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Implied Equity Duration: Lessons from the Japanese Financial Crises*

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Abstract

We present novel insights into the Japanese equity return term structure by examining the reversals of risk-adjusted returns on duration-sorted portfolios, as were particularly observed during the COVID-19 pandemic and are common during crises. Our analysis, conducted over the Japanese stock market from 1990 to 2022, reveals that market uncertainty significantly explains the returns of the long-short duration portfolio. Additionally, we find that the countercyclicality of the equity term structure can be attributed to differences in the response of returns to considerably large negative shocks. This study contributes to the understanding of the relationship between the timing of cash flows and stock returns and offers valuable implications for studies on the cross-section of stock returns.

Keywords: equity duration; cross-section of stock returns; market uncertainty; financial crisis; pandemic

JEL Classification: G12

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1 Introduction

Recent research has actively explored the relationship between a firm's cash flow timing and stock returns, or the term structure of stock returns. The literature indicates higher returns for stocks generating near-future cash flows compared to those with distant-future cash flows. Additionally, several studies suggest that the relationship between the timing of cash flows and stock returns may vary depending on the state of the economy. For example, Gormsen (2021) suggests that returns on stocks with dividends in the distant future increase in bad times. In addition, Gormsen (2021) states that the term structure of stock returns is both downward sloping on average (i.e., stocks with cash flows in the near future have higher returns on average) and countercyclical (i.e., stocks with cash flows in the distant future have higher returns during bad times).

We provide more specific findings on the countercyclical nature of the equity term structure. Dechow et al. (2021) find that portfolios that pay a large fraction of cash flows in the near future underperformed during the early phase of the COVID-19 pandemic in U.S., which is consistent with Gormsen's (2021) claim that the equity term structure is countercyclical. However, considering that Dechow et al. (2021) do not cover economic crises other than the pandemic, it is not clear whether their results are common during crises or a pandemic-specific phenomenon. Countercyclicality of the equity term structure may be caused by the reverse relationship between the timing of cash flows and stock returns during the crises.

Regarding these previous studies, we use Japanese stock market data since 1990, which includes three major economic downturns to specifically identify the negative shocks that may lead to changes in the relationship between the timing of cash flows and stock returns. Using the implied equity duration proposed by Dechow et al. (2004), a well-known measure of a firm's cash flow timing, we analyze the cross-section of duration-sorted portfolio returns.[1] We identify how the capital asset pricing model (CAPM) alphas of portfolios with different equity durations relate to the state of the economy. In addition, we examine the relationship between market uncertainty and the returns of the long-short duration portfolio.

The contributions of this paper can be summarized as follows: First, empirical evidence of this study demonstrates that a large negative shock or increased market uncertainty may cause the reversal of risk-adjusted returns on duration-sorted portfolios. During more severe crises, such reversals may contribute to the observed countercyclicality. Second, this study expands the literature on the equity term structure by presenting a detailed relationship between equity duration and the cross-section of stock returns using Japanese market data. Using data from the Japanese market allows us to include three major economic shocks in our analysis. Moreover, short duration portfolios perform poorly in bad times, indicating that a high premium for a short-duration portfolio is consistent with prevalent asset pricing theory. Simultaneously, a long-duration portfolio may serve as a risk-hedging device against large

[1] Implied equity duration proposed by Dechow et al. (2004) has been used in recent studies (e.g., Fukuta and Yamane (2015), Weber (2018), and Dechow et al. (2021)) and can be computed from a few financial variables, making it possible to analyze historically.

negative economic shocks. These findings may provide a useful clue in future research when considering the cross-section of stock returns.

The remainder of the paper is organized as follows: Section 2 presents the related literature. Section 3 describes the data and the method used to create the duration measure. Section 4 presents the properties of duration quintile portfolios in the Japanese market. Section 5 examines what leads to the countercyclicality of the equity term structure. Section 6 presents the robustness of the analysis. Finally, Section 7 concludes the paper.

2 Related Literature

This study is related to the literature on the timing of firms' cash flows and the cross-section of stock returns. Dechow et al. (2004) and other previous studies have used equity duration as a measure of the timing of cash flows.[2] Dechow et al. (2004) apply Macaulay duration to equities and analyze its relationship with equity returns. Weber (2018) uses Dechow et al.'s (2004) duration measure and demonstrates that portfolios with longer duration are overvalued when sentiment is high in the previous month. Da (2009) uses a two-factor model of cash flow covariance and duration, and shows that it can potentially explain the cross-section of stock returns. Schröder and Esterer (2016) measure duration using analyst forecasts, and Chen (2022) uses changes in stock prices before and after the monetary policy announcements to obtain a duration measure. More recent studies have also shown that short-duration premium is associated with premium for major risk factors such as profitability (Gonçalves (2021), Gormsen and Lazarus (2023)).[3]

Most studies analyzing the relationship between equity duration and cross-section of stock returns focus on the U.S. market, and non-U.S. analysis is limited. Fullana and Toscano (2014) calculate the implied equity duration for firms listed on the Spanish stock market, and compare the results with those of Dechow et al. (2004) for the U.S. market. Fukuta and Yamane (2015) find that the duration risk factor has similar information to the HML factor for the Japanese market. Bae and Lee (2021) demonstrate that the duration factor may explain the momentum profits in the Korean market.

Studies that address the relationship of equity term structure to the business cycle include Gormsen (2021) and Bansal et al. (2021). Using data on dividend index futures, Gormsen (2021) reveals that the slope of the term structure of stock returns is both countercyclical and downward on average. Bansal et al. (2021) also use data for dividend index futures and employ a regime-switching model to identify the difference in the term structure during periods of economic expansion and recession.

Our study is also related to studies of cross-sectional returns on the timing of firms' cash flows during

[2] There are also studies that use dividend strip data calculated from dividend future prices or option prices to analyze the term structure of equities; see van Binsbergen et al. (2012), van Binsbergen et al. (2013), van Binsbergen and Koijen (2017), Gormsen and Koijen (2020), Gormsen (2021) and Bansal et al. (2021).

[3] Some studies, such as Lettau and Wachter (2007), have related the timing of firms' cash flows to the value premium. See Fukuta and Yamane (2015) for a literature review.

the COVID-19 pandemic. Gormsen and Koijen (2020) demonstrate that when the stock-price decline during the pandemic recovered, the dividend prices of the near future remained low while the dividend prices of the distant future recovered. Dechow et al. (2021) obtain evidence that the average returns and CAPM alphas are higher for the short-duration portfolio than for the long-duration portfolio before the pandemic, whereas the average returns and CAPM alphas for the short-duration portfolio are lower than those of the long-duration portfolio during the pandemic. Studies that examine the pandemic period can also be related to the studies that consider the business cycle described above.

3 Data

We focus on firms listed on the first and second sections of the Tokyo Stock Exchange as of April 1, 2022. The sample period for the analysis of monthly returns is from February 1990 to June 2022, and the sample period for daily returns begins on January 5, 1990. However, for calculating durations, we use financial data spanning 1977 to 2022 to maximize the sample period for estimating future cash flow parameters. Financial variables and daily stock prices of individual stocks are obtained from the Nikkei NEEDS database, and monthly individual stock returns, daily and monthly market returns, and risk-free rates are obtained from Financial Data Solutions.[4] We exclude firms whose identification for the industry is not assigned, firms in the financial sector, non-surviving firms at the end of June 2022, and firms with an accounting period of less than 12 months.

Dechow et al. (2004) apply Macaulay duration to equities and propose implied equity duration. Macaulay duration is expressed as follows:

$$D_0^M = \frac{\sum_{t=1}^{T} t(CF_t^B/(1+r^B)^t)}{P_0^B}, \tag{1}$$

where CF_t^B denotes the cash flow at time t, r^B denotes the yield to maturity, T denotes the maturity, and P_0^B denotes the bond price at time 0. To apply this to equities, Dechow et al. (2004) assume that cash flow payments continue for an infinite period, while predicted cash flows change to a certain period T and remain constant after $T+1$. Equation (1) can therefore be rearranged as follows:

$$\begin{aligned} D_0 &= \frac{\sum_{t=1}^{\infty} t(CF_t/(1+r)^t)}{P_0} \\ &= \frac{\sum_{t=1}^{T} t(CF_t/(1+r)^t)}{P_0} + \frac{\sum_{t=T+1}^{\infty} t(CF_t/(1+r)^t)}{P_0} \\ &= \frac{\sum_{t=1}^{T} t(CF_t/(1+r)^t)}{P_0} + \left(T + \frac{1+r}{r}\right)\frac{(P_0 - \sum_{t=1}^{T} CF_t/(1+r)^t)}{P_0}, \end{aligned} \tag{2}$$

[4]The Nikkei NEEDS database is widely used in studies using financial data on Japanese firms. Financial Data Solutions provides data on stock returns and is widely used in the analysis of the Japanese market. Kubota and Takehara (2018) and Fukuta and Yamane (2015) also use these databases.

