Term Structure of Equity in the Cross Section

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Abstract

We use exchange-traded options on individual stocks to replicate claims on short-term dividends of underlying stocks, and estimate the term structure of equity from the returns on dividend claims and stocks. We find that the term structure aggregated across stocks is downward sloped, consistent with the finding from derivatives on equity market indexes. We also find that the levels and slopes of the term structure vary substantially across stocks. The term structure of stocks with short cash flow durations has a higher level and is more downward sloped than those with long durations. The term structure also varies with other stock characteristics associated with durations, including book-to-market ratio, profitability, investment, and payout. The results suggest that the differences in the cash flow durations alone cannot fully explain the return spreads between short and long duration stocks.

Keywords: term structure of equity; synthetic dividend strips; cash flow duration; value premium; stock options

1. Introduction

How to value future cash flows is an important question in finance. The literature of equity valuation has mostly focused on valuing the sum of all cash flows generated by a firm as a whole. In order to better understand how the stock price is determined, the literature has moved towards examining the value of each individual cash flow over different horizons and measuring the term structure of equity. At the aggregate level, the term structure of expected returns is found to be downward sloped. Van Binsbergen, Brandt, and Koijen (2012) show that a dividend strip, which is synthetically created by index options and only pays dividends in the near-term future, has a higher average return than the underlying market index. The conclusion is further supported by van Binsbergen, Hueskes, Koijen, and Vrugt (2013) using index dividend futures, and Cejnek and Randl (2016) using index dividend swaps.[1]

The above finding is important and interesting in its own right, but more importantly, it has been connected to a broader literature of cross-sectional stock returns. In particular, the downward sloped equity term structure is regarded as being consistent with the value premium or growth discount, which refers to the empirical fact that stocks with high book-to-market ratios (i.e., value stocks) have higher average returns than stocks with low book-to-market-to-book ratios (i.e., growth stocks).[2] Early studies along this line of research include Dechow, Sloan and Soliman (2004) and Lettau and Wachter (2007), for example. Value stocks are expected to have more cash flows in the recent future, i.e., shorter cash flow durations, relative to growth stocks. When the term structure of aggregate equity market returns is downward sloped, cash flows of value stocks weigh more in the short-end of the term structure where the expected return is high. As a result, returns on value stocks are expected to be higher than those on growth stocks.

[1]van Binsbergen and Koijen (2016) show that the downward sloped term structure is a robust result which is not driven by market microstructure noise or differential treatments of taxes on short and long term assets as Boguth, Carlson, Fisher, and Simutin (2013) and Schulz (2016) suggest.

[2]There is a large literature on the value premium since Fama and French (1992, 1993).

The cash flows duration based explanation has been applied to explaining not only the value premium but also the cross-sectional differences in stock returns associated with profitability, investment, and payout, for example, in Chen and Li (2020) and Gormsen and Lazarus (2021). It has been shown in the literature that stocks with high profitability or payout, or low investment earn high average returns.[3] Since cash flow characteristics of these stocks are expected to resemble those of the short-duration stocks, the cash flow duration can potentially provide a unified explanation for risk premiums associated with profitability, payout, and investment. In another line of literature, the differences in the cross-sectional stock returns are used to infer the term structure of the aggregate market. Weber (2018) shows that stocks with long cash flow durations earn lower average returns than short-duration stocks do which provides indirect evidence on the downward sloped term structure of the equity market.

For the duration based explanation to fully account for the cross-sectional differences in stock returns associated with variables mentioned above, that the term structures of stocks are the same as that of the aggregate market is implicitly assumed. It is not clear if such an assumption holds.[4] This study estimates the term structure of expected returns in the cross section and examines whether the term structures across stocks are the same. When the term structure of a stock does not change within a short period of time, it can be shown that the entire term structure of the stock for that period can be estimated from returns on the dividend strips of various tenors and the return on the stock. We use options to replicate short-term dividend strips of the underlying stocks, and estimate the short-end of the term structure by average returns on these dividend strips. Since stock

[3]The predictive power of profitability is documented in Fama and French (2006) and Novy-Marx (2013), of investment is documented in Titman, Wei and Xie (2004) and Cooper, Gulen and Schill (2008), of payout is documented in Boudoukh, Michaely, Richardson, and Roberts (2007), among others.

