

Interest Rate Risk around Monetary Policy Announcements and Asset Duration*

Masayuki Okada[†]

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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-duration 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 interest rate risk. Third, the elasticity of returns with respect to changes in interest rate risk is greater for long-duration assets than for short-duration assets, a result that holds for both bonds and equities.

Keywords: Monetary policy announcements; interest rate risk; asset duration; term structure of returns

JEL Classification: E43, E52, G12, G14

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[†]Bank of Japan. 2-1-1 Nihonbashi-Hongokuchō, Chuo-ku, Tokyo, Japan. 103-0021. Email: masayuki.okada@boj.or.jp

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 pattern that average asset returns are elevated on announcement days ([Savor and Wilson, 2013](#)).¹ Prior to announcements, investors face greater risk than they do in normal periods and demand higher expected returns to hold assets. This paper identifies the specific type of risk investors face and the assets that are more affected by it. The main findings are as follows: (i) the resolution of interest rate risk leads to higher returns, and (ii) asset duration is a key determinant of cross-sectional heterogeneity in risk exposures.

First, this paper highlights interest rate risk as a key factor, whereas the literature has primarily emphasized cash-flow risk as the main risk resolved by announcements ([Ai and Bansal, 2018](#); [Wachter and Zhu, 2022](#)). Monetary policy announcements convey information about future interest rates, resulting in a reduction in interest rate risk around announcements, as measured by option-implied volatility of interest rates ([Bauer, Lakdawala, and Mueller, 2022](#)).

Second, assets with different durations exhibit different 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 discount rates. Conversely, an interest rate reduction leads to larger gains for long-duration assets. Prior to announcements, investors who prefer early resolution of uncertainty place lower valuations on 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. Long-duration assets are more exposed to discount rate risk because cash flows in the distant future are sensitive to discount rates. Short-duration assets are more sensitive to cash-flow risk, as monetary policy affects short-term cash flows through monetary transmission mechanism, but monetary policy is neutral in the long run. Both risks are resolved upon announcements.

There are two theoretical predictions for assets without cash-flow risk, namely bonds, and assets with cash-flow risk, namely equities. The first concerns average returns on announcement days. For bonds, long-duration bonds are expected to yield higher average returns than short-duration bonds on announcement days because they provide claims on more distant future consumption and are more sensitive to discount rate risk.

The relative expected returns of short- and long-duration equities are theoretically ambiguous

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

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 logic is as follows: consider two announcements that differ in the magnitude of the change in interest rate risk. When monetary policy announcements resolve interest rate risk, the prices of long-duration assets, which are more sensitive to interest rates, increase. When interest rate risk does not fall or rises, long-duration asset prices remain unchanged or decline. In contrast, short-duration assets, which are less sensitive to interest rate risk, exhibit much smaller price movements in both cases.

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

First, I test the theoretical predictions for expected returns and find that longer-duration bonds have higher expected returns than shorter-duration bonds. For example, five-year Treasury bonds yield 4.8 basis points on average on monetary policy announcement days, while twenty-year bonds yield 10.0 basis points. This supports the prediction that the returns of long-duration bonds 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 of returns 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 basis points, while that on the shortest-duration portfolio is 233 basis points.

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 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 returns to interest rate risk is 12, meaning that the returns increase 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. This greater sensitivity of long-duration equities to interest rate risk highlights a contrast between unconditional and conditional return patterns across maturities. On average, long-duration equities do not earn higher returns than short-duration equities on announcement days. However, conditional on a decline in interest rate risk, long-duration equities exhibit a stronger response than short-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 macroeconomic announcement premium. [Savor and Wilson \(2013\)](#) document that excess returns on stocks and bonds are elevated on macro announcement days, a phenomenon that has been examined extensively in the empirical literature.² On the theoretical side, models have been developed to explain the macroeconomic announcement premium. [Ai and Bansal \(2018\)](#) provide a revealed preference theory for the announcement premium. [Wachter and Zhu \(2022\)](#) develop a framework based on rare disasters and the ability of the CAPM to explain announcement-day returns.³

²[Lucca and Moench \(2015\)](#) show that, for FOMC announcements, much of this excess return is concentrated in a pre-announcement drift. Related empirical contributions include [Brusa, Savor, and Wilson \(2020\)](#); [Neuhierl and Weber \(2018\)](#); [Cieslak, Morse, and Vissing-Jorgensen \(2019\)](#); [Mueller, Tahbaz-Salehi, and Vedolin \(2017\)](#); [Indriawan, Jiao, and Tse \(2021\)](#); [Wachter and Zhu \(2022\)](#).

³[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.

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, as proxied by declines in the VIX, falls more substantially 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 attribute the announcement premium to cash-flow risk, this paper introduces a framework that jointly incorporates both interest rate risk and cash-flow risk.

In addition to interest rate risk, this paper highlights duration as a key source of cross-sectional heterogeneity in exposure to monetary policy announcements. Prior empirical studies have often tested 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](#)). Theoretically, prior work has generally treated cross-sectional heterogeneity in the sensitivity as exogenous and has not directly addressed its sources ([Wachter and Zhu, 2022](#)). This paper instead provides an interpretation of the underlying determinants of such heterogeneity, demonstrating that variation in exposure to monetary policy announcements is systematically driven by differences in asset duration.

Second, this paper contributes to the literature that emphasizes the role of monetary policy uncertainty in determining asset prices. While the effects of uncertainty have been extensively studied, prior research has primarily focused on aggregate variables such as term premia and asset prices, with limited attention to cross-sectional heterogeneity.⁴ This paper addresses this gap by focusing on 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 Kojen \(2017\)](#), 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 rather than over monthly averages. The results show that the term structure on announcement days differs markedly from the pattern observed in monthly average returns. Within the theoretical framework, I provide an interpretation of this empirical finding.

⁴[Bundick, Herriford, and Smith \(2017\)](#) estimate that changes in short-term uncertainty positively impact the term premium on announcement days. [Bauer, Lakdawala, and Mueller \(2022\)](#) highlight that reductions in uncertainty influence asset prices in ways distinct from conventional policy surprises. [Lakdawala, Moreland, and Schaffer \(2021\)](#) demonstrate that changes in uncertainty affect spillovers to global bond yields. Similarly, [Kroencke, Schmeling, and Schrimpf \(2021\)](#) 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&P 500 Index	Group				
		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 the cross-sectional heterogeneity in average returns for S&P 500 firms. Firms are sorted based on their time-series average returns on FOMC days and then assigned to five groups based on these averages. 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&P 500 Index” represents the mean and standard deviation of the S&P 500 Index. Returns are expressed in basis points. Groups “1” through “5” denote portfolios from low to high. The sample period is from January 1990 to December 2019.

2 Heterogeneous Exposure to Monetary Policy Announcements

This section examines the cross-sectional heterogeneity in 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 (January 1990–December 2019). 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.

[Savor and Wilson \(2013\)](#) find that returns on the S&P 500 Index are higher on FOMC days (25.5 basis points) than on non-FOMC days (2.7 basis points). While much of the literature focuses on aggregate stock returns, Table 1 shows that these elevated returns are concentrated in a subset of firms rather than being uniformly distributed.

3 Theory

This section develops a model to generate testable predictions about risk factors and expected returns on announcement days. The framework builds on [Ai and Bansal \(2018\)](#) and introduces two key extensions: (i) investors face discount factor risk in addition to the cash-flow risk considered by [Ai and Bansal \(2018\)](#), and (ii) the model incorporates cross-sectional heterogeneity by allowing for variation in asset duration.

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 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). 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 that resolves uncertainty 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 does not depend on the realized state s .

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

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

subject to

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

where $C_t(s)$ denotes consumption in period t , e is the endowment, S_1 is saving from period 1 to 2, θ^S and θ^L are holdings of short- and long-duration assets, and $X_3(s)$ and $X_4(s)$ are the cash flows of short- and long-duration assets, respectively.

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 of short-duration assets is high, $X_3(s) = X_3^h$. In states s_2 and s_4 , the cash flow of short-duration assets is low, $X_3(s) = X_3^l$. The cash flow of long-duration assets is assumed to be invariant across states, $X_4(s) = X_4$.

There are two considerations. First, the investor faces uncertainty about the discount factor in period 1, reflecting uncertainty about the risk-free short-term interest rate before a monetary policy announcement. Because the risk-free rate is 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 the cash flows of long-duration assets remains unrevealed. This does not imply that long-term cash flows are invariant 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 is typically transitory (Christiano, Eichenbaum, and Evans, 2005; Ramey, 2016).

3.1 Bond as a No Cash-Flow Uncertainty Case

In this section, I derive theoretical predictions for assets without cash-flow uncertainty, which can be interpreted as bonds, since their cash flows are invariant across economic states, at least in nominal terms. In the model, this is represented by setting $p_1 > 0$, $p_2 > 0$, and $p_3 = p_4 = 0$, so that the cash flow in period 3 is invariant across all possible states. Proposition 1 provides an analytical solution for the difference in average announcement premia 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

$$(V(s_1) - V(s_2)) \left(\beta^h C_3(s_2)^{-\frac{1}{\psi}} C_4^{-\frac{1}{\psi}} - \beta^l C_3(s_1)^{-\frac{1}{\psi}} C_4^{-\frac{1}{\psi}} \right) < 0.$$

Here, $V(s_i)$ is defined as

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

Proof. See Appendix A.1. □

These 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 $C_3(s_1) \approx C_3(s_2)$, the average return of long-duration bonds is higher than that of short-duration bonds:*

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

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-duration bonds are therefore more sensitive to monetary policy announcements, as their returns are more exposed to discount rate risk. When $\gamma < \frac{1}{\psi}$, the investor places greater weight on unfavorable states and less weight on favorable states. Consequently, the resolution of uncertainty raises the prices of long-duration bonds more than those of short-duration bonds.

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 conveys information about future cash flows. Unlike the bond case, the expected return on short-duration equities exceeds that on long-duration equities when the dispersion of cash flows between high and low states is sufficiently large.

Proposition 2. *If*

$$X_3^h - X_3^l > \bar{\sigma},$$

then the expected return on short-duration assets exceeds that on long-duration 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, $\bar{\sigma}$ 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 is large, the resolution of cash-flow uncertainty leads to a larger price increase for short-duration equities, as they are more sensitive to cash-flow risk. In contrast, long-duration equities are less affected by cash-flow uncertainty. 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 last 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. Even though equities are subject to cash-flow uncertainty and bonds are not, the resolution of discount rate risk affects both asset classes. This is because when uncertainty about the discount rate is resolved, it leads to a more pronounced increase in the expected returns of long-duration assets compared to 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 bonds. 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 runs from the first quarter of 1990 to the fourth quarter of 2019, when data on interest rate risk are available.

4.1 Equity and Bond Returns

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

For Treasury bonds, returns are constructed using data from Liu and Wu (2021). This dataset provides daily zero-coupon yields on U.S. Treasury bonds for various maturities, $Y_t(n)$. The price of a bond with maturity 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 on a bond with maturity n years at time t .

4.2 The Duration of Assets

To analyze heterogeneous exposure across assets with different durations, we first measure asset duration. For zero-coupon bonds, duration equals years to maturity; thus, a bond with n years to maturity has duration n .

For equities, duration is not directly observable. Following Weber (2018), equity duration is constructed 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:

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

where $\text{Duration}_{i,t}$ is the duration of firm i at time t , $\text{CF}_{i,t+s}$ is the cash flow at time $t + s$, $P_{i,t}$ 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:

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

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:

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

Return on equity, defined as $E_{i,t+s}/BV_{i,t+s-1}$, is the ratio of income before extraordinary items to 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. Additional 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 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 shows a strong negative correlation between duration and the book-to-market ratio, with a correlation coefficient of -0.66. As shown in Appendix C.2, the theory implies a negative linear relationship between cash-flow duration and the book-to-market ratio. The close alignment between this theoretical prediction and the data suggests that our measure of cash-flow duration is a valid proxy for duration.

In the empirical analysis, the book-to-market ratio is used in robustness checks, following the literature that employs it as an alternative proxy for duration (Lettau and Wachter, 2011; Hansen, Heaton, and Li, 2008), and the results remain consistent.

Table 2: Summary Statistics and Correlations for Firm Characteristics.

	Dur	BM	Size	Prof	Lev	Sales	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							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 among 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” is percentage sales growth. “ME” is 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, Lakdawala, and Mueller \(2022\)](#). Specifically, [Bauer, Lakdawala, and Mueller \(2022\)](#) compute the standard deviation of one-year-ahead Eurodollar (ED) futures, 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 using information embedded in futures and options prices.

Figure 1 presents a histogram of the two-day change in interest rate risk surrounding FOMC announcement days, measured as $\log(\text{IRU}_{t+1}) - \log(\text{IRU}_{t-1})$ where t denotes 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, Moreland, and Schaffer, 2021](#)).⁵ In the subsequent analysis, I exploit the

⁵For example, the largest decrease occurred in August 2011; monetary policy uncertainty decreased by 29%, shown in the left tail of the histogram in Figure 1. Before the meeting, the FOMC stated that interest rates 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 rates. The central bank’s guidance played a crucial role in reducing interest rate risk.