where CF_t denotes the predicted net cash distribution to equity holders at time t, P_0 denotes the market capitalization of equity at time 0, r denotes the expected stock return, and T denotes the finite forecasting horizon. In addition, given the clean surplus condition, the cash flow at time t can be expressed as

$$\begin{aligned} CF_t &= E_t - (BE_t - BE_{t-1}) \\ &= BE_{t-1} \times \left[\frac{E_t}{BE_{t-1}} - \frac{(BE_t - BE_{t-1})}{BE_{t-1}} \right], \end{aligned} \tag{3}$$

where E_t denotes the earnings at time t, BE_t denotes the book equity at time t. Dechow et al. (2004) assume that return on equity (ROE), E_t/BE_{t-1} and growth in book equity, $(BE_t - BE_{t-1})/BE_{t-1}$ follow the AR (1) process, respectively, and obtain the predicted values of cash flows up to $t = T$ from equation (3). They substitute the predicted values of cash flows into equation (2) and refer to it as implied equity duration. The first line of equation (2) shows that implied equity duration is a weighted average of the timing of cash flows with the weight being the ratio of the discounted present value of cash flow in time t to the current market capitalization. Thus, the equity duration calculated with the method by Dechow et al. (2004) provides a measure of the timing of cash flows.

In this study, we obtain the equity duration using the same method as in Dechow et al. (2004). According to Weber (2018) and Dechow et al. (2021), the cash flow forecasting period T is set to 15 years, and the parameters for the autoregressive processes of ROE and book equity growth and r are the same for all firms.[5] In estimating the process of book equity growth, we obtain the autoregressive coefficients estimated from sales growth as in Dechow et al. (2004), considering that the prediction fits better with the parameters estimated using sales growth. The financial variables used in the calculation of the duration are book equity, earnings, sales growth, and market capitalization. We winsorize ROE and sales growth at 1% and 99 % levels, respectively, and samples with negative book equity are excluded from the analysis.

The autoregressive coefficients used to predict cash flows are the cross-sectional means of the estimated first-order autoregressive coefficients of ROE and sales growth for each firm, weighted by the number of samples in the time series for each firm. Firms with a time series sample of less than 10 are excluded. The autoregressive coefficient of ROE used in this study is 0.457, and the long-run average is 0.062, which is the annualized value of the average TOPIX monthly return. The autoregressive coefficient of the book equity growth rate is 0.166, and the long-run average is set to 0.044 using the long-run average of the nominal GDP growth rate.[6] These parameters are similar to those of Dechow et al. (2021) and

[5] Fukuta and Yamane (2015) use industry-specific parameters when calculating equity duration for the Japanese market, although they note that the ranking of durations is not substantially different from those using the same parameters across industries. Considering that we are using duration quintile portfolios in this study, the forecasting parameters being identical for all firms should not significantly affect the results.

[6] Although the forecasting model used in this study might be parsimonious, the correlation coefficient between realized dividend payments and forecasted cash flows is around 0.8, which is considered to be sufficiently well predicted.

Weber (2018) for the U.S. market, although the values are not the same.[7]

Table 1 presents the descriptive statistics for duration and financial variables. The statistics presented in this table span 1990-2022, in line with subsequent analyses. Panel A shows the means and standard deviations of the variables and the numbers of observations of firm × fiscal year, with a maximum number of firms of 2409. Panel B shows the correlations across variables. Duration has a strong negative correlation with the book-to-market ratio, a negative correlation with ROE, and a weak positive correlation with sales growth. Similar correlations between duration and firm characteristics are reported in Weber (2018) for the U.S. market. Note that the implied equity duration depends on the ratio of the present value of the expected cash flows in the near future to the current market capitalization, which may have similar information to the ratio of fundamentals to market capitalization, such as the book-to-market ratio.

[Insert Table 1 here]

4 Duration Quintile Portfolios in the Japanese Market

4.1 Returns on duration quintile portfolios

We conduct the analysis using portfolio returns sorted by equity duration to clarify the differences in the variation of returns across different values of equity duration. For each year in the sample, we obtain the duration's 20th, 40th, 60th, and 80th percentiles and create the quintile portfolios. Portfolios are rebalanced at the end of August each year and the daily and monthly value-weighted portfolio returns are obtained.[8]

Panel A of Table 2 presents the average duration, book-to-market ratio, and market capitalization of the duration quintile portfolios. The duration of the shortest-duration quintile portfolio averages 18.6 years, while the longest-duration portfolio averages 26.32 years. The book-to-market ratio is smaller for longer durations, and the difference between the shortest- and longest-duration portfolios is significant. Market capitalization tends to be larger for longer durations, and the difference between the portfolios with the longest and shortest durations is also significant. Thus, the short-duration portfolio tends to contain small and value stocks, and the long-duration portfolio tends to contain large and growth stocks.[9] The top panel of Panel B in Table 2 lists the means and standard deviations of the monthly value-weighted returns for the duration quintile portfolios. The Long-Short column presents the long-short portfolio, which is the difference between the longest-duration portfolio return and the shortest-duration portfolio

[7]For example, in Weber (2018), the autoregressive coefficient of ROE is assumed to be 0.41, with a long-run mean of 0.12, while the autoregressive coefficient of book equity growth is 0.24, with a long-run mean of 0.06.

[8]When conducting portfolio-based analysis for the Japanese market, portfolios are often constructed at the end of August, considering the fiscal year-end of companies (e.g., Kubota and Takehara (2018)).

[9]This suggests that the difference in return behavior with duration may be owing to firm size and book-to-market ratio. However, in Section 6, we show that the results of the subsequent analysis are robust even when controlling for size and book-to-market ratio.

return. The average returns are significantly higher for the short-duration portfolio than those for the long-duration portfolio. The bottom panel of Panel B lists the CAPM estimates for each duration portfolio and the long-short portfolio. The estimation results indicate that CAPM alpha is higher for short duration than for long duration, and beta is higher for long duration than for short duration. The long-short differences are significant in both cases. These results are similar to what Weber (2018) has shown for U.S. market data.

[Insert Table 2 here]

4.2 Findings of previous studies

In this subsection, we examine whether the portfolio return behavior presented in Dechow et al. (2021) and the countercyclicality discussed in Gormsen (2021) can be observed using Japanese duration quintile portfolio returns before moving on to the main analysis of this study.

First, Figure 1 depicts the cumulative daily returns of the duration quintile portfolios with a value of 1 on January 6, 2020, around the beginning of the COVID-19 pandemic. The shortest-duration portfolio indicated by the blue dotted line experienced the largest price decline, and the longest-duration portfolio indicated by the blue solid line experienced the smallest price decline during the large decline in the stock market from February to March 2020. Furthermore, the longest-duration portfolio recovered to its pre-decline level within about three months, whereas the shortest-duration portfolio took more than one and a half years to recover. The observed difference in the degree of decline at the beginning of the pandemic across equity durations is similar to the result of Dechow et al. (2021) with U.S. data. The faster recovery of stock prices in the long-duration portfolio is also consistent with Gormsen and Koijen (2020). They find that the distant future dividend strip prices recovered relatively faster using data on dividend futures.

[Insert Figure 1 here]

Subsequently, we show whether similar findings are obtained in the Japanese market by using the predictive regression that Gormsen (2021) uses to demonstrate the countercyclicality of the term structure of stock returns. The estimated equations are:

$$R^e_{i,t,t+12} = a_i + b_{1,i} R^e_{m,t,t+12} + b_{2,i}(d_t - p_t) + \epsilon_{i,t,t+12}, \tag{4}$$

$$R^e_{i,t,t+12} = a_i + b_{1.i}(d_t - p_t) + \epsilon_{i,t,t+12}, \tag{5}$$

where $R^e_{i,t,t+12}$ denotes the one-year ahead return on duration-sorted portfolio i in excess of the risk-free rate, $d_t - p_t$ denotes a log of the monthly market's dividend yield, and $R^e_{m,t,t+12}$ denotes the one-year ahead excess market return. Both formulas indicate whether or not the dividend yield in the current period predicts the return one year ahead. As the market dividend yield takes large values at bad times, the equity term structure is considered to be countercyclical if the coefficient of $d_t - p_t$ for the long-short duration portfolio is positive. We use the weighted average yield of the first section of the Tokyo Stock Exchange as the market's dividend yield.[10] As these data are available from January 1998 at most, the estimation is for the sample period from 1998 onward. The $d - p$ column in Table 3 summarizes the statistics for the log of the market's dividend yield.

[Insert Table 3 here]

Table 4 presents the results of the predictive regressions. Panel A lists the estimates from equation (4), and Panel B lists the estimates from equation (5). In both estimations, the longer the duration, the larger the $d_t - p_t$ loadings. The coefficient estimates of $d_t - p_t$ for the long-short portfolio are positive and significant at the 10% and 5% significance level for Panels A and B, respectively. Therefore, the countercyclicality shown by Gormsen (2021) is also observed for the Japanese market.