[4]A few asset pricing models do not restrict the term structure across stocks to be the same. Hansen, Heaton, and Li (2008) examine the pricing of risk in long-term cash flows. They find empirically that the level of the term structure for value (growth) stocks is high (low) and the slope for value (growth) stocks is upward (downward). Da (2009) finds that the covariance of cash flows from value (growth) stocks with consumption is positive (negative) so that the term structure of value (growth) stocks is downward (upward) sloped.

returns are weighted average returns on claims on all future dividends, we estimate the long end of the term structure from stock returns. Our approach is model-free since we do not make assumptions on the dynamics of dividends which are typically imposed in the literature.

Using a large cross section of stocks with options traded in the US market from January 1996 to June 2019, we find that the term structure of equity returns aggregated across stocks is downward sloped, consistent with the finding from derivatives on stocks indexes. This result provides additional evidence regarding the robustness of the downward sloped term structure of equity returns, which has been documented using derivatives on market indexes. We also find that the levels and slopes of the term structure vary substantially across individual stocks. There are non-trivial numbers of stocks with large average returns on short-term dividend strips in magnitudes, either positive or negative. While the majority of stocks have flat or download sloped term structures, quite a few stocks have significantly upward sloped term structures.

We then examine whether the term structure varies with cash flow duration and other related variables. We sort stocks into short, medium, and long cash flow duration portfolios, and calculate the value weighted quarterly returns on the dividend strips with various tenors and returns on stocks. We examine the quarterly returns because the most common dividend payment frequency is quarterly. We find that the time-series average returns on the dividend trips of the short duration portfolio are higher than those of the long duration portfolio, and the differences are larger for dividend strips with shorter tenors. The average slope of the term structure, defined as the difference in the average returns on the stock and on the 1-quarter dividend strip, the shortest tenor we consider, is significantly downward sloped for the short duration portfolio, but is flat for the long duration portfolio. These results suggest that the term structure varies substantially in the cross section. The term structure of the short duration stocks is not only higher in level but also more downward sloped than that of the long duration stocks.

We conduct a similar analysis for the portfolios sorted by the book-to-market ratio, profitability, investment and payout. The results show that portfolios of stocks with higher book-to-market ratio, operating profitability, payout yield, or lower asset growth, as the measure of investment earn higher average returns on their short-term dividend strips, and the slopes of their term structures are more downward sloped. That firms with these characteristics also earn higher average returns on stocks, as shown in the previous literature, can be partially explained by the differences in the term structure across stocks. The results in the paper can also help reconcile the seemingly inconsistent findings in the literature that growth stocks earn lower average returns than value stocks, but growth stocks do not have substantially higher future cash flow growth rates than value stocks, as reported in Chen (2017). The cash flow duration alone is unlikely to fully explain the short cash flow duration or value premium as there are non-trivial cross-sectional variations in the term structure across stocks with different durations or book-to-market ratios.

The remaining of the paper is organized as follows. In Section 2, we lay out our methodology and explain how we estimate the short-end and long-end term structure using short holding period returns on dividend strips and returns on stocks. In Section 3, we discuss the data and sample used in the empirical analysis and show the summary statistics of the returns on dividend strips. In Section 4, we construct the duration related variables and examine the cross-sectional variation of the term structure associated with these variables. Section 5 concludes the paper.

2. Methodology

2.1. Term Structure of Equity and Short-term Holding Period Returns

In this subsection, we discuss the relation between the term structure of equity returns and the short-term holding period returns on dividend claims and how we estimate the term structure from returns on dividend claims.