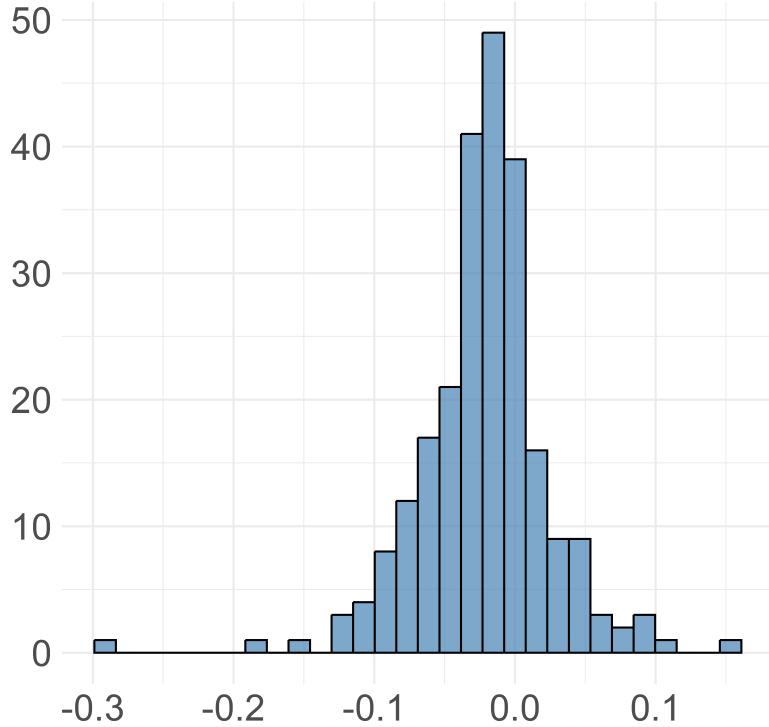


Figure 1: Histogram of Changes in Interest Rate Risk on FOMC days.

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 a FOMC announcement day. The sample period spans from January 1990 to December 2019, including 240 announcements. The data are obtained from [Bauer, Lakdawala, and Mueller \(2022\)](#).

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 average bond returns 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 maturities (in

years) 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 longer-maturity bonds. Consequently, the standard errors of returns increase with duration. This pattern is consistent with the findings of [Wachter and Zhu \(2022\)](#).

Since this paper examines the relationship between bond returns and interest rate risk, Figure 2(b) presents average returns for two subsamples defined by changes in interest rate risk. Specifically, the top 20% and bottom 20% of observations are selected based on these changes. 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 return 29.5 basis points, and twenty-year bonds return 63.4 basis points. When the decline is smaller, five-year and twenty-year bond returns are -22.0 and -54.3 basis points, respectively. These results highlight 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

$$y_t^m = \alpha^m + \beta_s^m X_{s,t} + \epsilon_t^m, \quad (3)$$

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 on risk factors 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 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.

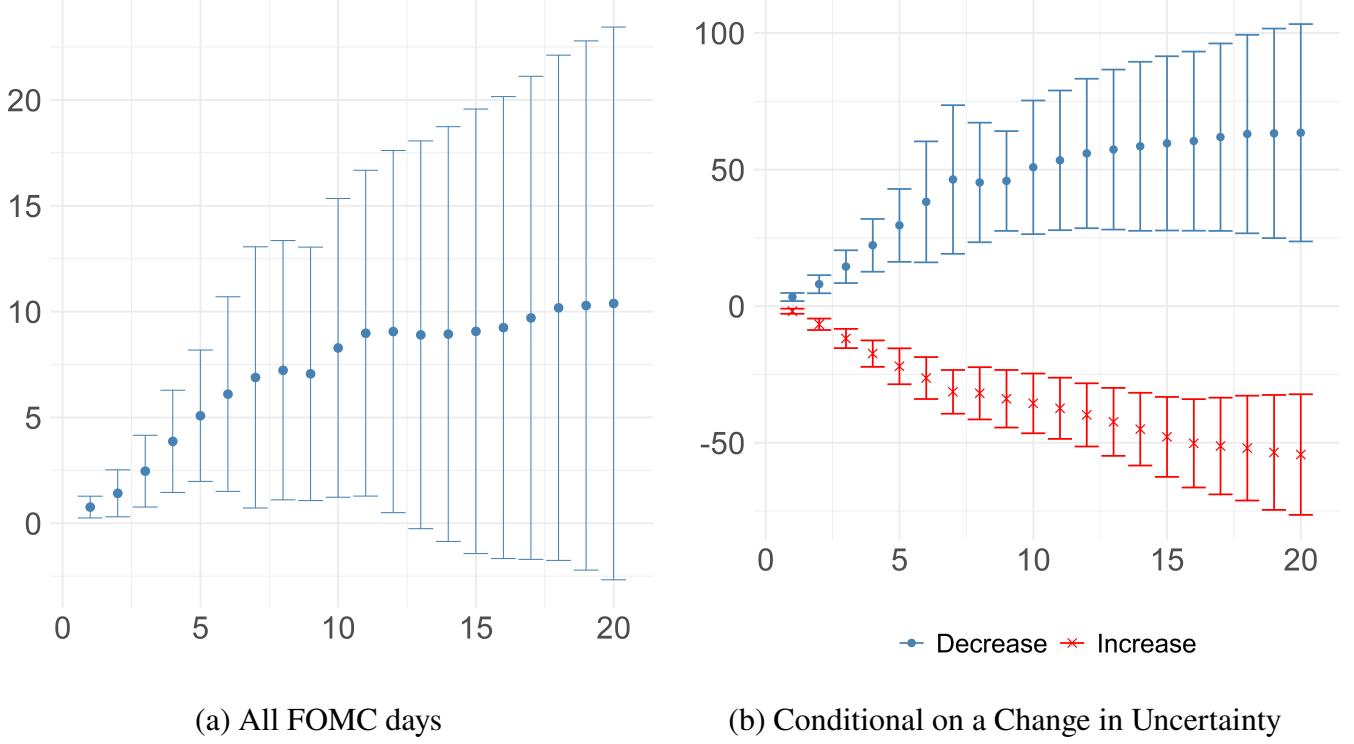


Figure 2: Average Return on Treasury Bonds on FOMC Days.

Notes: Figure 2 shows 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 in years. 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%. The 95% confidence intervals are calculated using Newey–West standard errors.

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

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

where t indexes the t -th 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 next day's interest rate risk minus the previous day's, when today is the t -th 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 plotted against maturity, with 95% confidence

Table 3: Average Returns on Treasury Bonds by Duration.

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

intervals based on 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}^m 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 stock market 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

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

where ΔVIX_t is defined as the logarithmic change in the VIX from the day before to the day after the t -th 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

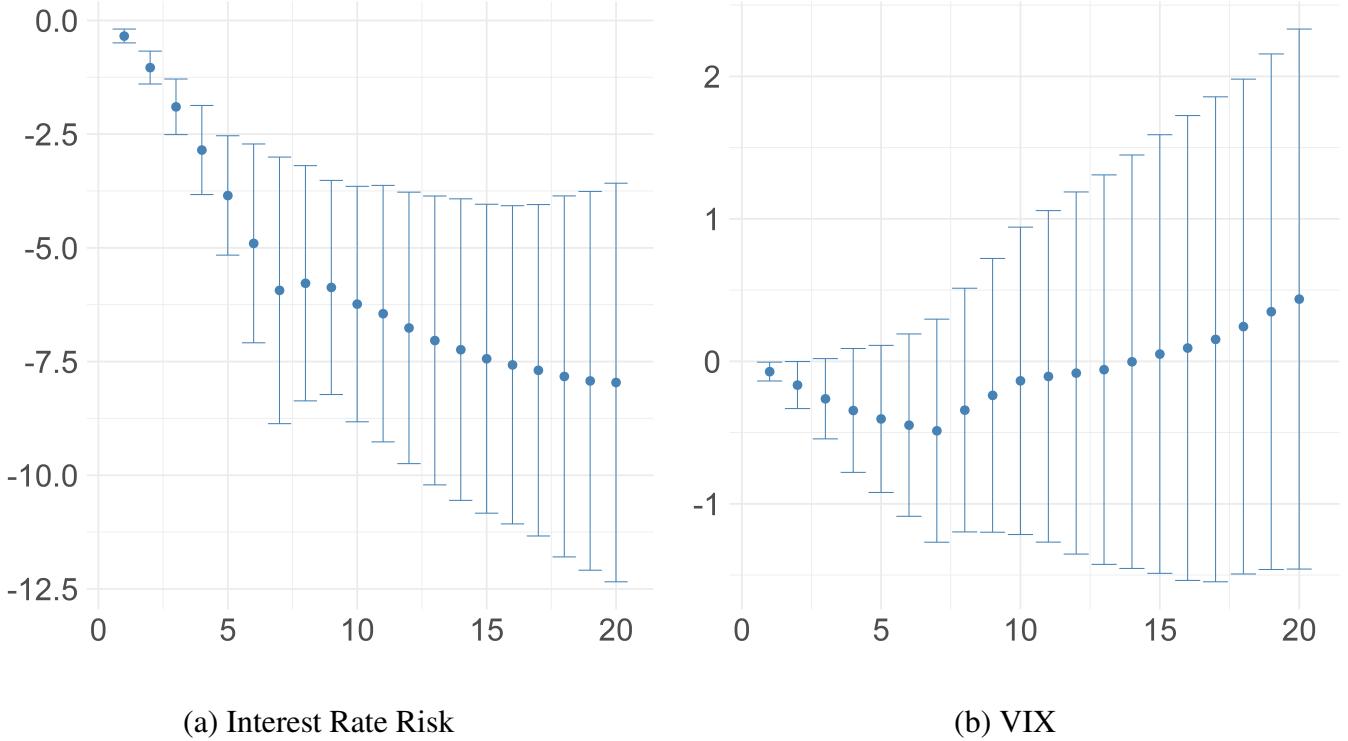


Figure 3: The Elasticity of Returns to Changes in Uncertainty by Duration.

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,

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

where ΔUnc_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.

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.

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

$$\text{Return}_{n,t} = \beta_1 \Delta \text{UNC}_t + \beta_2 \text{Duration}_{n,t} + \beta_3 \Delta \text{UNC}_t \times \text{Duration}_{n,t} + \gamma X_{n,t} + \epsilon_{n,t}, \quad (6)$$

where $\text{Return}_{n,t}$ is the return of bonds with duration n years at the t -th FOMC, expressed in basis points, ΔUNC_t is the measured change in IRU_t at the t -th FOMC, and $\text{Duration}_{n,t}$ equals n , the bond's maturity (in years). I use bonds with maturities ranging from one year to twenty-nine years, in one-year increments.

Table 4: Elasticity of Returns to Changes in Uncertainty by Duration.

	(1)	(2)	(3)	(4)	(5)	(6)
IRU	-2.800*** (0.5495)	-1.887*** (0.5277)				
Duration \times IRU	-0.2449** (0.1022)	-0.2675*** (0.0850)				
BP vol			-2.045*** (0.4064)	-1.422*** (0.3988)		
Duration \times BP vol				-0.1759** (0.0701)	-0.1852*** (0.0623)	
MOVE					-1.470*** (0.4502)	-0.8990* (0.4596)
Duration \times MOVE					-0.1256 (0.0856)	-0.1605** (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 results 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

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

where $\text{Return}_{n,t}$ is the return of bonds with duration n years at the t -th FOMC, ΔUNC_t is the change in uncertainty at the t -th FOMC, and $\text{Duration}_{n,t}$ equals n , where bonds mature in n years. Significance levels: *** $p < 0.01$, ** $p < 0.05$, * $p < 0.10$.

Control variables, $X_{n,t}$, 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 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 coefficient on 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 shorter duration.

I also conduct sensitivity analyses using alternative measures of interest rate risk for UNC_t in

equation (6). In the baseline analysis, 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 estimate of 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 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 subsample analyses for the pre-crisis and post-crisis periods, employ an alternative dataset of zero-coupon Treasury returns from [Gürkaynak, Sack, and Wright \(2007\)](#), 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 exhibit 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 is consistent with the bond case: long-duration equities will exhibit 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 on short- and long-duration equities are statistically indistinguishable. Specifically, the shortest-duration portfolio has an average return of 26.9 basis points, the second-shortest duration portfolio has 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.