[Insert Table 4 here]

We demonstrate the relationship between the long-short duration portfolio returns and the recession. Figure 2 plots the 12-month moving average of the long-short return on duration-sorted portfolios and the market return. The shadowed area represents the recession period, as stated by the Cabinet Office. Although the discussion up to this point would lead us to expect that the long-short portfolio return presented by the black solid line would be positive during economic downturns, it is not always positive during recessions. The correlation coefficient between the market return and the long-short portfolio return is 0.29. The argument that the term structure of stock returns is countercyclical does not simply mean that it is inversely correlated with a measure of economic fluctuations. Hence, we conduct further investigations to examine the relationship between countercyclicality and economic conditions.

[Insert Figure 2 here]

5 Empirical Results

In this section, we examine the relationship between the returns on duration-sorted portfolios and market uncertainty or the business cycle through regression analysis. Gormsen and Lazarus (2023) make CAPM alphas the subject of their analysis when discussing the cross-section of equity returns. They discuss whether returns are higher relative to conventional risk measures such as market betas. Similarly, we analyze the CAPM alpha, or risk-adjusted return on each portfolio and identify the factors that cause the countercyclical property of the term structure of stock returns by clarifying the variables that explain the risk-adjusted returns.

[10] This data is available on the website of the Japan Exchange Group https://www.jpx.co.jp/english/markets/statistics-equities/misc/03.html.

5.1 Time variation of CAPM alpha

We run the rolling regression of the CAPM on the daily returns of the shortest- and longest-duration quintile portfolios to examine the behavior of the market-adjusted returns. The estimation window, set at 60 days, involves shifting it daily by one day to generate a time series of CAPM alphas after April 3, 1990. Figure 3 shows the estimates and confidence intervals of CAPM alphas. The upper and lower panels show alphas of the shortest- and longest-duration portfolios, respectively. For either figure, the solid line is the estimate of CAPM alpha, the red dashed line is the 95% confidence interval, the blue-colored areas show the period when the CAPM alpha is significantly negative, and the orange-colored areas show the period when the CAPM alpha is significantly positive. The Japanese banking crisis around 1997-1999 and the global financial crisis in 2008 are shown in the figures, in addition to the COVID-19 pandemic in 2020 as events that would have had a significant impact on the market during the sample period.[11]

The shortest-duration portfolio tends to have positive CAPM alphas over the entire sample period, whereas significantly negative alphas are observed during the two financial crises and the pandemic that are mentioned above. Conversely, for the longest-duration portfolio, positive CAPM alphas are observed at a time close to when the short-duration portfolio's CAPM alphas are negative.[12] Thus, the risk-adjusted return on the short-duration portfolio is higher in normal times, whereas the risk-adjusted return on the long-duration portfolio is relatively high during the crisis.

[Insert Figure 3 here]

5.2 Market Uncertainty

As discussed in Section 4, the countercyclicality of equity term structure may not be caused by a negative correlation with the business cycle. As illustrated in Figure 3, the risk-adjusted return of the short-duration portfolio tends to decline when a negative shock occurs, while the risk-adjusted return of the long-duration portfolio tends to be zero or positive during the same period. That is, the risk-adjusted return on the long-short portfolio tends to be larger under negative shocks, although it is negative on average. Considering that the periods when the significant risk-adjusted returns observed for portfolio returns in Figure 3 roughly correspond to the periods of large negative shocks such as the financial crisis and the COVID-19 pandemic, the countercyclical nature of the slope of the term structure may reflect the difference in stock prices' response to considerably large negative shocks. To confirm this conjecture, we next examine the variables that explain the risk-adjusted returns on the duration-sorted portfolios.

[11] In Japan, Yamaichi Securities, one of the country's four major securities firms, and Hokkaido Takushoku Bank, the largest commercial bank in the northern part of Japan, went bankrupt in November 1997. Thereafter, several financial institutions failed, and the overall economic downturn continued. The global financial crisis of 2008 also had a major impact on the Japanese economy, resulting in a rapid economic slowdown.

[12] As there exist periods, such as 2019, when the CAPM alpha of the short-duration portfolio is significantly negative and the CAPM alpha of the long-duration portfolio is significantly positive, it is possible that there are events other than the crises focused on in this paper that cause similar phenomena.

First, to clarify the relationship between the state of the market and CAPM alpha, we add intercept dummy variables representing the state of the market to the CAPM. We use the following formulas:

$$R^e_{i,t} = \alpha_{0,i} + \alpha_{1,i} D_{Hret,t} + \alpha_{2,i} D_{Lret,t} + \beta_i R^e_{m,t} + \epsilon_{i,t}, \tag{6}$$

$$R^e_{i,t} = \alpha_{0,i} + \alpha_{1,i} D_{Hsd,t} + \beta_i R^e_{m,t} + \epsilon_{i,t}, \tag{7}$$

where $R^e_{i,t}$ denotes the monthly return on duration-sorted portfolio i in excess of the risk-free rate at time t, $R^e_{m,t}$ denotes the monthly excess market return at time t, $D_{Hret,t}$ is an indicator that takes 1 if the previous month's market return is in the top 10% of monthly returns during the sample period and 0 otherwise, $D_{Lret,t}$ is an indicator that takes 1 if the previous month's market return is in the bottom 10% of monthly returns during the sample period and 0 otherwise, and $D_{Hsd,t}$ is an indicator that takes 1 if the standard deviation of the previous month's market daily return is in the top 25% of the sample period and 0 otherwise.[13] If the ranking of risk-adjusted returns across portfolios reverses in the presence of relatively large negative shocks, then the sign of the coefficient of the indicator that corresponds to a negative shock should be positive for the long-short portfolio.

Panel A of Table 5 presents the results of equation (6). CAPM alpha is higher for short-duration portfolios than for long-duration portfolios, and CAPM beta is higher for long-duration portfolios than for short-duration portfolios. They are similar to the CAPM estimation results in Table 2. The coefficient of the indicator for high market return in the previous month is not significant for all five portfolios and the long-short portfolio. The coefficients of the indicator for low market return in the previous month tends to be larger for longer durations, although not monotonically, and is significantly positive for the long-short portfolio. This result indicates that the responses of the risk-adjusted returns of duration-sorted portfolios are asymmetric between times of extremely high and low market returns. Panel B presents the results of equation (7). CAPM alpha and beta have a similar tendency as Panel A. Focusing on the dummy variable that indicates a higher standard deviation of the previous month's return, the coefficient is monotonically larger for the long duration, and the coefficient is significantly positive for the long-short portfolio. The results of Panels A and B indicate that the risk-adjusted return of the long-short duration portfolio is positive when the market return is extremely low or when the market return is highly volatile.

[Insert Table 5 here]

We explain the risk-adjusted returns on the duration-sorted portfolios using variables that capture market uncertainty. Baker et al. (2016) quantify uncertainty about economic policy by picking the

[13] When we use a threshold model to identify the conditions under which the risk-adjusted returns of each portfolio would change, the thresholds vary considerably across portfolios. We use intercept dummy variables for clarity in Table 5. Note that the values of market return and standard deviation used to define the dummy variables are close to the threshold values obtained for some portfolios in the threshold model.

number of terms about policy in major newspaper articles. They index them and describe their Economic Policy Uncertainty Index as asymmetric in the sense that it spikes for large negative shocks and responds less to small shocks. Based on the results in Figure 3 and Table 5, we expect that an uncertainty measure that spikes in response to large negative shocks may explain the risk-adjusted returns on duration-sorted portfolios.

The variables included in the analysis are the one-month standard deviation of daily market returns (SD) and the monthly average of the Volatility Index Japan (VXJ) in addition to the Japan Economic Policy Uncertainty Index (EPU). EPU for Japan is created by Arbatli-Saxegaard et al. (2022) based on Baker et al. (2016).[14] Although EPU measures economic policy uncertainty, Smales (2020) and Arbatli-Saxegaard et al. (2022) find a strong relationship between financial market uncertainty and EPU in the Japanese market. Simultaneously, Cascaldi-Garcia et al. (2023) state that news-based indices of uncertainty such as EPU capture uncertainty in a broader sense than market-based uncertainty measures such as the volatility index. VXJ is a volatility index for the Japanese market based on daily Nikkei 225 option prices.[15] Note that all measures used here take higher values when market uncertainty increases. Descriptive statistics for the measures of uncertainty are presented in Table 3. Owing to data availability, the sample period for VXJ is from January 1998 onward.