Without loss of generality, quarterly dividend payments are assumed. Let D_q^i be the cash dividend of stock i in quarter q, S_q^i be the stock price at the end of quarter q, $V_q^i(\tau)$ be the end of quarter q price of a sum of all dividends from quarter $q+1$ to $q+\tau$, and $r_q^i(\tau)$ be the annualized and continuously compounded $q-$conditional expected return in quarter $q+\tau$. $V_q^i(\tau)$, $D_{q+\tau}^i$, and $r_q^i(\tau)$ are linked as follows,

$$V_q^i(\tau) = \sum_{t=1}^{\tau} E_q(D_{q+t}^i) \exp\left[-\sum_{j=1}^{t} r_q^i(j)/4\right], \tag{1}$$

where $E_q(\cdot)$ denotes the $q-$conditional expectation. Note that $V_q^i(0) = 0$ and $V_q^i(\infty) = S_q^i$.

The identification condition we require is that the term structure of expected returns does not change in a short period of time in the following sense, $r_q^i(\tau) = r_{q+1}^i(\tau)$ for all τ. Denote the 1-quarter holding period return on $V_q^i(\tau)$ by

$$R_{q+1}^i(\tau) = \frac{V_{q+1}^i(\tau-1) + D_{q+1}^i}{V_q^i(\tau)} - 1. \tag{2}$$

Since $E_q(D_{q+1}^i) = V_q^i(1)\exp[r_q^i(1)/4]$, and

$$\begin{aligned}
E_q[V_{q+1}^i(\tau-1)] &= E_q\left(\sum_{t=1}^{\tau-1}[V_{q+1}^i(t) - V_{q+1}^i(t-1)]\right) \\
&= E_q\left(\sum_{t=1}^{\tau-1} E_{q+1}(D_{q+1+t}^i)\exp\left[-\sum_{j=1}^{t} r_{q+1}^i(j)/4\right]\right) \\
&= \sum_{t=1}^{\tau-1} E_q(D_{q+1+t}^i)\exp\left[-\sum_{j=1}^{t} r_q^i(j)/4\right] \\
&= \sum_{t=1}^{\tau-1}[V_q^i(t+1) - V_q^i(t)]\exp[r_q^i(t+1)/4],
\end{aligned} \tag{3}$$

where the second and fourth equalities are from the definition of $V_q^i(\tau)$ as in (1), and the third equality is due to the iterated expectation and the identification condition, $r_q^i(\tau) = r_{q+1}^i(\tau)$, we have

$$E_q[R_{q+1}^i(\tau)] = \sum_{t=1}^{\tau} w_q^i(t)\exp[r_q^i(t)/4] - 1, \tag{4}$$

where

$$w_q^i(t) = [V_q^i(t) - V_q^i(t-1)]/V_q^i(\tau). \tag{5}$$

In other words, the q-conditional expected return in quarter $q+1$ on $V_q^i(\tau)$ is the average of the q-conditional expected returns in the term structure, weighted by the value of the dividend in quarter $q+t$ relative to the value of all dividends. $E_q[R_{q+1}^i(\tau)]$ with low (high) τ provides information on the short-end (both short- and long-end) of the term structure. Denote the return on stock i in quarter $q+1$ by $R_{q+1}^i = R_{q+1}^i(\infty)$, and it can be seen from (4) that the expected stock return, $E_q[R_{q+1}^i]$, is the average expected returns in the term structure, weighed by the values of cash flows, i.e., dividends, across the entire horizon.