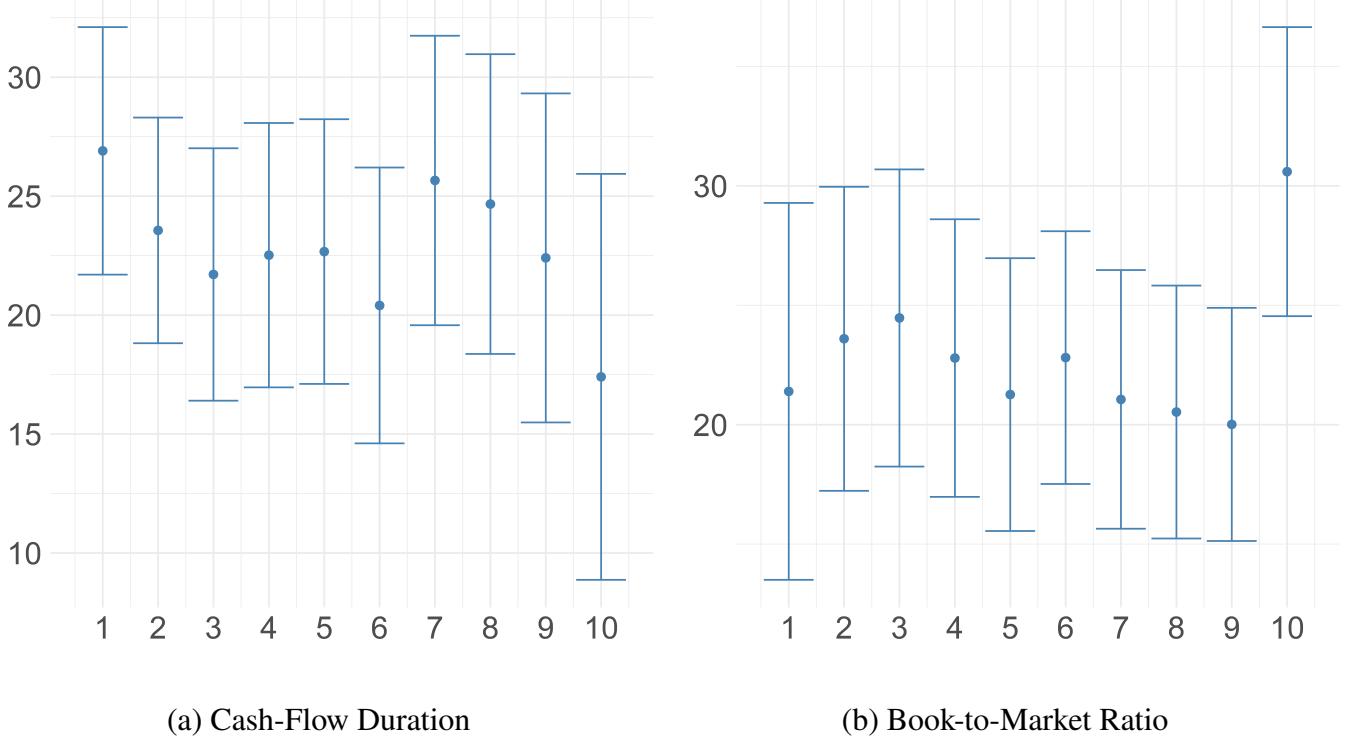


Figure 4: Average Returns Conditional on Duration.

Note: Figure 4 plots average portfolio returns on FOMC days. The horizontal axis represents portfolio duration, ranging from one (short duration) to ten (long duration). The vertical axis shows the average return for each portfolio. Equities are sorted into ten portfolios based on duration and rebalanced quarterly. Panel (a) presents portfolios sorted on cash-flow duration as defined by [Weber \(2018\)](#), while Panel (b) uses the book-to-market ratio. Confidence intervals are based on Newey-West standard errors.

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, Heaton, and Li \(2008\)](#). Figure 4(b) presents the average returns on portfolios sorted by the book-to-market ratio, with portfolios rebalanced quarterly. The results indicate that returns on low- and high-book-to-market portfolios are statistically indistinguishable.

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 and shows 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,

⁶Monthly 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.

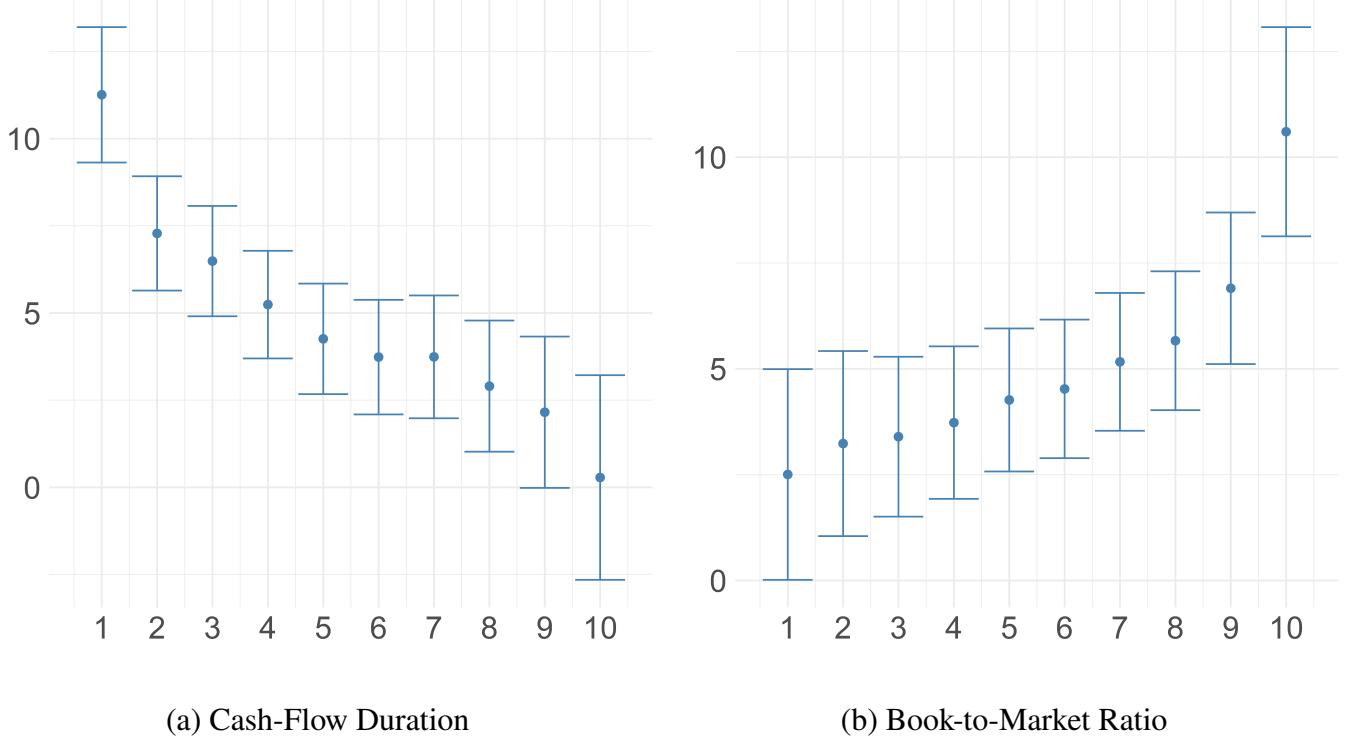


Figure 5: Monthly Average Returns Conditional on Duration.

Note: Figure 5 plots the time-series average of monthly returns for each portfolio. The horizontal axis represents portfolio duration, 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 errors. 95% confidence intervals are shown. The portfolios are rebalanced every quarter.

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 results suggest that average returns on long-duration equities are higher on FOMC days than on non-FOMC days, which is consistent with an upward-sloping term structure. This pattern arises 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 increase in interest rate risk exceeds a predetermined 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 predetermined threshold (red). The difference in the term structure between the two 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 days.

I estimate portfolio-level excess returns using risk factor regressions. The empirical specification is

$$y_t^m = \alpha^m + \beta_s^m X_{s,t} + \epsilon_t^m, \quad (7)$$

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

Panel A of Table 5 reports mean excess returns (OLS estimates) 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 beta: 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.

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

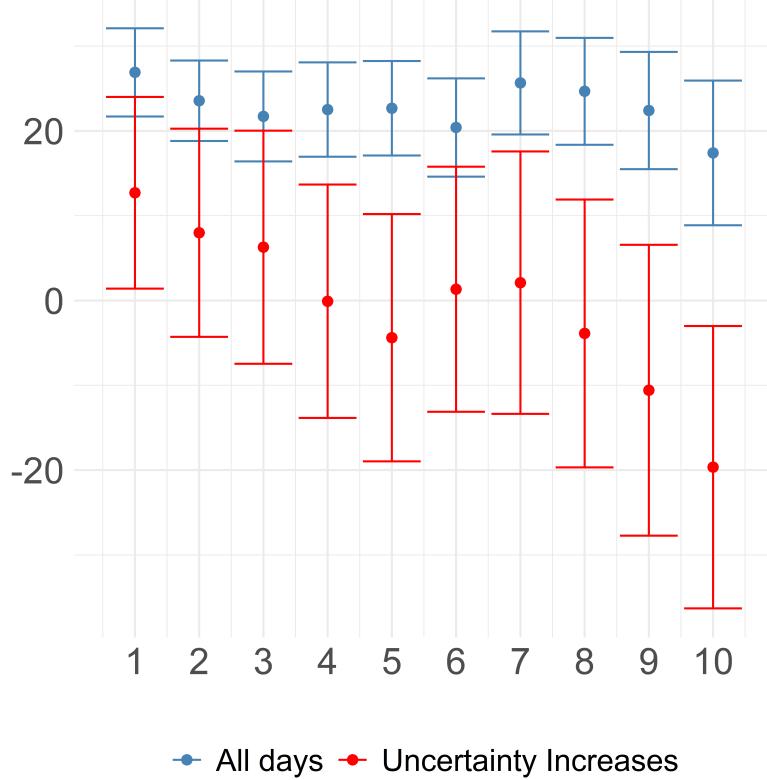


Figure 6: Average Returns Conditional on Duration and an Increase in Uncertainty.

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.

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:

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

where y_t^m is the return of portfolio m at time t expressed in percentage points, and ΔIRU_t is the

Table 5: Average Returns of Portfolios Sorted by Duration.

Portfolio	1	2	3	4	5	6	7	8	9	10
Panel A: FOMC days										
Average returns	26.9 (2.6)	23.6 (2.4)	21.7 (2.7)	22.5 (2.8)	22.7 (2.8)	20.4 (2.9)	25.7 (3.1)	24.7 (3.2)	22.4 (3.5)	17.4 (4.4)
CAPM α	26.1 (2.7)	22.5 (2.5)	20.1 (2.8)	20.9 (2.9)	20.4 (2.9)	17.6 (3.0)	22.5 (3.1)	21.5 (3.2)	18.1 (3.5)	11.9 (3.4)
CAPM β	0.2 (0.14)	0.28 (0.14)	0.42 (0.15)	0.41 (0.16)	0.57 (0.16)	0.70 (0.16)	0.80 (0.17)	0.80 (0.16)	1.05 (0.17)	1.29 (0.29)
FF3 α	26.0 (2.6)	20.8 (2.5)	19.6 (2.7)	20.6 (2.8)	19.9 (2.8)	18.1 (2.8)	23.1 (3.0)	22.5 (3.1)	19.1 (3.4)	13.3 (3.0)
Panel B: Average Monthly Returns										
Average returns	11.4 (1.0)	7.2 (0.8)	6.4 (0.8)	5.2 (0.8)	4.3 (0.8)	3.7 (0.8)	3.8 (0.9)	2.9 (1.0)	2.2 (1.1)	0.3 (1.5)
CAPM α	10.5 (1.0)	6.4 (0.8)	5.6 (0.8)	4.4 (0.7)	3.4 (0.7)	2.7 (0.8)	2.6 (0.8)	1.6 (0.9)	0.5 (1.0)	-1.7 (1.3)
CAPM β	1.4 (0.25)	1.4 (0.23)	1.3 (0.22)	1.3 (0.21)	1.5 (0.21)	1.6 (0.21)	1.8 (0.23)	2.1 (0.23)	2.6 (0.27)	3.0 (0.37)
FF3 α	9.4 (1.0)	5.3 (0.8)	4.5 (0.8)	3.4 (0.8)	2.5 (0.8)	1.9 (0.8)	2.0 (0.9)	1.3 (0.9)	0.6 (1.0)	-1.2 (1.4)
Panel C: Properties 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 \(1993\)](#). “1”–“10” represent the portfolios ordered from short to long duration. Panel A uses daily returns on FOMC days. Panel B uses monthly portfolio returns. In Panel B, returns are converted to a daily scale by dividing monthly returns by the number of business days in the month. Panel C shows the average cash-flow duration of the portfolios in years. Standard errors in parentheses are Newey–West standard errors. The sample period is 1990/1–2019/12.

change in interest rate risk at time t . Portfolios are indexed by $m \in \{1, \dots, 10\}$ 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 plotted against portfolio duration m , along with 95% confidence intervals based on OLS standard errors. The coefficients decrease 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_{iru}^m 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