To clarify whether these uncertainty measures explain risk-adjusted returns on duration-sorted portfolios, we use the following formula:

$$R^e_{i,t} = \alpha_i + \beta_{1,i} R^e_{m,t} + \beta_{2,i} X + \epsilon_{i,t}, \tag{8}$$

where $R^e_{i,t}$ denotes the monthly return on duration-sorted portfolio i in excess of the risk-free rate at time t, $R^e_{m,t}$ denotes the monthly excess market return at time t, and X denotes the measures of uncertainty at time t or time $t-1$. Table 6 presents the estimation results: Panel A summarizes the results when the contemporaneous uncertainty measure is used as the explanatory variable; Panel B summarizes the results when the one-period lag of the uncertainty measure is used as the explanatory variable. β_1 denotes the CAPM beta, and β_2 denotes the coefficient of the uncertainty measure of interest. Regardless of the timing of the uncertainty measure, the value of CAPM beta is higher for the long-duration portfolio than for the short-duration portfolio in all cases, a similar pattern to the CAPM estimation results in Table 2. Conversely, the coefficient of the uncertainty measure added to the CAPM is higher for long duration than for short duration and the coefficient estimate for the long-short portfolio is significantly positive in SD (both contemporaneous and lagged) and EPU (contemporaneous); that is, the risk-adjusted returns of the duration-sorted portfolios are affected significantly by the standard deviation of the market returns

[14] The Japan Economic Policy Uncertainty Index is available on the website of Economic Policy Uncertainty https://www.policyuncertainty.com.

[15] VXJ is available on the website of the Center for Mathematical Modeling and Data Science, Osaka University https://www-mmds.sigmath.es.osaka-u.ac.jp/structure/activity/vxj.php (in Japanese).

or EPU. For VXJ, the estimated coefficients for the long-short portfolio are positive but not significant, which might be partly because of the shorter sample period than for SD and EPU estimation.[16]

[Insert Table 6 here]

To validate that the results of the analysis thus far depend on the period of severe recession or times of crisis, we estimate a threshold model that allows the coefficients of the uncertainty measures to vary with the degree of market uncertainty for equation (8). We use the EPU, which captures a broader concept of uncertainty, as an indicator of the degree of market uncertainty. We assume that the regime differs depending on the value of EPU. Table 7 presents the estimation results of the threshold model for the long-short duration portfolio. We use SD (contemporaneous and lagged) and contemporaneous EPU as explanatory variables because the β_2 estimates of these variables for the long-short portfolio are significant in Table 6.

Panels A and B in Table 7 present the results of adding the SD (contemporaneous or lagged) to the CAPM as an explanatory variable. Regime 1 corresponds to good times, and Regime 2 corresponds to bad times. The evidence indicates that the coefficients of SD are not significant in good times. In contrast, the coefficients of SD are positive and significant for bad times, suggesting that the results presented in Table 6 reflect the impact of crises with particularly high EPU. Panel C summarizes the results when contemporaneous EPU is used as an explanatory variable. Considering that the coefficient on EPU is significantly positive regardless of the value of EPU, EPU has explanatory power for the duration premium.

[Insert Table 7 here]

The results thus far indicate that the countercyclicality of the equity term structure may arise from the differences in response to large negative shocks that increase market uncertainty.[17] In addition, the short-duration portfolio is risky; that is, it performs poorly during bad times, while the long-duration portfolio may work as a risk-hedging device against negative shocks. While this paper does not discuss investors' preferences or risks reflected in stock prices, and therefore we cannot make a rigorous argument, these points may be consistent with the fact that the short-duration portfolio earns a higher premium from the perspective of asset pricing theory.

[16] As the Japanese market is known to be affected by changes in U.S. economic policy (e.g., Hausman and Wongswan (2011)), we also used the EPU for the U.S. and the ambiguity measure from Brenner and Izhakian (2018). However, the U.S. measures did not provide the expected results. We thank Yehuda Izhakian for sharing the data.

[17] Our results are based on risk-adjusted returns using the CAPM as a benchmark. Although the Fama-French 3-factor model or the 5-factor model could be used as a benchmark, the difference in Fama-French 3-factor model alpha between long- and short-duration portfolios is insignificant for the Japanese market because the HML factor is strongly related to the duration premium. However, the analysis presented in Section 6 is sufficiently robust to book-to-market ratio or firm size, and the correspondence with previous studies by Dechow et al. (2021) and Gormsen and Lazarus (2023) makes it reasonable to use CAPM as a benchmark in this study.

6 Robustness Test

As mentioned in Section 3, the measure of duration used in this study has a high negative correlation with the book-to-market ratio of the firms. Therefore, the results thus far may reflect the effect of differences in firm characteristics such as book-to-market ratio or firm size on stock returns. In this section, we demonstrate that the results remain unchanged even after controlling for size and book-to-market ratio.

First, Table 8 presents the results of the analysis controlling for firm size. All firms in the sample are categorized as either large-cap or small-cap based on the median market capitalization of stocks listed on the first section of the Tokyo Stock Exchange. For each of the large-cap and small-cap stocks, we take the 30th and 70th percentile points of duration and create three portfolios, making six portfolios.[18] Panel A of Table 8 presents the monthly portfolio return statistics. The mean of short-duration portfolio return exceeds the mean of long-duration portfolio return, although the statistical significance is slightly weak for both large and small stocks. Panel B presents the results of the CAPM estimation based on equation (8) without uncertainty measures X and the estimation results for several variables from the analyses in Tables 5 and 6 based on equation (8). For both large and small stocks, CAPM alpha is larger for short duration than for long duration, and CAPM beta is larger for the long duration portfolio. In the regression where the uncertainty measures are included, the coefficient estimates of the uncertainty indicator for the long-short portfolio are positive in all cases and significant in several cases.

[Insert Table 8 here]

We analyze the case where we control for the book-to-market ratio in the same manner. First, we use the median book-to-market ratio of stocks listed on the first section of the Tokyo Stock Exchange to sort the firms into value and growth portfolios. We then classify each of them into three duration portfolios. Panel A of Table 9 presents the monthly return statistics for the six portfolios, and Panel B presents the CAPM estimates and the estimation results with variables indicating market uncertainty. Although less statistically significant, the average return and CAPM alpha are higher for the short duration and CAPM beta is higher for the long duration. The coefficients of market uncertainty measures for the long-short portfolio are generally positive and significant.

[Insert Table 9 here]

The above analysis confirms similar patterns as in Tables 2, 5, and 6, even when controlling for size and book-to-market ratio, although the results are weak in some cases. The result suggests that the risk-adjusted return of a long-short duration portfolio, which is negative on average, increases when the

[18] The analysis in this section uses three portfolios sorted by the 30th and 70th percentiles, whereas up to Section 5, we use quintile portfolios. Some of the weak results in this section regarding the difference between short and long duration may be owing to the rough sorting of the duration portfolios. However, to ensure a sufficient number of firms per portfolio, we sorted the portfolios into three, instead of quintile, portfolios.

variable indicating market uncertainty increases. This evidence remains robust even after controlling for firm characteristics.

7 Conclusion

We used the implied equity duration presented by Dechow et al. (2004) for the Japanese market and observed a consistent finding with previous studies on the term structure of stock returns: the term structure of equity returns is downward sloping on average and the slope is countercyclical. The increase in returns on the long-short duration portfolio observed in the late 1990s, the late 2000s, and 2020 may correspond to the two financial crises in Japan and the COVID-19 pandemic. Furthermore, long- and short-duration portfolio returns tend to increase and decrease, respectively, when market returns are extremely low or when the standard deviation of market returns is high. Economic uncertainty such as the standard deviation of market returns, or EPU, may have explanatory power for the long-short duration portfolio returns. The countercyclicality of stock return term structure may stem from different responses to significantly large negative shocks, heightening market uncertainty.

We finally mention some topics that should be investigated in future studies. As discussed in Section 5, we indicated that portfolios with shorter durations underperform during serious economic downturns, which could be a possible explanation for the duration premium. To understand these empirical results, a more formal discussion is needed. We have to develop a theoretical model compatible with the empirical findings of this study to better understand the duration premium and the cross-section of stock returns. Second, the empirical model in this paper is related to the EPU, which has high explanatory power for the long-short portfolio return. We have to consider what the EPU means.

References

Arbatli-Saxegaard, Elif C., Steven J. Davis, Arata Ito, and Naoko Miake (2022) "Policy uncertainty in Japan," *Journal of the Japanese and International Economies*, 64, 101192.

Bae, Jaewan and Changjun Lee (2021) "Illiquidity, duration and momentum profits: evidence from the Korean stock market," *Journal of Derivatives and Quantitative Studies*, 29 (1), 49–72.

Baker, Scott R., Nicholas Bloom, and Steven J. Davis (2016) "Measuring economic policy uncertainty," *The Quarterly Journal of Economics*, 131 (4), 1593–1636.

Bansal, Ravi, Shane Miller, Dongho Song, and Amir Yaron (2021) "The term structure of equity risk premia," *Journal of Financial Economics*, 142 (3), 1209–1228.