For a given stock i, since $w_q^i(\tau) \geq 0$ for all τ, a downward sloped term structure, i.e., $r_q^i(\tau+1) \leq r_q^i(\tau)$ for all τ, implies that $E_q[R_{q+1}^i(\tau+1)] \leq E_q[R_{q+1}^i(\tau)]$ for all τ, and an upward sloped term structure, $r_q^i(\tau+1) \geq r_q^i(\tau)$ for all τ, implies that $E_q[R_{q+1}^i(\tau+1)] \geq E_q[R_{q+1}^i(\tau)]$ for all τ. One straight-forward way to examine whether the term structure across stocks are the same, i.e., $r_q^i(\tau) = r_q^j(\tau)$ for all τ and $i \neq j$, is to test the difference in the expected return on the dividend strip with the shortest tenor, $E_q[R_{q+1}^i(1)] = E_q[R_{q+1}^j(1)]$ for $i \neq j$. If the condition is rejected, it implies that the term structure is not the same across stocks. If we assume that the weights, $w_q^i(\tau)$, for a given stock i, are the same for $\tau \leq \tau^*$, $r_q^i(\tau) = r_q^j(\tau)$ implies $E_q[R_{q+1}^i(\tau)] = E_q[R_{q+1}^j(\tau)]$, for $\tau \leq \tau^*$. We can also test the differences in the term structure by testing $E_q[R_{q+1}^i(\tau)] = E_q[R_{q+1}^j(\tau)]$ for $\tau \leq \tau^*$. In actuality, the above condition of the same weights for τ within one or two years approximately holds since growth stocks or long duration stocks are unlikely to become value or short duration stocks in such a short period of time.

2.2. Returns on Synthetic Dividend Strips

Within the rational expectation framework, we use ex post realized returns to measure ex ante expected returns. We only need to calculate quarterly returns on $V_q^i(\tau)$ with various τ, as in (2). The approach is model-free without any assumptions on the dynamics of dividends.

The price of dividend strips, $V_q^i(\tau)$, can be either calculated from futures or options on the underlying asset. We use options to construct dividend strips synthetically in this study since options market of individual stocks are much more developed than their futures market counterpart in the U.S. According to the put-call parity, the price of a dividend strip at the end of quarter q with tenor τ is given by,

$$V_q^i(\tau) = P_q^i(\tau, K) + S_q^i - C_q^i(\tau, K) - K \exp[-r_q^f(\tau)\tau], \tag{6}$$

where $C_q^i(\tau, K)$ and $P_q^i(\tau, K)$ are the mid closing bid-ask prices of call and put options on stock i with strike price K and time to maturity τ at the end of quarter q, S_q^i is the closing stock price at the end of quarter q, and $r_q^f(\tau)$ is the annualized and continuously compounded risk-free rate with tenor τ.

The pairs of call and put options are selected as follows. We require the options to have non-missing implied volatility, positive offer and bid prices, and offer price greater than bid price. We select the near-the-money options, i.e., $K/S - 1$ within -0.2 to 0.2, and the standard options which usually matures on the third Friday of each month. We also require option prices satisfying the no-arbitrage bounds for American-style options,

$$C_q^i(\tau, K) + K \exp[-r_q^f(\tau)\tau] \leq P_q^i(\tau, K) + S_q^i \leq C_q^i(\tau, K) + K + \sum_{j=1}^{\tau} D_{q+t}^i \exp[-r_q^f(t)t]. \tag{7}$$

The left inequality imposes that the price of the dividend strip is non-negative, and the right inequality imposes that the price of dividend strip is bounded from above to avoid arbitrage opportunities.[5] We select the pair of options with the moneyness, $K/S - 1$, closest to zero, since the near-the-money options tend to have better liquidity.[6] At the

[5]For the upper bound, since the future dividends, D_{q+t}^i, for $t > 0$, are unknown at the end of quarter q, we use the dividend of the same quarter in the last year as the estimate of future dividends. Using the actual dividends does not affect our empirical results.

[6]The put-call parity relation as in (6) holds exactly for European options. Options written on individual stocks are American options, and the prices of dividend strips estimated from American option prices are contaminated by the difference in early exercise premiums between put and call prices. Since early exercise premiums of at-the-money options are small and in a similar magnitude between calls and puts, using the most at-the-money options minimizes the potential bias caused by early exercise premiums.

end of quarter q, we exclude the options with less than 2 months time to maturities because the shortest tenor of the dividend strip we intend to calculate is 3 months. For a stock to be included in the sample at a given point of time, we require that options on the stock with both relatively short maturity (no greater than 6 months) and relatively long maturity (at least 1 year) exist so that we can calculate the dividend strips with various tenors for the stock.