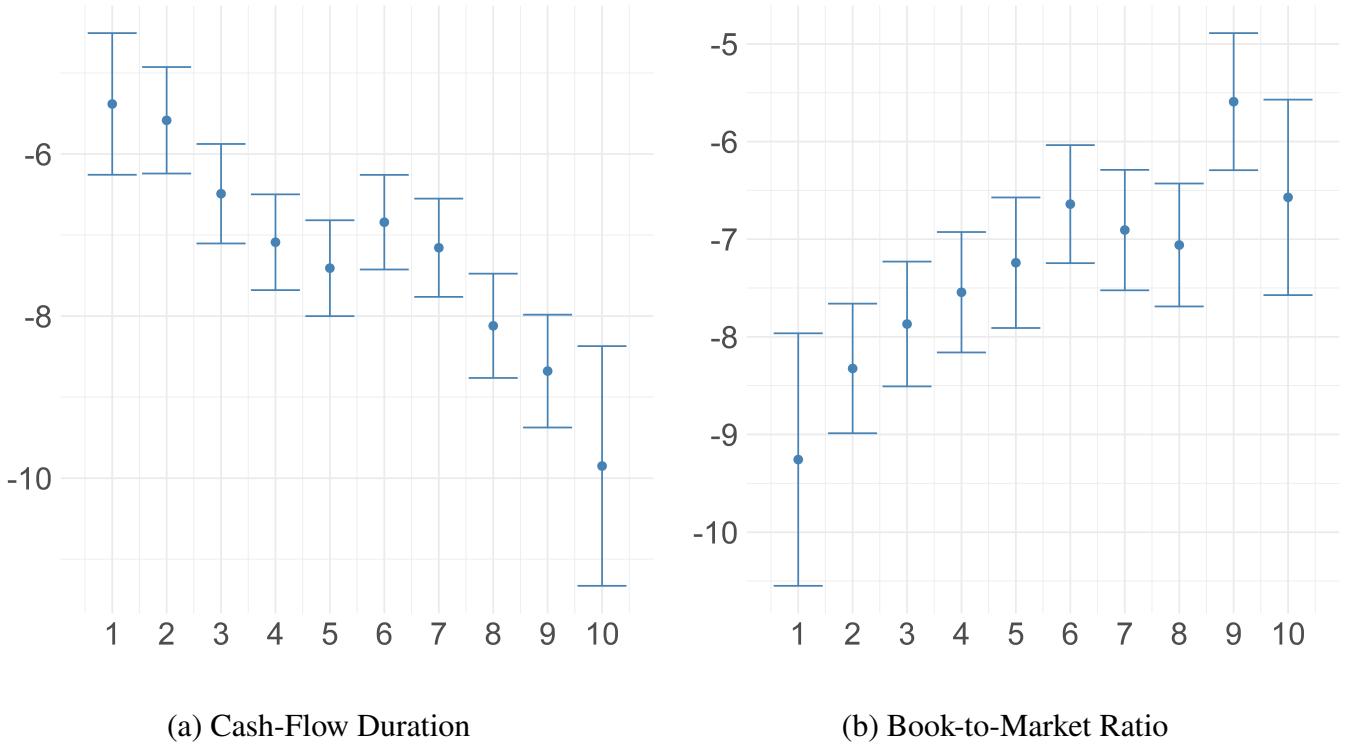


Figure 7: The Elasticity of Returns to interest rate risk Conditional on Duration.

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

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

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 $m \in \{1, \dots, 10\}$. 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 are taken from [Bauer, Lakdawala, and Mueller \(2022\)](#). The figure plots the coefficients β^m for each portfolio m , along with their two-standard-error bands.

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:

$$\text{Return}_{i,t} = \beta_1 \Delta IRU_t + \beta_2 \text{Duration}_{i,t} + \beta_3 \Delta IRU_t \times \text{Duration}_{i,t} + \gamma X_{i,t} + \epsilon_{i,t}, \quad (8)$$

where i indexes firms, t indexes t -th FOMC, $\text{Return}_{i,t}$ denotes the stock return of firm i on the

t -th FOMC day (in basis points), ΔIRU_t is the change in interest rate risk associated with the t -th FOMC, and $\text{Duration}_{i,t}$ is the duration of firm i at time t . $X_{i,t}$ 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 statistically 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.

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.

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

	(1)	(2)	(3)
Duration × IRU	-0.3194*** (0.0570)	-0.3674*** (0.0573)	-0.3908*** (0.0549)
Profit × IRU		20.30* (11.47)	13.52 (10.15)
Leverage × IRU		1.009 (0.9006)	-0.3120 (0.8878)
Sales growth × IRU		-1.538** (0.7683)	-1.652** (0.7817)
IRU	-1.591* (0.9639)	5.210*** (0.9060)	5.205*** (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

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

where i indexes firms, t is the t -th FOMC, $\text{Return}_{i,t}$ is the stock return of firm i at the t -th FOMC, ΔIRU_t is the measured change in uncertainty caused by the t -th FOMC, and $\text{Duration}_{i,t}$ is the measured duration of firm i at the t -th FOMC. Significance levels: *** $p < 0.01$, ** $p < 0.05$, * $p < 0.10$.

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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*** (0.0521)	-0.2597*** (0.0510)	-0.2867*** (0.0495)			
Duration × MOVE				-0.2976*** (0.0476)	-0.3338*** (0.0450)	-0.3528*** (0.0443)
Duration	-1.654*** (0.1621)	-1.685*** (0.1681)	-3.044*** (0.2623)	-1.613*** (0.1683)	-1.639*** (0.1721)	-2.744*** (0.2787)
BP vol	-1.900** (0.8656)	2.368*** (0.6556)	2.945*** (0.6661)			
MOVE				0.1215 (0.7960)	3.620*** (0.6268)	4.198*** (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 pooled regressions of equity returns over 240 FOMC event days. Explanatory variables include the change in the uncertainty measure, duration, their interaction, and control variables. Basis point volatility (BP vol) is the product of Black IV and the futures price. MOVE is a weighted average of basis point volatility for one-month Treasury options across maturities. Control variables include (i) firm and year fixed effects, (ii) size, profitability, leverage, and sales growth, and (iii) interactions between (ii) and the change in interest rate risk. Standard errors are clustered at the firm level. Significance levels: *** $p < 0.01$, ** $p < 0.05$, * $p < 0.10$.

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Appendix A Proof

A.1 Proposition 1

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

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

$$\begin{aligned}
& E_1 \left[\frac{P_2^S(s)}{P_1^S} \right] - E_1 \left[\frac{P_2^L(s)}{P_1^L} \right] \\
&= \frac{E \left[\left[C_2^{1-\frac{1}{\psi}} + \beta(s)C_3(s)^{1-\frac{1}{\psi}} + \beta^2(s)C_4^{1-\frac{1}{\psi}} \right]^{\frac{1}{1-\frac{1}{\psi}}} E \left[\beta(s)C_3(s)^{-\frac{1}{\psi}} X_3(s) \right] \right]}{E \left[\left[C_2^{1-\frac{1}{\psi}} + \beta(s)C_3(s)^{1-\frac{1}{\psi}} + \beta^2(s)C_4^{1-\frac{1}{\psi}} \right]^{\frac{1}{1-\frac{1}{\psi}}} \beta(s)C_3(s)^{-\frac{1}{\psi}} X_3(s) \right]} \\
&\quad - \frac{E \left[\left[C_2^{1-\frac{1}{\psi}} + \beta(s)C_3(s)^{1-\frac{1}{\psi}} + \beta^2(s)C_4^{1-\frac{1}{\psi}} \right]^{\frac{1}{1-\frac{1}{\psi}}} E \left[\beta^2(s)C_4^{-\frac{1}{\psi}} X_4 \right] \right]}{E \left[\left[C_2^{1-\frac{1}{\psi}} + \beta(s)C_3(s)^{1-\frac{1}{\psi}} + \beta^2(s)C_4^{1-\frac{1}{\psi}} \right]^{\frac{1}{1-\frac{1}{\psi}}} \beta^2(s)C_4^{-\frac{1}{\psi}} X_4 \right]}. \tag{9}
\end{aligned}$$

When (9) is positive, the expected return on short-duration assets exceeds that on long-duration assets. Conversely, when (9) is negative, the expected return on short-duration assets falls below that on long-duration assets. The sing of (9) is equal to

$$\begin{aligned}
& E \left[\beta(s)C_3(s)^{-\frac{1}{\psi}} X_3(s) \right] E \left[\left[C_2^{1-\frac{1}{\psi}} + \beta(s)C_3(s)^{1-\frac{1}{\psi}} + \beta^2(s)C_4^{1-\frac{1}{\psi}} \right]^{\frac{1}{1-\frac{1}{\psi}}} \beta^2(s)C_4^{-\frac{1}{\psi}} X_4 \right] \\
&\quad - E \left[\beta^2(s)C_4^{-\frac{1}{\psi}} X_4 \right] E \left[\left[C_2^{1-\frac{1}{\psi}} + \beta(s)C_3(s)^{1-\frac{1}{\psi}} + \beta^2(s)C_4^{1-\frac{1}{\psi}} \right]^{\frac{1}{1-\frac{1}{\psi}}} \beta(s)C_3(s)^{-\frac{1}{\psi}} X_3(s) \right] \tag{10}
\end{aligned}$$

To simplify the notation,

$$V(s_i) \equiv \left[C_2^{1-\frac{1}{\psi}} + \beta(s_i)C_3(s_i)^{1-\frac{1}{\psi}} + \beta^2(s_i)C_4^{1-\frac{1}{\psi}} \right]^{\frac{1}{1-\frac{1}{\psi}}} \quad (11)$$

Equation (10) can be written as

$$\begin{aligned} & \left(p\beta^h C_3(s_1)^{-\frac{1}{\psi}} X_3 + (1-p)\beta^l C_3(s_2)^{-\frac{1}{\psi}} X_3 \right) \\ & \times \left(pV(s_1)(\beta^h)^2 C_4^{-\frac{1}{\psi}} X_4 + (1-p)V(s_2)(\beta^l)^2 C_4^{-\frac{1}{\psi}} X_4 \right) \\ & - \left(p\beta^h C_4^{-\frac{1}{\psi}} X_4 + (1-p)\beta^l C_4^{-\frac{1}{\psi}} X_4 \right) \\ & \times \left(pV(s_1)(\beta^h)^2 C_3(s_1)^{-\frac{1}{\psi}} X_3 + (1-p)V(s_2)(\beta^l)^2 C_3(s_2)^{-\frac{1}{\psi}} X_3 \right) \\ & = p(1-p)\beta^h\beta^l X_3 X_4 (V(s_1) - V(s_2)) \left(\beta^h C_3(s_2)^{-\frac{1}{\psi}} C_4^{-\frac{1}{\psi}} - \beta^l C_3(s_1)^{-\frac{1}{\psi}} C_4^{-\frac{1}{\psi}} \right). \end{aligned} \quad (12)$$

Here, $p(1-p)\beta^h\beta^l X_3 X_4$ in equation (12) is positive. Therefore, the sign of average returns of short minus long-duration bonds is equal to

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

□

A.1.1 Corollary 1

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

$$(V(s_1) - V(s_2)) \left(\beta^h C_3(s_2)^{-\frac{1}{\psi}} C_4^{-\frac{1}{\psi}} - \beta^l C_3(s_1)^{-\frac{1}{\psi}} C_4^{-\frac{1}{\psi}} \right). \quad (13)$$

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 under the assumption that $\beta^h > \beta^l$. Moreover, the first term in (13),

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

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

$$\begin{aligned} & E \left[\beta(s) C_3(s)^{-\frac{1}{\psi}} X_3(s) \right] E \left[\left[C_2^{1-\frac{1}{\psi}} + \beta(s) C_3(s)^{1-\frac{1}{\psi}} + \beta^2(s) C_4^{1-\frac{1}{\psi}} \right]^{\frac{1}{1-\frac{1}{\psi}}} \beta^2(s) C_4^{-\frac{1}{\psi}} X_4 \right] \\ & - E \left[\beta^2(s) C_4^{-\frac{1}{\psi}} X_4 \right] E \left[\left[C_2^{1-\frac{1}{\psi}} + \beta(s) C_3(s)^{1-\frac{1}{\psi}} + \beta^2(s) C_4^{1-\frac{1}{\psi}} \right]^{\frac{1}{1-\frac{1}{\psi}}} \beta(s) C_3(s)^{-\frac{1}{\psi}} X_3(s) \right] \\ &= (X_3^h C_3(s_1)^{-\frac{1}{\psi}} - X_3^l C_3(s_2)^{-\frac{1}{\psi}}) p_1 p_2 (\beta^h)^3 C_4^{-\frac{1}{\psi}} (V(s_2) - V(s_1)) \\ &+ (X_3^h C_3(s_3)^{-\frac{1}{\psi}} - X_3^l C_3(s_4)^{-\frac{1}{\psi}}) p_3 p_4 (\beta^l)^3 C_4^{-\frac{1}{\psi}} (V(s_4) - V(s_3)) \\ &+ (\beta^h C_3(s_3)^{-\frac{1}{\psi}} - \beta^l C_3(s_1)^{-\frac{1}{\psi}}) p_1 p_3 X_3^h \beta^h \beta^l C_4^{-\frac{1}{\psi}} (V(s_1) - V(s_3)) \\ &+ (\beta^h C_3(s_4)^{-\frac{1}{\psi}} - \beta^l C_3(s_2)^{-\frac{1}{\psi}}) p_2 p_4 X_3^l \beta^h \beta^l C_4^{-\frac{1}{\psi}} (V(s_2) - V(s_4)) \\ &+ p_1 p_4 \beta^h \beta^l C_4^{-\frac{1}{\psi}} (\beta^h X_3^l C_3(s_4)^{-\frac{1}{\psi}} - \beta^l X_3^h C_3(s_1)^{-\frac{1}{\psi}}) (V(s_1) - V(s_4)) \\ &+ p_2 p_3 \beta^h \beta^l C_4^{-\frac{1}{\psi}} (\beta^h X_3^h C_3(s_3)^{-\frac{1}{\psi}} - \beta^l X_3^l C_3(s_2)^{-\frac{1}{\psi}}) (V(s_2) - V(s_3)). \end{aligned} \tag{14}$$

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

$$X_3^h \equiv \bar{X} + \sigma$$

$$X_3^l \equiv \bar{X} - \sigma,$$

where σ is the dispersion of cash flow.

