indicating that on FOMC days, the return increases by 0.2 basis points for every one-year increase in bond maturity. Among the interaction terms, the largest estimated coefficient is observed for GDP announcement days (1.7), followed by FOMC (0.2), CPI (0.17), and employment status (-0.28). The slope of the term structure is steepest on GDP announcement days, even exceeding that observed on FOMC announcement days.



(a) GDP



(b) CPI



(c) Employment Status

Figure 14: Average Return of Equities on Other Announcement Days.

Notes: Figure 13 shows average returns on equities with different cash flow duration on GDP, CPI, and employment status announcemet dats. The vertical represents the returns on each portfolio expressed in basis points. The horizontal axis repressents the duration of equities. The 95% confidence intervals are calculated. The sample period is 1990/1-2021/12.

Table 12: The Elasticity of Return to Change in Uncertainty Conditional on Duration.

	(1)
FOMC	2.842
	(0.5466)
GDP	-2.033
	(0.7168)
CPI	0.9441
	(0.2593)
EMP	-0.2537
	(0.3741)
Duration × FOMC	0.2067
	(0.0260)
Duration × GDP	1.785
	(0.0624)
Duration × CPI	0.1747
	(0.0137)
Duration × EMP	-0.2823
	(0.0345)
R^2	0.00192
Observations	217,761

Note: Table 12 reports the coefficient estimates of the pooled regression of bond returns in equation (36).