D^i_{q+1} in (2) is calculated as the sum of the realized dividends for which the ex-dividend dates fall between the end of quarter q and the end of quarter $q+1$. Since the bid-ask spreads of options are relatively large, which introduces errors to the return calculation. We take the following step to reduce these errors, especially for the dividend strips with short tenors. If all the dividends from the end of quarter $q+1$ to the maturity date of the options are announced by the end of quarter $q+1$, i.e., the dividend declaration dates occur before the end of quarter $q+1$, we replace $V^i_{q+1}(\tau-1)$ with the sum of the actual amount of announced dividends. If a stock does not pay a dividend in a given quarter in which case the dividend announcement date is not reported in the data, we use the earnings announcement date as the dividend announcement date. For a small number of short-term options which expire before the end of quarter $q+1$, we exclude the dividends with ex-dividend dates falling between the maturity dates of the options and the end of quarter $q+1$ from D^i_{q+1}, and set $V^i_{q+1}(\tau-1)$ to be zero.

3. Empirical Analysis

3.1. Data and Sample

We obtain the stock price data and the dividend payment history data from the Center for Research in Security Prices (CRSP). Our sample includes firms listed on NYSE, AMEX, or NASDAQ with share codes 10 and 11. The earnings announcement dates and accounting data are from Compustat. The options data are obtained from OptionMetrics. We use the LIBOR for the risk-free rate, which is also from OptionMetrics. We filter out potential illiquid stocks by requiring the stock closing price to be larger than $5. We also exclude firms in the finance and utility industries. Our sample period is from January 1996 to June 2019.

The summary statistics of the option sample at the end of each month are reported in Table 1. We calculate the statistics across options in each month and report the time-series averages of the statistics. Since the most at-the-money pairs of call and put options are used to construct the synthetic dividend strips, the sample of options has an average moneyness, $K/S - 1$, close to 0, and the range of moneyness is narrow. As we require stocks to have options of maturities greater than 1 year, the sample of options has longer maturities than typical options traded in the exchanges. On average, the sample of options has a time to maturity of 312 days. Since we use both short maturity and long maturity options to construct dividend strips with various tenors, the range of time to maturity is large, with the average 5th percentile being 49 days and the average 95th percentile being 730 days. The average implied volatility from call options is 34.9%, slightly lower than that of put options of 36%. There are 1507 unique stocks in the sample, the average number of stocks at each cross section is 236, and the average number of option pairs at each cross section is 1724.

[Table 1 here]

3.2. Summary Statistics of Returns

We examine returns on dividend strips with various tenors ranging from 1 quarter to 8 quarters. As options do not mature at the end of each quarter and options with desired expiring month may not always be available, we linearly interpolate the returns on dividend strips with the closest tenors to the target tenor, i.e., the return is weighted by the distances between maturities of the options to the target tenor. If the target tenor is outside the range of available tenors, we use the tenor closest to the target tenor. We examine quarterly returns, rather than monthly returns as the typical studies in the asset pricing literature. There are a few reasons why we do so. First, the most common dividend payment frequency is quarterly, so it is natural to examine the quarterly returns on dividend strips. Second, option prices tend to have relatively large bid-ask spreads which lead to estimation errors in prices of dividend strips. The variations in prices due to the information regarding expected dividends or risk premium, relative to noises caused by bid-ask spreads are larger in quarterly returns than in monthly returns. Third, for the dividend strips with 1-quarter tenor, the payoffs at the end of quarter $q+1$ are simply the actual dividends without any estimation errors. In the empirical analysis below, we examine the monthly observations of quarter returns, i.e., the returns are overlapping. The prices of dividend strips at the end of each month are calculated from different option contracts which provide additional information for estimating the returns. We examine all monthly observations of quarterly returns to fully utilize the information in the option prices regarding the short-end term structure and to enhance the power of statistical tests.