Equation (14) can be written as

$$\begin{aligned}
&= ((\bar{X} + \sigma)C_3(s_1)^{-\frac{1}{\psi}} - (\bar{X} - \sigma)C_3(s_2)^{-\frac{1}{\psi}})p_1p_2(\beta^h)^3C_4^{-\frac{1}{\psi}}(V(s_2) - V(s_1)) \\
&+ ((\bar{X} + \sigma)C_3(s_3)^{-\frac{1}{\psi}} - (\bar{X} - \sigma)C_3(s_4)^{-\frac{1}{\psi}})p_3p_4(\beta^l)^3C_4^{-\frac{1}{\psi}}(V(s_4) - V(s_3)) \\
&+ (\beta^h C_3(s_3)^{-\frac{1}{\psi}} - \beta^l C_3(s_1)^{-\frac{1}{\psi}})p_1p_3(\bar{X} + \sigma)\beta^h\beta^l C_4^{-\frac{1}{\psi}}(V(s_1) - V(s_3)) \\
&+ (\beta^h C_3(s_4)^{-\frac{1}{\psi}} - \beta^l C_3(s_2)^{-\frac{1}{\psi}})p_2p_4(\bar{X} - \sigma)\beta^h\beta^l C_4^{-\frac{1}{\psi}}(V(s_2) - V(s_4)) \\
&+ p_1p_4\beta^h\beta^l C_4^{-\frac{1}{\psi}}(\beta^h(\bar{X} - \sigma)C_3(s_4)^{-\frac{1}{\psi}} - \beta^l(\bar{X} + \sigma)C_3(s_1)^{-\frac{1}{\psi}})(V(s_1) - V(s_4)) \\
&+ p_2p_3\beta^h\beta^l C_4^{-\frac{1}{\psi}}(\beta^h(\bar{X} + \sigma)C_3(s_3)^{-\frac{1}{\psi}} - \beta^l(\bar{X} - \sigma)C_3(s_2)^{-\frac{1}{\psi}})(V(s_2) - V(s_3)) \\
&= \frac{1}{16}\sigma \left[(C_3(s_1)^{-\frac{1}{\psi}} + C_3(s_2)^{-\frac{1}{\psi}})(\beta^h)^3C_4^{-\frac{1}{\psi}}(V(s_2) - V(s_1)) \right. \\
&+ (C_3(s_3)^{-\frac{1}{\psi}} + C_3(s_4)^{-\frac{1}{\psi}})(\beta^l)^3C_4^{-\frac{1}{\psi}}(V(s_4) - V(s_3)) \\
&+ (\beta^h C_3(s_3)^{-\frac{1}{\psi}} - \beta^l C_3(s_1)^{-\frac{1}{\psi}})\beta^h\beta^l C_4^{-\frac{1}{\psi}}(V(s_1) - V(s_3)) \\
&- (\beta^h C_3(s_4)^{-\frac{1}{\psi}} - \beta^l C_3(s_2)^{-\frac{1}{\psi}})\beta^h\beta^l C_4^{-\frac{1}{\psi}}(V(s_2) - V(s_4)) \\
&- \beta^h\beta^l C_4^{-\frac{1}{\psi}}(\beta^h C_3(s_4)^{-\frac{1}{\psi}} - \beta^l C_3(s_1)^{-\frac{1}{\psi}})(V(s_1) - V(s_4)) \\
&\left. + \beta^h\beta^l C_4^{-\frac{1}{\psi}}(\beta^h C_3(s_3)^{-\frac{1}{\psi}} - \beta^l C_3(s_2)^{-\frac{1}{\psi}})(V(s_2) - V(s_3)) \right] \\
&+ t.i.p. \tag{15}
\end{aligned}$$

To abbreviate the notation, I define terms independent of parameters σ in the equation (15).

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

$$+ p_2 p_3 \beta^h \beta^l C_4^{-\frac{1}{\psi}} (\beta^h \bar{X} C_3(s_3)^{-\frac{1}{\psi}} + \beta^l \bar{X} C_3(s_2)^{-\frac{1}{\psi}}) (V(s_2) - V(s_3)). \quad (16)$$

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 contrast, the aggregate consumption is not affected by discount rate.

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

$$V(s_1) < V(s_2)$$

$$V(s_3) < V(s_4).$$

In the equation (15), the coefficient on σ , defined as α^σ , is

$$\begin{aligned} \alpha^\sigma \equiv & \frac{1}{16} \left[(C_3(s_1)^{-\frac{1}{\psi}} + C_3(s_2)^{-\frac{1}{\psi}})(\beta^h)^3 C_4^{-\frac{1}{\psi}} (V(s_2) - V(s_1)) \right. \\ & + (C_3(s_3)^{-\frac{1}{\psi}} + C_3(s_4)^{-\frac{1}{\psi}})(\beta^l)^3 C_4^{-\frac{1}{\psi}} (V(s_4) - V(s_3)) \\ & + (\beta^h C_3(s_3)^{-\frac{1}{\psi}} - \beta^l C_3(s_1)^{-\frac{1}{\psi}}) p_1 p_3 \beta^h \beta^l C_4^{-\frac{1}{\psi}} (V(s_1) - V(s_3)) \\ & - (\beta^h C_3(s_4)^{-\frac{1}{\psi}} - \beta^l C_3(s_2)^{-\frac{1}{\psi}}) p_2 p_4 \beta^h \beta^l C_4^{-\frac{1}{\psi}} (V(s_2) - V(s_4)) \\ & - \beta^h \beta^l C_4^{-\frac{1}{\psi}} (\beta^h C_3(s_4)^{-\frac{1}{\psi}} + \beta^l C_3(s_1)^{-\frac{1}{\psi}}) (V(s_1) - V(s_4)) \\ & \left. + \beta^h \beta^l C_4^{-\frac{1}{\psi}} (\beta^h C_3(s_3)^{-\frac{1}{\psi}} + \beta^l C_3(s_2)^{-\frac{1}{\psi}}) (V(s_2) - V(s_3)) \right]. \end{aligned} \quad (17)$$

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, $\bar{\sigma}$ is

$$\bar{\sigma} \equiv 2 \frac{-t.i.p}{\alpha^\sigma}. \quad (18)$$

□

A.2.1 Lemma 1

Lemma 1. *The coefficient on σ ,*

$$\begin{aligned}
& (C_3(s_1)^{-\frac{1}{\psi}} + C_3(s_2)^{-\frac{1}{\psi}})(\beta^h)^3 C_4^{-\frac{1}{\psi}}(V(s_2) - V(s_1)) \\
& + (C_3(s_3)^{-\frac{1}{\psi}} + C_3(s_4)^{-\frac{1}{\psi}})(\beta^l)^3 C_4^{-\frac{1}{\psi}}(V(s_4) - V(s_3)) \\
& + (\beta^h C_3(s_3)^{-\frac{1}{\psi}} - \beta^l C_3(s_1)^{-\frac{1}{\psi}})\beta^h \beta^l C_4^{-\frac{1}{\psi}}(V(s_1) - V(s_3)) \\
& - (\beta^h C_3(s_4)^{-\frac{1}{\psi}} - \beta^l C_3(s_2)^{-\frac{1}{\psi}})\beta^h \beta^l C_4^{-\frac{1}{\psi}}(V(s_2) - V(s_4)) \\
& - \beta^h \beta^l C_4^{-\frac{1}{\psi}}(\beta^h C_3(s_4)^{-\frac{1}{\psi}} + \beta^l C_3(s_1)^{-\frac{1}{\psi}})(V(s_1) - V(s_4)) \\
& + \beta^h \beta^l C_4^{-\frac{1}{\psi}}(\beta^h C_3(s_3)^{-\frac{1}{\psi}} + \beta^l C_3(s_2)^{-\frac{1}{\psi}})(V(s_2) - V(s_3)), \tag{19}
\end{aligned}$$

is positive.

Proof. Since $V(s_1) < V(s_2)$ and $V(s_3) < V(s_4)$ are true, the first two terms in (19) are positive:

$$\begin{aligned}
& (C_3(s_1)^{-\frac{1}{\psi}} + C_3(s_2)^{-\frac{1}{\psi}})(\beta^h)^3 C_4^{-\frac{1}{\psi}}(V(s_2) - V(s_1)) > 0. \\
& + (C_3(s_3)^{-\frac{1}{\psi}} + C_3(s_4)^{-\frac{1}{\psi}})(\beta^l)^3 C_4^{-\frac{1}{\psi}}(V(s_4) - V(s_3)) > 0.
\end{aligned}$$

The remaining term (the sum of third to sixth terms in (19)) is

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

$$\begin{aligned}
& + \beta^h \beta^l C_4^{-\frac{1}{\psi}} (\beta^h C_3(s_3)^{-\frac{1}{\psi}} + \beta^l C_3(s_2)^{-\frac{1}{\psi}}) (V(s_2) - V(s_4)) \\
& = \beta^h \beta^l (V(s_1) - V(s_4)) \left((\beta^h - \beta^l) C_3(s_1)^{-\frac{1}{\psi}} - (\beta^h C_3(s_4)^{-\frac{1}{\psi}} + \beta^l C_3(s_1)^{-\frac{1}{\psi}}) \right) \\
& + \beta^h \beta^l (V(s_2) - V(s_4)) \left(\beta^h C_3(s_3)^{-\frac{1}{\psi}} + \beta^l C_3(s_2)^{-\frac{1}{\psi}} - (\beta^h - \beta^l) C_3(s_2)^{-\frac{1}{\psi}} \right) \\
& = \beta^h \beta^l (V(s_1) - V(s_4)) \left(-(\beta^h C_3(s_4)^{-\frac{1}{\psi}} + \beta^l C_3(s_1)^{-\frac{1}{\psi}}) \right) \\
& + \beta^h \beta^l (V(s_2) - V(s_4)) \left(\beta^h C_3(s_3)^{-\frac{1}{\psi}} + \beta^l C_3(s_2)^{-\frac{1}{\psi}} \right) \\
& + \beta^h \beta^l (V(s_1) - V(s_4)) \left((\beta^h - \beta^l) C_3(s_1)^{-\frac{1}{\psi}} \right) \\
& + \beta^h \beta^l (V(s_2) - V(s_4)) \left(-(\beta^h - \beta^l) C_3(s_2)^{-\frac{1}{\psi}} \right)
\end{aligned} \tag{20}$$

Here, the sum of first and second terms in (20) is positive:

$$\begin{aligned}
& \beta^h \beta^l (V(s_1) - V(s_4)) \left(-(\beta^h C_3(s_4)^{-\frac{1}{\psi}} + \beta^l C_3(s_1)^{-\frac{1}{\psi}}) \right) \\
& + \beta^h \beta^l (V(s_2) - V(s_4)) \left(\beta^h C_3(s_3)^{-\frac{1}{\psi}} + \beta^l C_3(s_2)^{-\frac{1}{\psi}} \right) \\
& \geq \beta^h \beta^l (V(s_1) - V(s_4)) \\
& \times \left(-\beta^h C_3(s_2)^{-\frac{1}{\psi}} - \beta^l C_3(s_1)^{-\frac{1}{\psi}} + \beta^h C_3(s_1)^{-\frac{1}{\psi}} + \beta^l C_3(s_2)^{-\frac{1}{\psi}} \right) \\
& = \beta^h \beta^l (V(s_1) - V(s_4)) (\beta^h - \beta^l) (C_3(s_1)^{-\frac{1}{\psi}} - C_3(s_2)^{-\frac{1}{\psi}}) \\
& \geq 0
\end{aligned} \tag{21}$$

The sum of third and fourth terms in (20) is positive:

$$\begin{aligned}
& \beta^h \beta^l (V(s_1) - V(s_4)) \left((\beta^h - \beta^l) C_3(s_1)^{-\frac{1}{\psi}} \right) \\
& + \beta^h \beta^l (V(s_2) - V(s_4)) \left(-(\beta^h - \beta^l) C_3(s_2)^{-\frac{1}{\psi}} \right) \\
& \geq \beta^h \beta^l (V(s_1) - V(s_4)) (\beta^h - \beta^l) (C_3(s_1)^{-\frac{1}{\psi}} - C_3(s_2)^{-\frac{1}{\psi}}) \\
& \geq 0
\end{aligned} \tag{22}$$

□

A.3 Proposition 3

As shown in equation (14), the difference between short- and long-duration assets is given by

$$\begin{aligned}
& (X_3^h C_3(s_1)^{-\frac{1}{\psi}} - X_3^l C_3(s_2)^{-\frac{1}{\psi}}) p_1 p_2 (\beta^h)^3 C_4^{-\frac{1}{\psi}} (V(s_2) - V(s_1)) \\
& + (X_3^h C_3(s_3)^{-\frac{1}{\psi}} - X_3^l C_3(s_4)^{-\frac{1}{\psi}}) p_3 p_4 (\beta^l)^3 C_4^{-\frac{1}{\psi}} (V(s_4) - V(s_3)) \\
& + (\beta^h C_3(s_3)^{-\frac{1}{\psi}} - \beta^l C_3(s_1)^{-\frac{1}{\psi}}) p_1 p_3 X_3^h \beta^h \beta^l C_4^{-\frac{1}{\psi}} (V(s_1) - V(s_3)) \\
& + (\beta^h C_3(s_4)^{-\frac{1}{\psi}} - \beta^l C_3(s_2)^{-\frac{1}{\psi}}) p_2 p_4 X_3^l \beta^h \beta^l C_4^{-\frac{1}{\psi}} (V(s_2) - V(s_4)) \\
& + p_1 p_4 \beta^h \beta^l C_4^{-\frac{1}{\psi}} (\beta^h X_3^l C_3(s_4)^{-\frac{1}{\psi}} - \beta^l X_3^h C_3(s_1)^{-\frac{1}{\psi}}) (V(s_1) - V(s_4)) \\
& + p_2 p_3 \beta^h \beta^l C_4^{-\frac{1}{\psi}} (\beta^h X_3^h C_3(s_3)^{-\frac{1}{\psi}} - \beta^l X_3^l C_3(s_2)^{-\frac{1}{\psi}}) (V(s_2) - V(s_3))
\end{aligned} \tag{23}$$

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

$$\beta^h = \beta + \sigma^\beta$$

$$\beta^l = \beta - \sigma^\beta$$

What to be shown is that the derivative of equation (23) 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 (23) is approximately equal to zero.