Brenner, Menachem and Yehuda Izhakian (2018) "Asset pricing and ambiguity: Empirical evidence," *Journal of Financial Economics*, 130 (3), 503–531.

Cascaldi-Garcia, Danilo, Cisil Sarisoy, Juan M. Londono, Bo Sun, Deepa D. Datta, Thiago Ferreira, Olesya Grishchenko, Mohammad R. Jahan-Parvar, Francesca Loria, Sai Ma, Marius Rodriguez, Ilknur Zer, and John Rogers (2023) "What is certain about uncertainty?" *Journal of Economic Literature*, 61 (2), 624–654.

Chen, Zhanhui (2022) "Inferring stock duration around FOMC surprises: Estimates and implications," *Journal of Financial and Quantitative Analysis*, 57 (2), 669–703.

Da, Zhi (2009) "Cash flow, consumption risk, and the cross-section of stock returns," *The Journal of Finance*, 64 (2), 923–956.

Dechow, Patricia M., Ryan D. Erhard, Richard G. Sloan, and Mark T. Soliman (2021) "Implied equity duration: A measure of pandemic shutdown risk," *Journal of Accounting Research*, 59 (1), 243–281.

Dechow, Patricia M., Richard G. Sloan, and Mark T. Soliman (2004) "Implied equity duration: A new measure of equity risk," *Review of Accounting Studies*, 9 (2-3), 197–228.

Fukuta, Yuichi and Akiko Yamane (2015) "Value premium and implied equity duration in the Japanese stock market," *Journal of International Financial Markets, Institutions and Money*, 39, 102–121.

Fullana, Olga and David Toscano (2014) "The implied equity duration for the Spanish listed firms," *The Spanish Review of Financial Economics*, 12 (1), 33–39.

Gonçalves, Andrei S. (2021) "The short duration premium," *Journal of Financial Economics*, 141 (3), 919–945.

Gormsen, Niels Joachim (2021) "Time variation of the equity term structure," *The Journal of Finance*, 76 (4), 1959–1999.

Gormsen, Niels Joachim and Ralph S. J. Koijen (2020) "Coronavirus: Impact on stock prices and growth expectations," *The Review of Asset Pricing Studies*, 10 (4), 574–597.

Gormsen, Niels Joachim and Eben Lazarus (2023) "Duration-driven returns," *The Journal of Finance*, 78 (3), 1393–1447.

Hausman, Joshua and Jon Wongswan (2011) "Global asset prices and FOMC announcements," *Journal of International Money and Finance*, 30 (3), 547–571.

Kubota, Keiichi and Hitoshi Takehara (2018) "Does the Fama and French five-factor model work well in Japan?" *International Review of Finance*, 18 (1), 137–146.

Lettau, Martin and Jessica A. Wachter (2007) "Why is long-horizon equity less risky? A duration-based explanation of the value premium," *The Journal of Finance*, 62 (1), 55–92.

Newey, Whitney K. and Kenneth D. West (1987) "A simple, positive semi-definite, heteroskedasticity and autocorrelation consistent covariance matrix," *Econometrica*, 55 (3), 703–708.

Schröder, David and Florian Esterer (2016) "A new measure of equity and cash flow duration: The duration-based explanation of the value premium revisited," *Journal of Money, Credit and Banking*, 48 (5), 857–900.

Smales, Lee A. (2020) "Examining the relationship between policy uncertainty and market uncertainty across the G7," *International Review of Financial Analysis*, 71, 101540.

van Binsbergen, Jules H., Michael W. Brandt, and Ralph S.J. Koijen (2012) "On the timing and pricing of dividends," *The American Economic Review*, 102 (4), 1596–1618.

van Binsbergen, Jules H., Wouter Hueskes, Ralph S.J. Koijen, and Evert B. Vrugt (2013) "Equity yields," *Journal of Financial Economics*, 110 (3), 503–519.

van Binsbergen, Jules H. and Ralph S.J. Koijen (2017) "The term structure of returns: Facts and theory," *Journal of Financial Economics*, 124 (1), 1–21.

Weber, Michael (2018) "Cash flow duration and the term structure of equity returns," *Journal of Financial Economics*, 128 (3), 486–503.

Table 1: Summary Statistics for Equity Duration and Financial Variables

Panel A: Means and standard deviations

	Duration	*BE*	*ME*	*BE/ME*	*ROE*	*salesgr*
Mean	22.806	112954.9	176291.9	1.064	0.058	0.036
Std	3.311	475638.9	723991.7	0.774	0.119	0.138
Obs	59534	59534	59534	59534	59534	59534

Panel B: Correlations

	Duration	*BE*	*ME*	*BE/ME*	*ROE*	*salesgr*
Duration		0.020	0.095	-0.741	-0.233	0.190
BE			0.865	-0.047	0.034	0.000
ME				-0.133	0.075	0.035
BE/ME					-0.243	-0.240
ROE						0.366

Notes. This table presents the descriptive statistics for firm characteristics and financial variables used for forecasting firms' cash flows. *BE* is book equity, *ME* is market equity, *BE/ME* is the book-to-market ratio, *ROE* is return on equity, and *salesgr* is sales growth. *BE* and *ME* are in million yen. Panel A shows means, standard deviations (Std), and numbers of observations of the variables (Obs). Panel B shows their correlation coefficients. The sample period is from 1990 to 2022.

Table 2: Duration Quintile Portfolios

Panel A: Characteristics of duration quintile portfolios

	Short Dur	2	3	4	Long Dur	Long-Short
Duration	18.60	21.70	23.11	24.31	26.32	7.72
						(204.2)
BE/ME	1.94	1.26	0.93	0.67	0.53	-1.41
						(-142.4)
ME(million yen)	49698	99562	192151	281607	258676	208978
						(25.7)

Panel B: Monthly returns and CAPM coefficients

	Short Dur	2	3	4	Long Dur	Long-Short
Monthly return						
Mean	0.672	0.578	0.359	0.311	0.066	-0.606
Std	5.828	5.351	5.436	5.388	6.102	(-2.73)
CAPM						
α	0.474	0.381	0.160	0.110	-0.141	-0.615
	(2.54)	(2.72)	(1.28)	(1.35)	(-1.24)	(-2.38)
β	0.912	0.896	0.936	0.956	1.067	0.155
	(23.5)	(27.0)	(25.9)	(26.1)	(32.4)	(2.49)

Notes. This table presents the summary statistics for duration quintile portfolios. Panel A shows means of the duration, book-to-market ratio and market equity of each portfolio. The Long-Short column shows the difference between the portfolios with longest and shortest duration. Values in parentheses indicate t-values. Notes on Table 1 are also referred. Panel B shows the monthly value-weighted returns and CAPM coefficients for duration quintile portfolios. The top panel shows the means and standard deviations (Std) of monthly returns on each portfolio (in %). The bottom panel shows the estimates of CAPM alpha and beta for each portfolio. The Long-Short column shows the result for the longest-duration portfolio return minus the shortest-duration portfolio return. Values in parentheses indicate t-values that are based on Newey and West (1987) standard errors corrected for 12 lags. The sample period is from February 1990 to June 2022.

Table 3: Summary Statistics for Uncertainty and Cyclicality Variables

Panel A: Means and standard deviations

	SD	EPU	VXJ	$d-p$
Mean	1.180	105.8	24.68	0.384
Std	0.563	33.34	8.365	0.415
Obs	389	389	294	294
Sample period	1990:02-2022:06	1990:02-2022:06	1998:01-2022:06	1998:01-2022:06

Panel B: Correlation

	SD	EPU	VXJ	$d-p$
SD		0.403	0.796	0.025
EPU			0.508	0.350
VXJ				0.102

Notes. This table provides the summary statistics for uncertainty and cyclicality variables. Panel A shows the means and standard deviations, and panel B shows the correlation coefficients. SD is the monthly standard deviation of daily market return, EPU is the Japan Economic Policy Uncertainty Index, VXJ is the Volatility Index Japan, and $d-p$ is the log of the market dividend-to-price ratio. Correlation coefficients with VXJ and $d-p$ are calculated on the sample from January 1998 to June 2022. Other correlation coefficients are calculated on the sample from February 1990 to June 2022.