We first examine whether prices of dividend strips of various tenors contain independent information about asset price dynamics. To do so, we calculate the correlations among the returns on dividend strips and on stocks. Table 2 shows the cross-sectional averages of time-series pairwise correlations among returns on dividend strips of 1-, 2-, 4-, 6- and 8-quarters, $R(1)$, $R(2)$, $R(4)$, $R(6)$, and $R(8)$, respectively, and stock returns, R. To ensure that the correlations are estimated accurately, we include stocks with at least three years observations. As expected, correlations between returns on dividend strips of closer tenors are higher. For example, the average correlation between the returns on the 1-quarter and 2-quarter dividend strips is 0.655, whereas the average correlation between the returns on the 1-quarter and 8-quarter dividend strips is only 0.245. It is also shown that the returns on dividend strips are only weakly correlated with stock returns. The results suggest that prices of dividend strips of various tenors and of stock are driven by multiple state variables and each of the dividend strips provides additional information to the stock price for understanding asset price dynamics.

[Table 2 here]

We calculate the time-series averages of monthly observations of quarterly returns, and report the 5th, 25th, 50th, 75th, and 95th percentiles of the cross-sectional distribution in Table 3. Since returns are overlapping, the t-statistics reported are adjusted using the Newey and West (1987) procedure with two lags. To ensure that the average returns are representable, we select stocks with at least three years of observations. There are large cross-sectional variations in the average returns on dividend strips, and the variation is greater for short-term dividend strips. These variations are considerably larger in magnitude than those of stocks reported in the last row. For some stocks, the average returns on short-term dividend strips are negative and statistically significant.

[Table 3 here]

The second last column of Table 3, denoted by AGG, shows the time-series average returns on dividend strips of the aggregated market. The aggregate market returns are calculated as average returns on dividend strips of individual stocks, weighted by the total values of dividend strips, i.e., the prices of dividend strips per share multiplied by the number of shares outstanding of the stock. It is shown that the aggregate short-term dividend strips earn higher average returns than the aggregate long-term dividend strips do. For example, the aggregate dividend strip with a 3-month tenor earns an average quarterly return of 12.8%, the number reduces to 5.6% for the 1-year tenor, and further reduces to 2.4% for the 2-year tenor, which is comparable with the aggregate stock return of 2.6%, reported in the last row. The results are consistent with the downloaded sloped term structure of equity returns documented in the existing literature. The last column, denoted by SPX, shows the time-series average returns on dividend strips of the S&P 500 index, calculated from options on the S&P 500 index. We estimate the actual dividends of the S&P 500 index from the difference between the return index and the price index downloaded from Datastream, and follow the same procedure as the one for individual stocks to calculate the returns on the S&P 500 dividend strips. It is shown that the term structure of equity returns estimated from the index options is also downward sloped, and the magnitudes of the returns are remarkably close to those for the aggregated dividend strips from individual stocks. These results provide additional evidence on the downward sloped term structure of the equity market returns.

The term structure of equity at the market level is downward sloped, however, the results in Table 3 also suggest that the slope of the term structure may vary in the cross section because the average returns on dividends strips of various tenors vary substantially across stocks. We define the slope of the term structure as the difference between the stock return and the 1-quarter dividend strip return, $R - R(1)$. Table 4 shows the cross-sectional distribution of the time-series averages of the slopes. It is shown that for more than half of the stocks, the term structure is either downward sloped or flat. The insignificant downward sloped term structure is due to the large time-series variations in the dividend strips returns at the stock level. There are also stocks with significant and positive sloped term structure of returns. The results provide direct evidence that the term structure of equity returns varies across stocks. We further decompose the slope of the term structure into two segments, the long term, which is the difference between returns on dividend strips with tenors of 8 quarters and 1 quarter, $R(8) - R(1)$, and the long term, which is the difference between the stock return and the 8-quarter dividend strip return, $R - R(8)$. The results suggest that the cross-sectional variation exists in both short-term and long-term slopes, and the variation is larger for the short-term slopes. The result for the aggregate market, AGG, suggests that the term structure of equity return is on average downward sloped, consistent with the finding in prior studies using index dividend derivatives or index options. Our analysis on the S&P 500 index options further confirms the results. In addition, we find that the negative slope is mainly from the short-end of the term structure at the market level as well.