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

$$\begin{aligned}
& (C_3(s_3)^{-\frac{1}{\psi}} + C_3(s_1)^{-\frac{1}{\psi}}) p_1 p_3 X_3^h (\beta^2 - (\sigma^\beta)^2) C_4^{-\frac{1}{\psi}} (V(s_1) - V(s_3)) \\
& + (\beta^h C_3(s_3)^{-\frac{1}{\psi}} - \beta^l C_3(s_1)^{-\frac{1}{\psi}}) p_1 p_3 X_3^h (\beta^2 - (\sigma^\beta)^2) C_4^{-\frac{1}{\psi}} \left(\frac{\partial V(s_1)}{\partial \sigma^\beta} - \frac{\partial V(s_3)}{\partial \sigma^\beta} \right) \\
& + (\beta^h C_3(s_3)^{-\frac{1}{\psi}} - \beta^l C_3(s_1)^{-\frac{1}{\psi}}) p_1 p_3 X_3^h (-2\sigma^\beta) C_4^{-\frac{1}{\psi}} (V(s_1) - V(s_3)) \\
& \approx p_1 p_3 X_3^h C_4^{-\frac{1}{\psi}} (V(s_1) - V(s_3)) \left((C_3(s_3)^{-\frac{1}{\psi}} + C_3(s_1)^{-\frac{1}{\psi}}) \beta^2 + (\beta^h C_3(s_3)^{-\frac{1}{\psi}} - \beta^l C_3(s_1)^{-\frac{1}{\psi}}) (-2\sigma^\beta) \right) \\
& + (\beta^h C_3(s_3)^{-\frac{1}{\psi}} - \beta^l C_3(s_1)^{-\frac{1}{\psi}}) p_1 p_3 X_3^h (\beta^2) C_4^{-\frac{1}{\psi}} \left(\frac{\partial V(s_1)}{\partial \sigma^\beta} - \frac{\partial V(s_3)}{\partial \sigma^\beta} \right)
\end{aligned} \tag{24}$$

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

$$(C_3(s_3)^{-\frac{1}{\psi}} + C_3(s_1)^{-\frac{1}{\psi}})\beta^2 + (\beta^h C_3(s_3)^{-\frac{1}{\psi}} - \beta^l C_3(s_1)^{-\frac{1}{\psi}})(-2\sigma^\beta) > 0. \quad (25)$$

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, (24) 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

$$\begin{aligned} &p_1 p_4 (-2\sigma^\beta) C_4^{-\frac{1}{\psi}} (\beta^h X_3^l C_3(s_4)^{-\frac{1}{\psi}} - \beta^l X_3^h C_3(s_1)^{-\frac{1}{\psi}})(V(s_1) - V(s_4)) \\ &+ p_1 p_4 \beta^h \beta^l C_4^{-\frac{1}{\psi}} (X_3^l C_3(s_4)^{-\frac{1}{\psi}} + X_3^h C_3(s_1)^{-\frac{1}{\psi}})(V(s_1) - V(s_4)) \\ &+ p_1 p_4 \beta^h \beta^l C_4^{-\frac{1}{\psi}} (\beta^h X_3^l C_3(s_4)^{-\frac{1}{\psi}} - \beta^l X_3^h C_3(s_1)^{-\frac{1}{\psi}}) \left(\frac{V(s_1)}{\partial \sigma^\beta} - \frac{V(s_4)}{\partial \sigma^\beta} \right) \\ &= p_1 p_4 (V(s_1) - V(s_4)) C_4^{-\frac{1}{\psi}} \\ &\times (-2\sigma^\beta \beta^h X_3^l C_3(s_4)^{-\frac{1}{\psi}} + 2\sigma^\beta \beta^l X_3^h C_3(s_1)^{-\frac{1}{\psi}} + \beta^h \beta^l X_3^l C_3(s_4)^{-\frac{1}{\psi}} + \beta^h \beta^l X_3^h C_3(s_1)^{-\frac{1}{\psi}}) \\ &+ p_1 p_4 \beta^h \beta^l C_4^{-\frac{1}{\psi}} (\beta^h X_3^l C_3(s_4)^{-\frac{1}{\psi}} - \beta^l X_3^h C_3(s_1)^{-\frac{1}{\psi}}) \left(\frac{V(s_1)}{\partial \sigma^\beta} - \frac{V(s_4)}{\partial \sigma^\beta} \right) \end{aligned} \quad (26)$$

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 (26) is negative. Similary, the derivative of sixth term with respect to σ^β is negative. Therefore, the derivative of equation (23) 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.
2. Daily return of S&P 500 Index is obtained from CRSP.
3. Daily return on the Center for Research in Security Prices (CRSP) value-weighted NYSE / NASDAQ / AMEX is from CRSP.
4. VIX data is from Chicago Board Options Exchange through WRDS.
5. The monetary policy uncertainty measure is based on daily market data from [Bauer, Lakdawala, and Mueller \(2022\)](#) and is obtained from Michael Bauer's webpage.
6. Firm characteristics are from Compustat.
7. The daily Treasury data is from [Liu and Wu \(2021\)](#) and is obtained 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, Sloan, and Soliman \(2004\)](#) and [Weber \(2018\)](#). This measure represents the weighted average time to cash flow maturity:

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

where $\text{Duration}_{i,t}$ is the duration of firm i at time t , $\text{CF}_{i,t+s}$ is the cash flow at time $t + s$, $P_{i,t}$ is equity price, and r is the risk-free rate, which is assumed to be common across time and firms.

Equities do not have a well-defined finite maturity (T). Therefore, the duration formula is decomposed into a finite-period component and an infinite-horizon terminal value:

$$\text{Duration}_{i,t} = \frac{\sum_{s=1}^T s \times \text{CF}_{i,t+s}/(1+r)^s}{P_{i,t}} + (T + \frac{1+r}{r}) \times \frac{P_{i,t} - \sum_{s=1}^T \text{CF}_{i,t+s}/(1+r)^s}{P_{i,t}}. \quad (27)$$

Future cash flows are decomposed into two terms and are approximated using an AR(1) process:

$$\begin{aligned} \text{CF}_{i,t+s} &= E_{i,t+s} - (BV_{i,t+s} - BV_{i,t+s-1}) \\ &= BV_{i,t+s-1} \left[\frac{E_{i,t+s}}{BV_{i,t+s-1}} - \frac{BV_{i,t+s} - BV_{i,t+s-1}}{BV_{i,t+s-1}} \right]. \end{aligned} \quad (28)$$

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

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

where $\overline{\frac{E}{BV}}$ denotes the average cost of equity and $\overline{\frac{BV}{G}}$ the average growth in book equity.⁸ 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 $\frac{BV_{i,t+s+1} - BV_{i,t+s}}{BV_{i,t+s}}$ with AR(1) process.
2. Compute $\frac{E_{i,t+s+1}}{BV_{i,t+s}}$ with AR(1) process.
3. Compute $\text{CF}_{i,t+1}$ in equation (28).
4. Update $BV_{i,t+1}$ with

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

⁸These are set to 0.03 and 0.015, respectively, with the risk-free rate fixed at 0.03 and the terminal period T set to 60 quarters, as specified in [Weber \(2018\)](#).

This is a recursive procedure in which n -period-ahead cash flows are calculated in the same manner. Duration is then measured using these future cash flows and equation (27).

C.1 Derive equation (1)

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

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

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

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

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,

$$\sum_{s=T+1}^{\infty} \text{CF}_{i,t+s}/(1+r)^s = P_{i,t} - \sum_{s=t}^{\infty} \text{CF}_{i,t+s}/(1+r)^s. \quad (30)$$

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

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

By substituting this and equation (30) into equation (29), 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 derived under certain assumptions.

The cash-flow duration is defined as

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

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

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

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

Under this assumption, cash-flow duration can be written as

$$\text{Duration}_{i,t} = T + \frac{1+r}{r} - T \frac{\text{E}_{i,t}}{r P_{i,t}}.$$

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

$$\text{Duration}_{i,t} = T + \frac{1+r}{r} - T \frac{\text{BV}_{i,t}}{P_{i,t}}.$$

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

Appendix D Sensitivity Analysis for Bonds

This subsection presents a sensitivity analysis for bond returns.

Alternative Measure for Zero-Coupon Bonds In the baseline analysis, Treasury bond returns are taken from [Liu and Wu \(2021\)](#), where the yield curve is estimated using a non-parametric kernel-smoothing method. I also incorporate an alternative dataset on zero-coupon Treasury bonds from [Gürkaynak, Sack, and Wright \(2007\)](#), which estimates the forward rate using a parametric approach.

The empirical specification is given in equation (6), and the results are reported 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 are consistent 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.

Table 8: The Elasticity of Returns to Changes in Uncertainty Conditional on Duration: Alternative Measure for Zero-Coupon Bonds

	(1)	(2)	(3)	(4)	(5)	(6)
IRU	-3.052*** (0.5141)	-2.069*** (0.4990)				
Duration \times IRU	-0.1484* (0.0875)	-0.2114** (0.0819)				
BP vol		-2.303*** (0.3868)	-1.638*** (0.3702)			
Duration \times BP vol		-0.1198** (0.0498)	-0.1578*** (0.0489)			
MOVE				-1.556*** (0.4642)	-0.9002* (0.4857)	
Duration \times MOVE				-0.0867 (0.0808)	-0.1460* (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 from the pooled regression of Treasury returns. The explanatory variables include the change in interest rate risk, duration, and their interaction. Standard errors are clustered by time. The dependent variables are Treasury bond returns of different maturities, expressed in basis points. Columns (2) and (4) additionally include the two-day change in VIX, the monetary policy shock, the interaction between the change in VIX and duration, and the interaction between the monetary policy shock and duration. The regression equation is

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

where $\text{Return}_{n,t}$ is the return on bonds with duration n years at the t -th FOMC meeting, ΔIRU_t is the measured change in interest rate risk at the t -th FOMC meeting, and $\text{Duration}_{n,t} = n$, since the bonds mature in n years. Standard errors are clustered by time. Significance levels: *** $p < 0.01$, ** $p < 0.05$, * $p < 0.10$.

Different Time Subsample I also conduct a subsample analysis by dividing the sample period into the pre-crisis (1990–2007) and post-crisis (2008–2019) periods. The empirical specification follows equation (6), with the uncertainty measure given by the benchmark interest rate risk variable, IRU_t . The results are reported in Table 9. Columns (1) and (2) use the pre-crisis period, while Columns (3) and (4) use the post-crisis period. The results are consistent across the subsamples: the interaction term between duration and the uncertainty measure is significantly negative. Overall, the findings are robust to the choice of uncertainty measure and subsample period.

Quantitatively, the coefficients for the post-crisis period are smaller in absolute value. During this period, the nominal interest rate is close to zero, and investors face less uncertainty about future interest rates. As a result, the resolution of interest rate risk is less significant, and the response of returns to this resolution is smaller in the post-crisis period.

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

	(1)	(2)	(3)	(4)
IRU	-2.149*** (0.5889)	-1.010** (0.4584)	-3.190*** (0.8077)	-2.350*** (0.7801)
Duration \times IRU	-0.3196*** (0.1146)	-0.3139*** (0.1161)	-0.2115 (0.1474)	-0.2840*** (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 from the pooled regression of Treasury returns for the 1990–2019 subsample analysis. The explanatory variables include the change in interest rate risk, duration, and their interaction. Standard errors are clustered by time. The dependent variables are Treasury bond returns of different maturities, expressed in basis points. Columns (1) and (2) use the pre-crisis period (1990–2007), while Columns (3) and (4) use the post-crisis period (2008–2019). Columns (2) and (4) additionally include the two-day change in VIX, the monetary policy shock, the interaction between the change in VIX and duration, and the interaction between the monetary policy shock and duration. The regression equation is

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

where $\text{Return}_{n,t}$ is the return on bonds with duration n years at the t -th FOMC meeting, ΔIRU_t is the measured change in interest rate risk at the t -th FOMC meeting, and $\text{Duration}_{n,t} = n$, since the bonds mature in n years. Standard errors are clustered by time. Significance levels: *** $p < 0.01$, ** $p < 0.05$, * $p < 0.10$.