Table 4: Predictive Regressions

Panel A: Controlling for the market and $d-p$

	Short Dur	2	3	4	Long Dur	Long-Short
$R^e_{m,t,t+12}$	0.895	0.760	0.811	0.907	1.095	0.199
	(7.97)	(6.08)	(8.36)	(12.2)	(11.6)	(1.09)
$d_t - p_t$	-14.13	-6.987	-5.980	-0.829	3.520	17.65
	(-2.14)	(-1.27)	(-1.42)	(-0.30)	(0.86)	(1.81)
$\bar{R}^2$	0.66	0.70	0.79	0.92	0.89	0.19

Panel B: Controlling for $d-p$

	Short Dur	2	3	4	Long Dur	Long-Short
$d_t - p_t$	-1.765	3.515	5.225	11.70	18.64	20.40
	(-0.20)	(0.53)	(0.80)	(1.50)	(1.96)	(2.44)
R^2	0.00	0.01	0.01	0.05	0.09	0.15

Notes. This table reports the results of the predictive regressions. Panel A shows the results of the estimation of equation (4), and Panel B shows the results of the estimation of equation (5). The Long-Short column shows the results for the longest-duration portfolio return minus the shortest-duration portfolio return. Values in parentheses indicate t-values and $\bar{R}^2$ denotes the adjusted R^2. The t-values are based on Newey and West (1987) standard errors corrected for 18 lags. The sample period is from January 1998 to June 2022.

Table 5: Regression with Dummy Variables

Panel A: Dummy variables for market returns

	Short Dur	2	3	4	Long Dur	Long-Short
α_0	0.485	0.336	0.246	0.102	-0.263	-0.749
	(2.31)	(2.03)	(1.75)	(1.09)	(-2.15)	(-2.61)
D_{Hret}	0.653	0.200	-0.353	-0.400	0.463	-0.190
	(1.16)	(0.69)	(-1.21)	(-1.31)	(1.11)	(-0.26)
D_{Lret}	-0.763	0.252	-0.506	0.477	0.759	1.521
	(-1.23)	(0.60)	(-1.61)	(1.03)	(2.45)	(2.33)
β	0.906	0.895	0.937	0.959	1.067	0.161
	(24.1)	(27.2)	(25.7)	(25.6)	(31.4)	(2.61)
$\bar{R}^2$	0.71	0.81	0.86	0.91	0.88	0.04

Panel B: Dummy variable for standard deviations of market returns

	Short Dur	2	3	4	Long Dur	Long-Short
α_0	0.603	0.399	0.155	0.090	-0.229	-0.832
	(2.91)	(2.50)	(1.17)	(0.90)	(-1.78)	(-3.06)
D_{Hsd}	-0.515	-0.072	0.017	0.079	0.348	0.862
	(-1.69)	(-0.28)	(0.07)	(0.38)	(1.37)	(2.01)
β	0.913	0.896	0.936	0.956	1.067	0.154
	(23.4)	(27.0)	(25.8)	(26.2)	(32.6)	(2.47)
$\bar{R}^2$	0.71	0.81	0.85	0.91	0.88	0.04

Notes. This table presents the results of the monthly CAPM with the addition of intercept dummy variables representing the state of the market. Panel A shows the result of equation (6), and Panel B shows the result of equation (7). The Long-Short column shows the results for the longest-duration portfolio return minus the shortest-duration portfolio return. Values in parentheses indicate t-values and $\bar{R}^2$ denotes the adjusted R^2. The t-values are based on Newey and West (1987) standard errors corrected for 12 lags. The sample period is from February 1990 to June 2022.

Table 6: Regression with Market Uncertainty Indicators

Panel A: Contemporaneous variables

X		Short Dur	2	3	4	Long Dur	Long-Short
SD_t	α	1.068	0.688	0.432	0.018	-0.758	-1.825
		(2.44)	(2.72)	(1.71)	(0.07)	(-3.01)	(-3.55)
	β_1	0.897	0.888	0.929	0.958	1.083	0.186
		(23.4)	(26.3)	(25.7)	(22.9)	(34.2)	(3.13)
	β_2	-0.503	-0.260	-0.230	0.078	0.522	1.025
		(-1.51)	(-1.40)	(-1.22)	(0.34)	(2.71)	(2.63)
	$\bar{R}^2$	0.71	0.81	0.86	0.91	0.88	0.05
EPU_t	α	1.506	0.639	0.449	-0.085	-1.419	-2.924
		(2.62)	(1.79)	(1.38)	(-0.32)	(-3.49)	(-3.62)
	β_1	0.904	0.894	0.934	0.957	1.077	0.173
		(24.7)	(27.5)	(25.7)	(25.6)	(34.5)	(3.02)
	β_2	-0.010	-0.002	-0.003	0.002	0.012	0.022
		(-1.77)	(-0.75)	(-0.91)	(0.84)	(3.09)	(2.68)
	$\bar{R}^2$	0.71	0.81	0.85	0.91	0.89	0.06
VXJ_t	α	0.908	0.426	0.375	0.473	-0.694	-1.602
		(1.45)	(1.22)	(0.80)	(2.10)	(-1.64)	(-1.78)
	β_1	0.941	0.856	0.894	0.911	1.051	0.110
		(19.2)	(17.7)	(20.5)	(38.4)	(28.3)	(1.47)
	β_2	-0.012	- 0.000	-0.005	-0.014	0.027	0.039
		(-0.56)	(-0.04)	(-0.25)	(-1.83)	(1.60)	(1.16)
	$\bar{R}^2$	0.68	0.73	0.80	0.91	0.85	0.01

Panel B: Lagged variables

X		Short Dur	2	3	4	Long Dur	Long-Short
SD_{t-1}	α	1.038	0.300	0.389	0.042	-0.514	-1.552
		(3.09)	(1.32)	(1.87)	(0.26)	(-2.42)	(-3.63)
	β_1	0.911	0.896	0.935	0.956	1.068	0.157
		(23.2)	(27.0)	(26.0)	(26.0)	(32.4)	(2.50)
	β_2	-0.478	0.069	-0.194	0.058	0.316	0.795
		(-1.98)	(0.39)	(-1.07)	(0.49)	(2.09)	(2.57)
	$\bar{R}^2$	0.71	0.81	0.86	0.91	0.88	0.04
EPU_{t-1}	α	1.041	0.311	0.364	0.049	-0.681	-1.722
		(1.71)	(0.85)	(1.12)	(0.23)	(-2.20)	(-2.30)
	β_1	0.912	0.896	0.936	0.956	1.067	0.155
		(23.6)	(27.0)	(25.8)	(26.1)	(32.7)	(2.50)
	β_2	-0.005	0.001	-0.002	0.001	0.005	0.010
		(-1.00)	(0.23)	(-0.72)	(0.38)	(1.78)	(1.50)
	$\bar{R}^2$	0.71	0.81	0.85	0.91	0.88	0.04
VXJ_{t-1}	α	0.844	0.025	0.026	0.184	-0.293	-1.137
		(1.35)	(0.07)	(0.07)	(0.77)	(-0.92)	(-1.38)
	β_1	0.935	0.855	0.894	0.921	1.039	0.105
		(20.5)	(17.6)	(20.3)	(43.0)	(29.0)	(1.46)
	β_2	-0.011	0.016	0.009	-0.002	0.011	0.022
		(-0.57)	(1.47)	(0.58)	(-0.27)	(0.95)	(0.82)
	$\bar{R}^2$	0.68	0.73	0.80	0.91	0.85	0.01

Notes. This table reports the results of the monthly regressions of equation (8). Panel A shows the results with the contemporaneous variable as X and Panel B shows the results with the lagged variable as X. The Long-Short column shows the results for the longest-duration portfolio return minus the shortest-duration portfolio return. Values in parentheses indicate t-values, and $\bar{R}^2$ denotes the adjusted R^2. The t-values are based on Newey and West (1987) standard errors corrected for 12 lags. The sample period for SD and EPU is from February 1990 to June 2022, and for VXJ is from January 1998 to June 2022.

Table 7: Regression with Market Uncertainty Indicators in Two Regimes

Panel A: SD_t as independent variable		
α	-1.262	
	(-2.46)	
β_1	0.179	
	(4.24)	
	Regime 1: $EPU \leq 111.72$	Regime 2: $EPU > 111.72$
β_2	0.165	1.120
	(0.31)	(2.82)

Panel B: SD_{t-1} as independent variable		
α	-1.178	
	(-2.61)	
β_1	0.158	
	(3.82)	
	Regime 1: $EPU \leq 111.72$	Regime 2: $EPU > 111.72$
β_2	0.182	0.934
	(0.40)	(2.55)

Panel C: EPU_t as independent variable		
α	-4.754	
	(-3.94)	
β_1	0.172	
	(4.16)	
	Regime 1: $EPU \leq 124.85$	Regime 2: $EPU > 124.85$
β_2	0.043	0.030
	(3.40)	(3.26)

Notes. This table provides the results of the threshold model for equation (8). The dependent variable is the long-short duration portfolio return. The coefficients of uncertainty measures (described as β_2 in equation (8)) are allowed to vary with the value of the EPU. Values in parentheses indicate t-values that are based on Newey and West (1987) standard errors corrected for 12 lags. The sample period is from February 1990 to June 2022.

Table 8: Controlling for the Size

Panel A: Monthly returns

	small stocks				large stocks			
	1	2	3	Long-Short	1	2	3	Long-Short
Mean	0.591	0.439	0.445	-0.146	0.483	0.336	0.130	-0.353
Std	6.006	5.879	6.751	(-1.10)	5.219	5.314	5.939	(-1.83)

Panel B: CAPM and market uncertainty indicators

	small stocks				large stocks			
	1	2	3	Long-Short	1	2	3	Long-Short
CAPM								
α	0.392	0.240	0.239	-0.153	0.288	0.136	-0.075	-0.363
	(1.88)	(1.47)	(1.21)	(-1.02)	(2.11)	(1.94)	(-0.68)	(-1.58)
β	0.929	0.937	1.052	0.123	0.872	0.954	1.042	0.169
	(24.0)	(21.0)	(22.2)	(3.83)	(23.8)	(35.9)	(29.6)	(2.66)
Regression with a dummy variable								
α	0.449	0.268	0.267	-0.182	0.317	0.154	-0.173	-0.490
	(2.01)	(1.48)	(1.25)	(-1.19)	(2.14)	(1.99)	(-1.36)	(-1.95)
β	0.922	0.933	1.049	0.126	0.869	0.952	1.054	0.185
	(23.7)	(21.1)	(23.3)	(3.95)	(25.8)	(32.0)	(29.3)	(3.06)
D_{Hsd}	-0.564	-0.277	-0.282	0.282	-0.293	-0.175	0.962	1.255
	(-0.89)	(-0.42)	(-0.39)	(0.63)	(-0.67)	(-0.45)	(2.69)	(2.09)
Regression with uncertainty indicators: SD_t								
α	1.034	0.552	0.500	-0.534	0.652	0.171	-0.650	-1.302
	(1.84)	(1.05)	(0.94)	(-1.93)	(2.23)	(0.81)	(-2.49)	(-2.98)
β_1	0.913	0.929	1.046	0.133	0.863	0.953	1.056	0.193
	(24.0)	(22.1)	(22.4)	(3.90)	(25.7)	(31.6)	(28.9)	(3.22)
β_2	-0.543	-0.264	-0.221	0.322	-0.308	-0.029	0.486	0.795
	(-1.22)	(-0.61)	(-0.52)	(1.29)	(-1.28)	(-0.16)	(2.56)	(2.43)
Regression with uncertainty indicators: EPU_t								
α	0.543	-0.365	-0.672	-1.215	0.895	0.229	-0.963	-1.858
	(0.86)	(-0.74)	(-1.02)	(-2.53)	(2.46)	(0.95)	(-2.84)	(-3.11)
β_1	0.928	0.941	1.059	0.131	0.868	0.953	1.049	0.181
	(25.0)	(22.1)	(23.0)	(4.05)	(25.0)	(35.1)	(30.4)	(3.02)
β_2	-0.001	0.006	0.009	0.010	-0.006	-0.001	0.008	0.014
	(-0.26)	(1.25)	(1.51)	(2.18)	(-1.73)	(-0.40)	(2.76)	(2.61)

Notes. This table presents the results when controlling for firm size. Panel A shows means and standard deviations of size $\times$ duration portfolios. The Long-Short column shows the difference between the longest duration portfolio (labeled as 3) and the shortest duration portfolio (labeled as 1). Panel B presents the results of CAPM and several analyses from those in Tables 5 and 6. D_{Hsd} is an intercept dummy variable that takes 1 when the standard deviation of the previous month's daily market return is in the top 10% of the sample period and 0 otherwise. Values in parentheses indicate t-values that are based on Newey and West (1987) standard errors corrected for 12 lags. The sample period is from February 1990 to June 2022.

Table 9: Controlling for the Book-to-Market Ratio

Panel A: Monthly returns

	growth stocks				value stocks			
	1	2	3	Long-Short	1	2	3	Long-Short
Mean	0.376	0.258	0.062	-0.314	0.661	0.532	0.524	-0.136
Std	5.378	5.450	6.187	(-1.57)	5.853	5.306	5.918	(-1.05)

Panel B: CAPM and market uncertainty indicators

	growth stocks				value stocks			
	1	2	3	Long-Short	1	2	3	Long-Short
CAPM								
α	0.178	0.056	-0.144	-0.322	0.463	0.336	0.321	-0.142
	(1.28)	(0.79)	(-1.03)	(-1.26)	(2.41)	(2.39)	(2.46)	(-1.12)
β	0.915	0.971	1.055	0.139	0.912	0.881	1.007	0.095
	(21.9)	(27.7)	(25.8)	(2.20)	(22.3)	(27.5)	(29.9)	(2.85)
Regression with a dummy variable								
α	0.245	0.034	-0.237	-0.481	0.527	0.308	0.291	-0.236
	(1.56)	(0.39)	(-1.57)	(-1.73)	(2.61)	(1.99)	(1.96)	(-1.85)
β	0.907	0.974	1.066	0.158	0.904	0.884	1.011	0.106
	(22.7)	(24.6)	(26.4)	(2.78)	(22.8)	(28.8)	(29.3)	(3.30)
D_{Hsd}	-0.663	0.222	0.918	1.582	-0.639	0.279	0.301	0.940
	(-1.33)	(0.43)	(2.49)	(2.17)	(-1.17)	(0.69)	(0.68)	(1.94)
Regression with uncertainty indicators: SD_t								
α	0.652	-0.239	-0.677	-1.329	1.151	0.432	0.373	-0.777
	(1.97)	(-0.81)	(-2.48)	(-2.60)	(2.76)	(1.56)	(1.40)	(-2.28)
β_1	0.903	0.978	1.068	0.165	0.895	0.879	1.006	0.111
	(22.5)	(24.3)	(26.8)	(2.91)	(22.2)	(27.6)	(28.2)	(3.47)
β_2	-0.401	0.250	0.451	0.852	-0.582	-0.081	-0.044	0.538
	(-1.47)	(1.01)	(2.22)	(2.12)	(-1.83)	(-0.37)	(-0.21)	(2.00)
Regression with uncertainty indicators: EPU_t								
α	0.326	-0.412	-1.308	-1.634	1.551	0.519	0.836	-0.715
	(0.86)	(-1.44)	(-3.19)	(-2.33)	(2.59)	(1.44)	(2.24)	(-1.71)
β_1	0.914	0.975	1.064	0.150	0.904	0.880	1.003	0.099
	(21.9)	(27.4)	(27.2)	(2.46)	(23.5)	(28.3)	(30.1)	(3.07)
β_2	-0.001	0.004	0.011	0.012	-0.010	-0.002	-0.005	0.005
	(-0.44)	(1.75)	(2.90)	(2.01)	(-1.77)	(-0.49)	(-1.33)	(1.44)

Notes. This table presents the results when controlling for the book-to-market ratio. Panel A shows means and standard deviations of book-to-market ratio × duration portfolios. The Long-Short column shows the difference between the longest duration portfolio (labeled as 3) and the shortest duration portfolio (labeled as 1). Panel B presents the results of CAPM and several analyses from those in Tables 5 and 6. D_{Hsd} is an intercept dummy variable that takes 1 when the standard deviation of the previous month's daily market return is in the top 10% of the sample period and 0 otherwise. Values in parentheses indicate t-values that are based on Newey and West (1987) standard errors corrected for 12 lags. The sample period is from February 1990 to June 2022.