Different Maturity of Bonds In the baseline analysis, I use bonds with maturities ranging from one to twenty-nine years, in one-year increments. This section examines the sensitivity of the results to the choice of maturity range. I analyze three alternative datasets: maturities from one to five years, from one to ten years, and from eleven to twenty-one years, all in one-year increments. The empirical specification follows equation (6), with the uncertainty measure given by the benchmark interest rate risk variable, IRU_t . The results are reported in Table 10. Columns (1) and (2) use maturities from one to five years, Columns (3) and (4) use maturities from one to ten years, and Columns (5) and (6) use maturities from eleven to twenty-one years.

The results are consistent across maturities, showing a significantly negative interaction term between duration and the uncertainty measure. The estimated coefficients are larger in absolute value for shorter-maturity bonds (Columns (1) and (2)) and smaller for longer-maturity bonds (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 example, when investors discount a consumption claim twenty years into the future, the discount factor is much less affected by monetary policy announcements.

Table 10: The Elasticity of Returns to Changes in Uncertainty Conditional on Duration: Different Bond Maturities.

	(1)	(2)	(3)	(4)	(5)	(6)
IRU	0.5630*** (0.1384)	0.6244*** (0.1507)	0.0160 (0.2061)	0.4067** (0.1974)	-4.834*** (1.190)	-3.414*** (1.182)
Duration × IRU	-0.8382*** (0.1430)	-0.6620*** (0.1367)	-0.7066*** (0.1484)	-0.6426*** (0.1366)	-0.1649* (0.0986)	-0.2113** (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 from the pooled regression of Treasury returns. The explanatory variables include the change in interest rate risk, duration, their interaction, and control variables. Standard errors are clustered by time. The dependent variables are Treasury bond returns of different maturities, expressed in basis points. Columns (1) and (2) use maturities from one to five years, Columns (3) and (4) use maturities from one to ten years, and Columns (5) and (6) use maturities from eleven to twenty-one years. The regression equation is

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

where $\text{Return}_{n,t}$ is the return on bonds with duration n years at the t -th FOMC meeting, ΔIRU_t is the measured change in interest rate risk at the t -th FOMC meeting, and $\text{Duration}_{n,t} = n$, since the bonds mature in n years. Standard errors are clustered by time. Significance levels: *** $p < 0.01$, ** $p < 0.05$, * $p < 0.10$.

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

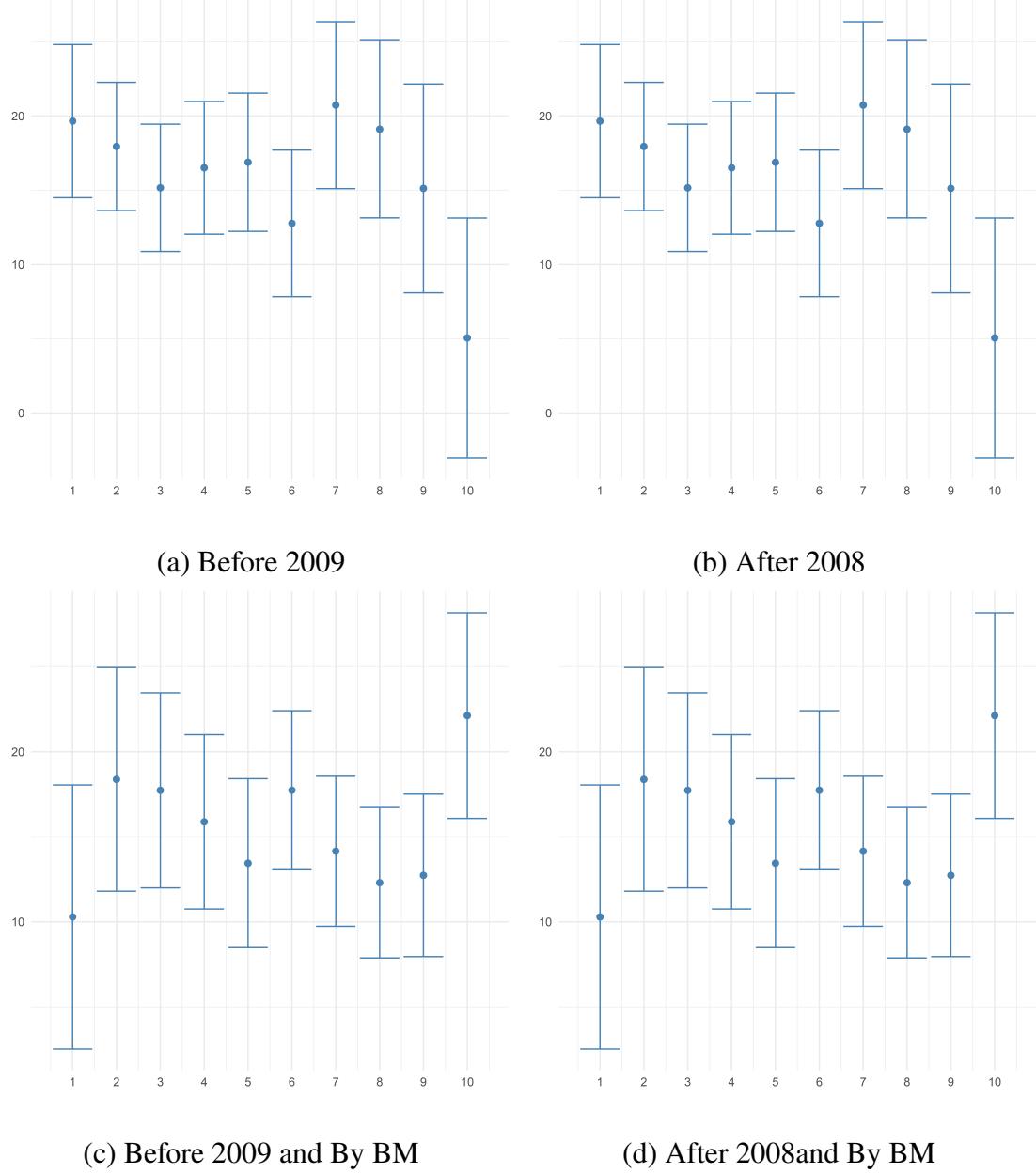


Figure 8: Average Returns Conditional on Duration: Different Time Subsamples.

Note: Figure 8 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 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. Portfolios are rebalanced every quarter. Panels (a) and (c) use the 1990–2007 sample, while Panels (b) and (d) use the 2007–2019 sample. Panels (a) and (b) sort portfolios by cash-flow duration, whereas Panels (c) and (d) sort portfolios by the book-to-market ratio.

E.1.2 The Elasticity of Returns to Interest Rate Risk

Table 11 estimates a regression of the form (8) using different time subsamples. Columns (1) and (2) use the 1990–2007 sample, while Columns (3) and (4) use the 2007–2019 sample. The results are similar across the two periods: the interaction term between interest rate risk and duration is negative and significant in both samples.

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

	(1)	(2)	(3)	(4)
Duration × IRU	-0.2303*** (0.0451)	-0.2379*** (0.0484)	-0.6256*** (0.1279)	-0.6582*** (0.0989)
Profit × IRU		10.21** (4.750)		1.810 (19.73)
Leverage × IRU		0.1842 (1.002)		-5.376*** (1.636)
Sales growth × IRU		-0.3396 (0.7310)		-4.742** (1.915)
IRU	0.7087 (0.8280)	1.618 (1.067)	-2.987 (2.054)	6.362*** (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 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 include (i) firm and year fixed effects and (ii) the interaction of firm characteristics with the change in interest rate risk. Standard errors are clustered at the firm level. Columns (1) and (2) use the 1990–2007 sample, while Columns (3) and (4) use the 2007–2019 sample. Significance levels: *** $p < 0.01$, ** $p < 0.05$, * $p < 0.10$.

E.2 Sensitivity for Parameters in Cash-Flow Duration

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

I conduct a sensitivity analysis by varying the parameters. The baseline case is set as $\rho_1 = 0.67$, $\rho_2 = 0.18$, $\overline{BVG} = 0.015$, $\frac{\overline{E}}{BV} = 0.03$, $r = 0.03$, and $T = 60$. One parameter is changed at a

time while the others are held constant. Specifically, the persistence in ROE is set to 0.55 and 0.75 (baseline 0.67); the persistence in sales growth to 0.1 and 0.3 (baseline 0.18); the long-run growth rate in sales to 0.01 and 0.02 (baseline 0.015); the long-run growth rate in ROE to 0.02 and 0.04 (baseline 0.03); the discount rate to 0.025 and 0.035 (baseline 0.03); and the forecasting horizon to 12 years and 18 years (baseline 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. Firms are then sorted by duration, and I estimate the average returns on FOMC days for each portfolio. Figures 9 and 10 plot the average return as a function of cash-flow duration under twelve different parameter values. In each figure, only one parameter is varied while the other parameters are held fixed at their baseline values.

E.2.2 Interest Rate Uncertainty and Contemporaneous Relationship

This subsection presents a sensitivity analysis of the elasticity of equity returns to interest rate risk. After calculating cash-flow duration under different parameter values and sorting firms by duration, I regress portfolio returns on changes in interest rate risk. The equation is

$$y_t^m = \beta^m \Delta \text{IRU}_t + \epsilon_t, \quad (31)$$

where ΔIRU_t is the change in interest rate risk, and portfolios are indexed by $m \in \{1, \dots, 10\}$.

Figure 11 and Figure 12 show the coefficients β^m for each portfolio m along with their two-standard-error bands. The figures demonstrate that the elasticity of equity returns to interest rate risk increases with duration in absolute value. This result does not depend on the parameter values assumed when calculating cash-flow duration.

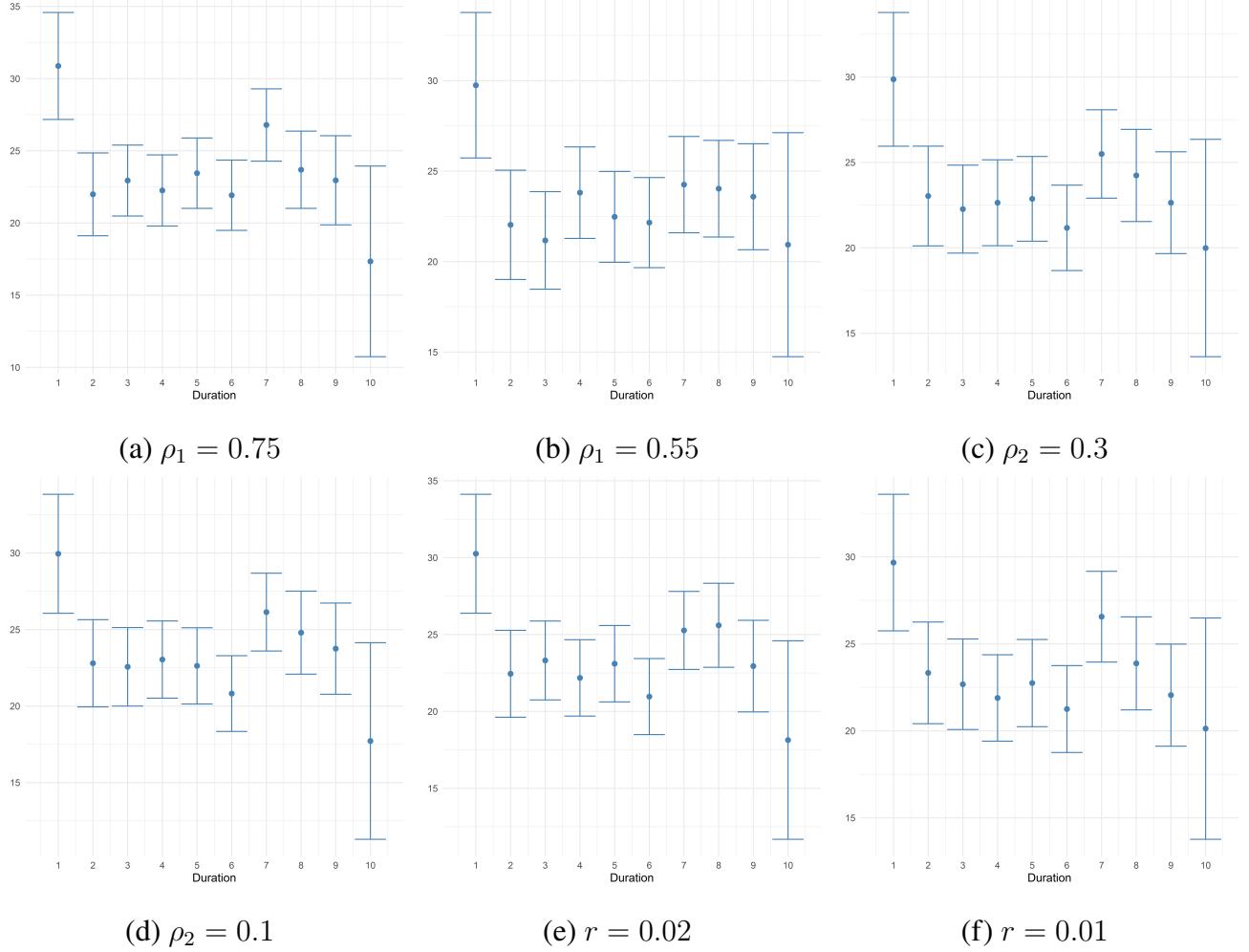


Figure 9: Sensitivity Analysis for Average Returns.

Note: Figure 9 plots the time-series average of portfolio returns on FOMC days under different parameter values. 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. Equities are divided into ten groups, from low to high, based on duration, and the average return within each group is calculated. Each panel varies one parameter at a time while holding the others constant.