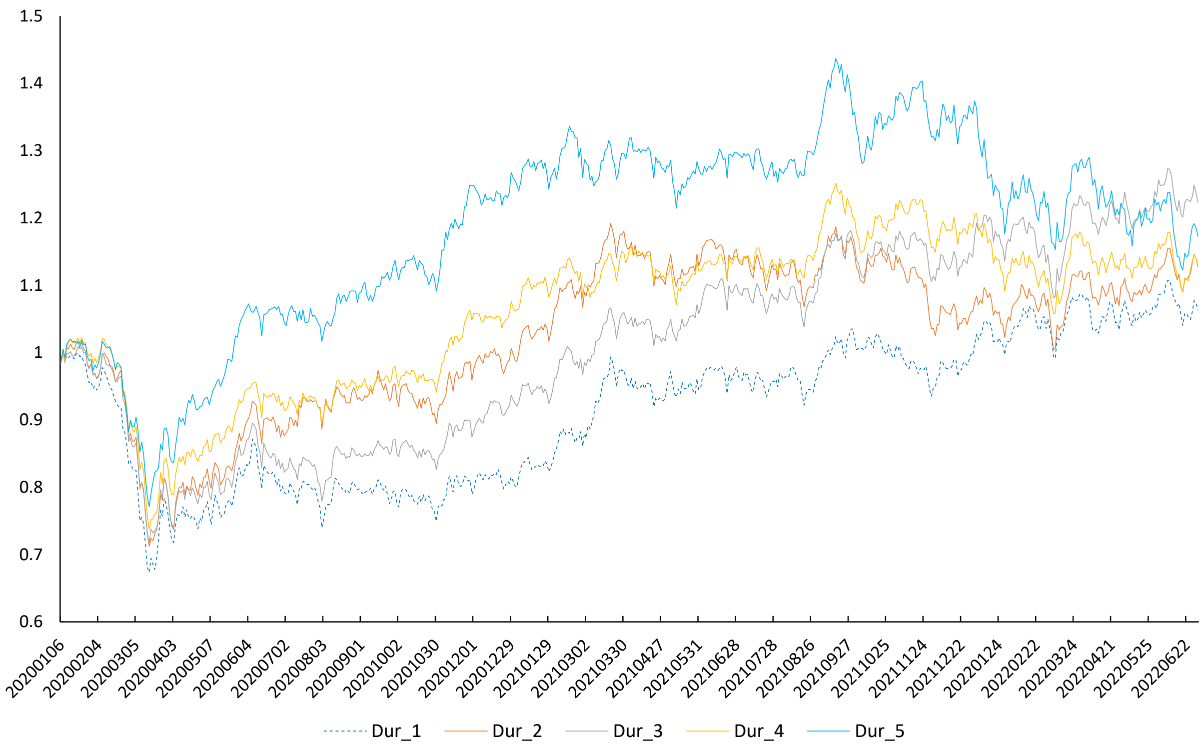

Figure 1: Cumulative Daily Returns on Duration Quintile Portfolios

Notes. This figure illustrates the cumulative daily returns on duration quintile portfolios with a value of 1 on January 6, 2020. Dur_1 indicates the shortest duration portfolio and Dur_5 is the longest duration portfolio.

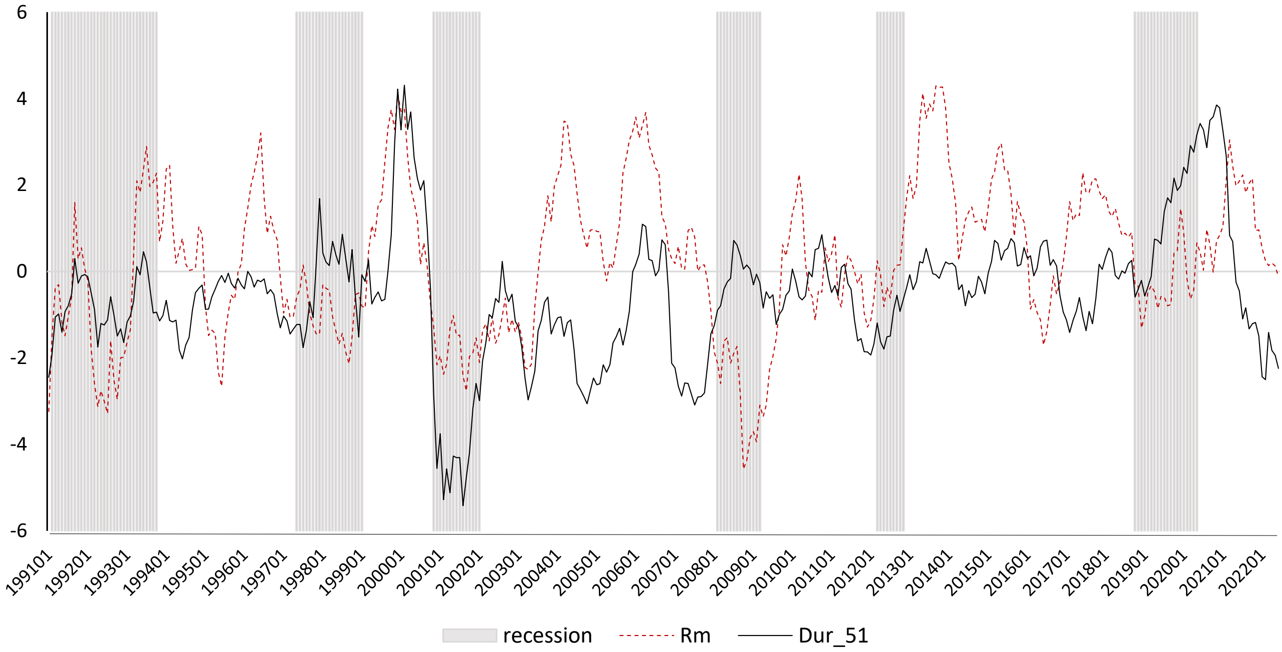

Figure 2: Moving Average Returns of the Duration Long-Short Portfolio and the Market

Notes. This figure depicts the 12-month moving average of the long-short duration portfolio return (Dur_51) and the market return (Rm). The shadowed area represents the recession period as stated by the Cabinet Office.

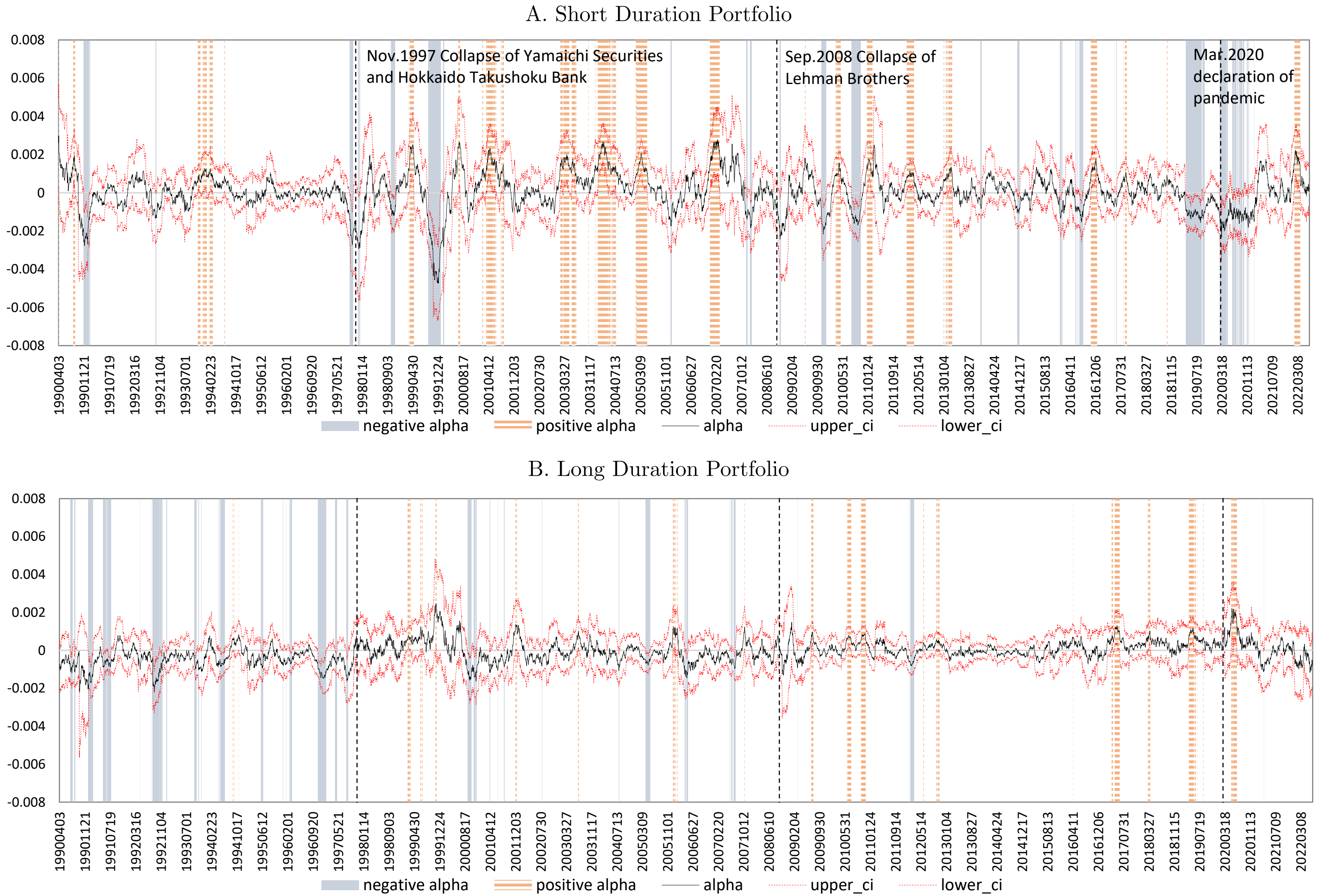

Figure 3: CAPM Alphas

Notes. This figure shows the estimates of the CAPM alpha for the shortest and longest-duration portfolio returns. The red dashed line is the 95% confidence interval; the blue and orange areas show the period when the alpha is significantly negative and positive, respectively. The standard errors are based on Newey and West (1987) with 5 lags. The initial rolling regression was on April 3, 1990, and the last was on June 30, 2022.