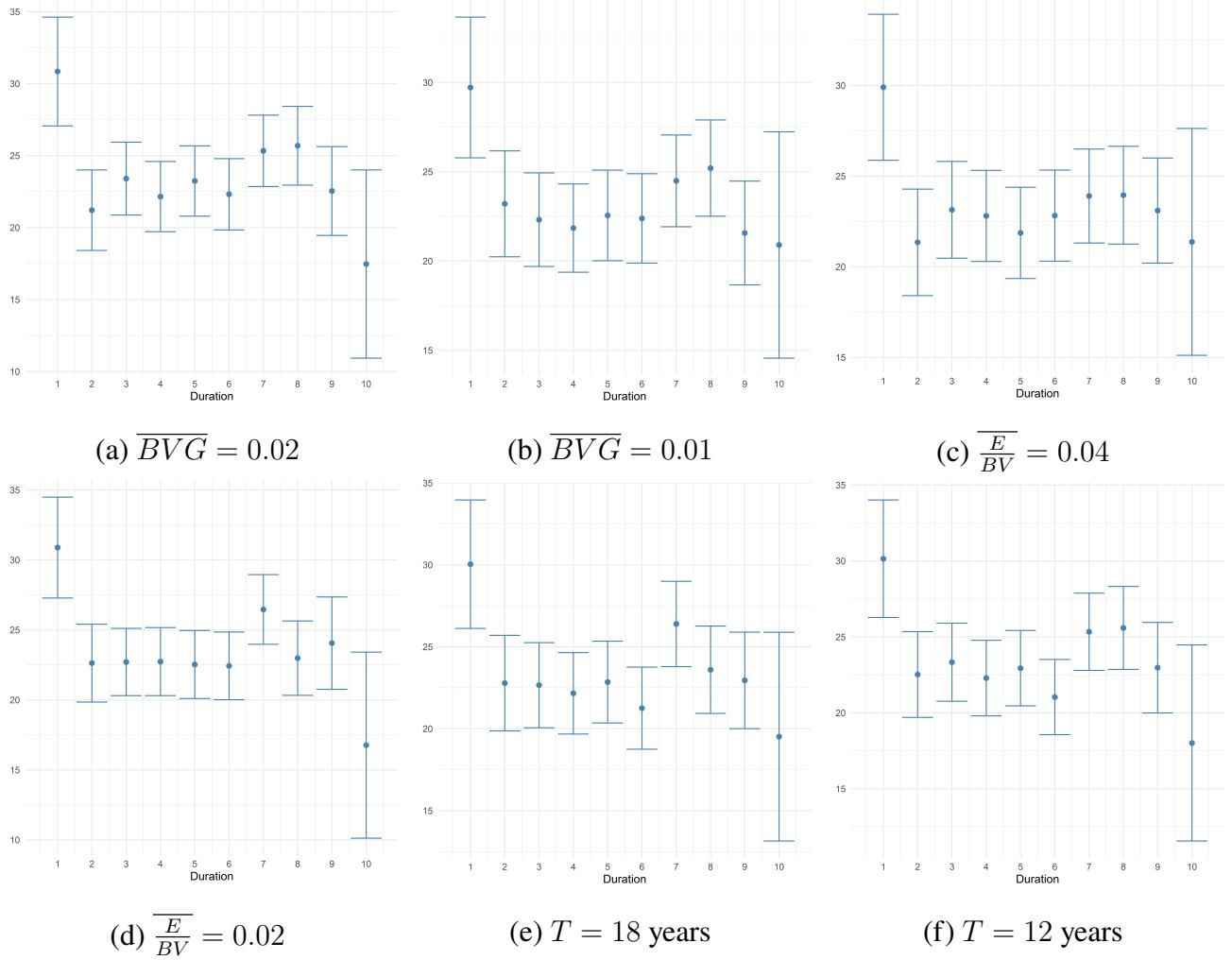


Figure 10: Sensitivity Analysis for Average Returns.

Note: Figure 10 plots the time-series average of portfolio returns on FOMC days under different parameter values. 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. Equities are divided into ten groups, from low to high, based on duration, and the average return within each group is calculated. Each panel varies one parameter at a time while holding the others constant.

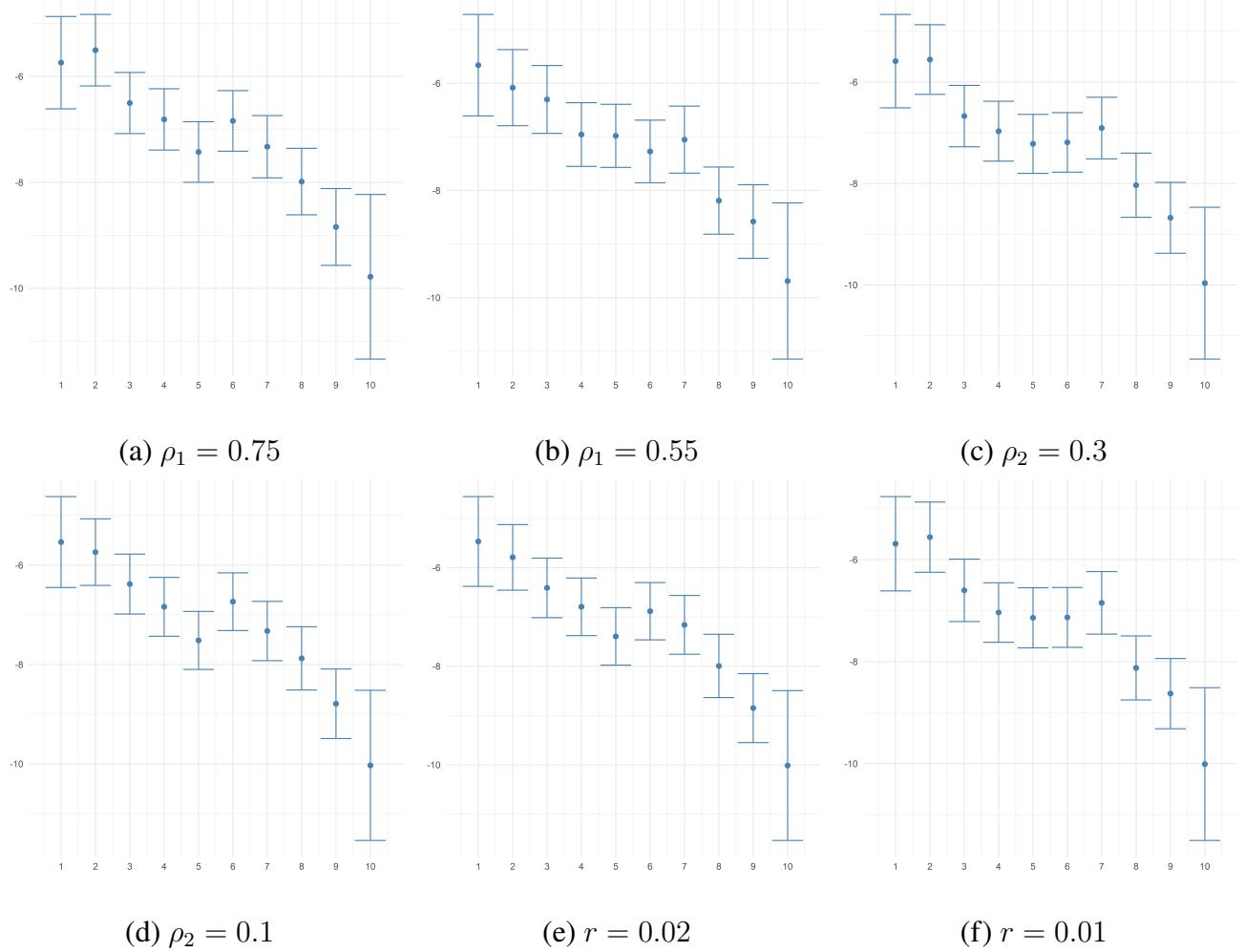


Figure 11: Sensitivity Analysis for the Elasticity to Interest Rate Risk.

Note: Figure 11 shows the sensitivity of equity returns to changes in interest rate risk. I separately regress portfolio returns on changes in the uncertainty measure,

$$y_t^m = \beta^m \Delta \text{IRU}_t + \epsilon_t, \quad (32)$$

where ΔIRU_t is the change in interest rate risk and portfolios are indexed by $m \in \{1, \dots, 10\}$. Portfolios are sorted by cash-flow duration in Panel (a) and by book-to-market ratio in Panel (b). The interest rate risk measure is taken from [Bauer, Lakdawala, and Mueller \(2022\)](#). The vertical axis plots the coefficients β^m for each portfolio m along with their two-standard-error bands. Each panel varies one parameter at a time while holding the others constant.

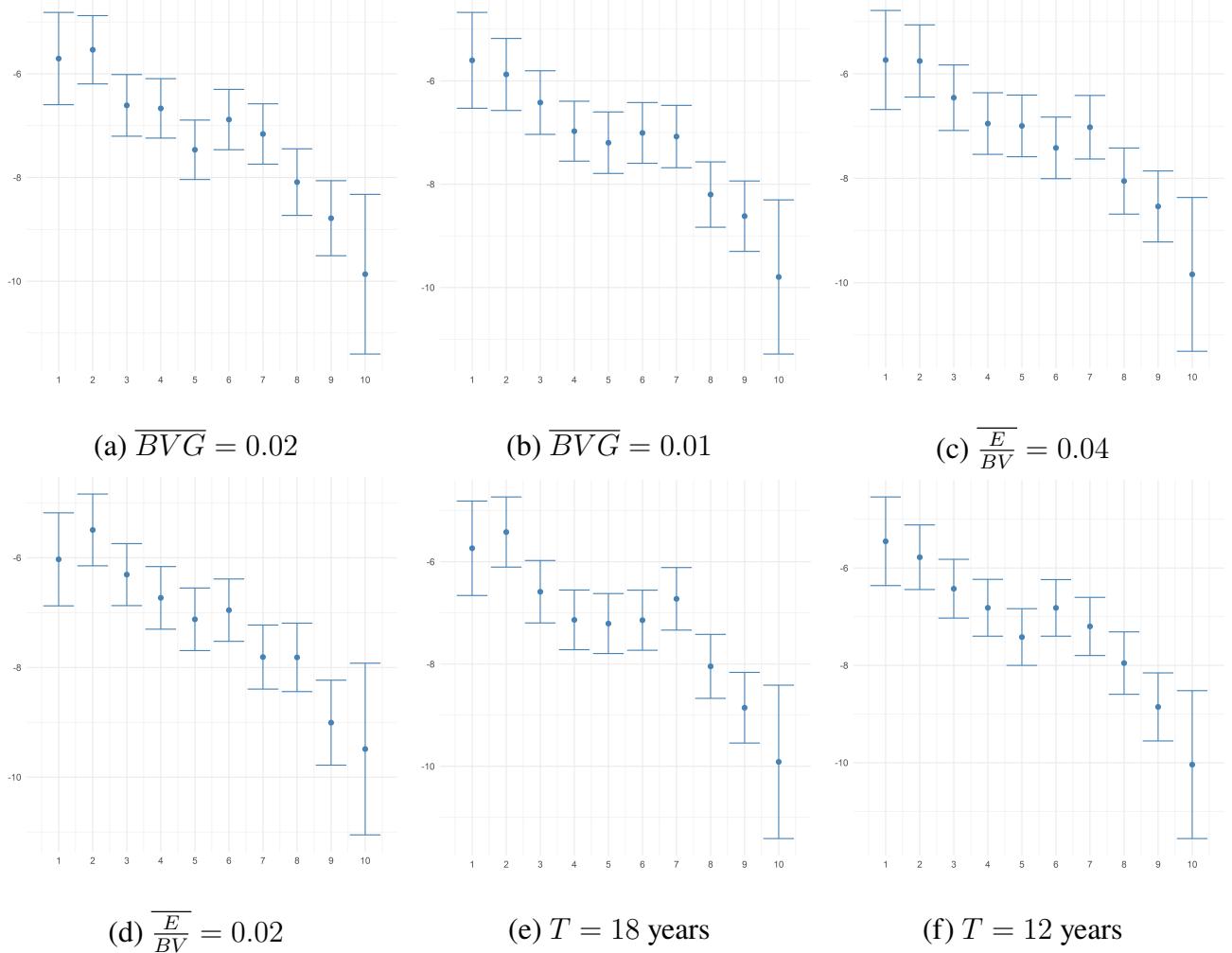


Figure 12: Sensitivity Analysis for the Elasticity to Interest Rate Risk.

Note: Figure 12 shows the sensitivity of equity returns to changes in interest rate risk. I separately regress portfolio returns on changes in the uncertainty measure,

$$y_t^m = \beta^m \Delta IRU_t + \epsilon_t, \quad (33)$$

where ΔIRU_t is the change in interest rate risk and portfolios are indexed by $m \in \{1, \dots, 10\}$. Portfolios are sorted by cash-flow duration in Panel (a) and by book-to-market ratio in Panel (b). The interest rate risk measure is taken from [Bauer, Lakdawala, and Mueller \(2022\)](#). The vertical axis plots the coefficients β^m for each portfolio m along with their two-standard-error bands. Each panel varies one parameter at a time while holding the others constant.