[Table 4 here]

4. Equity Duration and Term Structure

4.1. Equity Duration and Related Variables

In this section, we examine whether the term structure of returns varies with cash flow duration and related variables across stocks. Such an analysis helps to better understand the short duration premium and value premium documented in the literature.

The cash flow duration is defined according to Dechow, Sloan and Soliman (2004) and Weber (2018) as

$$\mathrm{DR}_y^i = \frac{\sum_{t=1}^{\infty} t \times E_y(\mathrm{CF}_{y+t}^i)/(1+\bar{r}^i)^t}{\mathrm{ME}_y^i}, \tag{8}$$

where ME_y^i is the market value at the end of year y for firm i, $E_y(\mathrm{CF}_{y+t}^i)$ is the expected annual cash flow during year $y+t$ for firm i conditional on information at the end of year y, and $\bar{r}^i$ is the average annual discount rate for firm i.[7] Cash flow duration is the present value weighted cash flows in different horizons.

Using the clean surplus relation,

$$\mathrm{CF}_y^i = \mathrm{ER}_y^i - (\mathrm{BE}_y^i - \mathrm{BE}_{y-1}^i) = \mathrm{BE}_{y-1}^i \times (\mathrm{ROE}_y^i - \mathrm{BEG}_y^i), \tag{9}$$

where ER_y^i is earnings of firm i in year y, BE_y^i is the book value of equity of firm i at the end of year y, $\mathrm{ROE}_y^i = \mathrm{ER}_y^i/\mathrm{BE}_{y-1}^i$ is the return on equity in year y, and $\mathrm{BEG}_y^i = (\mathrm{BE}_y^i - \mathrm{BE}_{y-1}^i)/\mathrm{BE}_{y-1}^i$ is the book equity growth rate in year y.

Firms will eventually reach the steady state, in which both ROE and BEG, and hence the cash flow growth rate, are constant. Weber(2018) assumes that it takes the same T years for all the firms to reach the steady state with a common BEG of g and a common ROE, which is further assumed to be the average discount rate, $\bar{r}$.[8] Under these

[7]DR is similar to the Macaulay duration in the fixed income securities, where the expected cash flows are coupons and principal and $\bar{r}^i$ is the yield to maturity. Note that the constant $\bar{r}^i$ is not inconsistent with the non-flat term structure of discount rates.

[8]The steady state ROE is slightly lower (higher) than the average discount rate if the term structure of equity returns is downward- (upward-) sloped.

assumptions, it can be shown that

$$
\begin{aligned}
\mathrm{DR}_y^i &= \frac{\sum_{t=1}^{T} t \times E_y(\mathrm{CF}_{t+t}^i)/(1+\bar{r})^t}{\mathrm{ME}_y^i} \\
&\quad + \left(T + \frac{1+\bar{r}}{\bar{r}-g}\right) \times \frac{\mathrm{ME}_y^i - \sum_{t=1}^{T} E_y(\mathrm{CF}_{y+t}^i)/(1+\bar{r})^t}{\mathrm{ME}_y^i}. \qquad (10)
\end{aligned}
$$

We follow Weber (2018) to set T to be 15 years and steady state ROE and BEG to be 12% and 0%, respectively. Before firms reach their steady state, both ROE_y^i and BEG_y^i are assumed to follow a first-order autoregressive process with the same parameters across the firms. Empirically, ROE is calculated as the ratio of income before extraordinary items to book value of equity, and BEG is calculated as the growth rate of total sales. We run a pool regression among the NYSE stocks excluding the finance and utility industries from 1963 to 2018 to estimate autoregressive coefficients for ROE as 0.54 and for BEG as 0.28, assuming the unconditional means of ROE and BEG to be 12% and 6%, respectively, as in the literature. Given the processes of ROE and BEG, we estimate the expected future cash flows iteratively using (9), and calculate DR_y^i for each firm i and each year y using (10).

The book-to-market ratio (BM) has been associated with the cash flow duration in the literature as growth stocks are expected to have cash flows weighted more in the future and thus should have longer cash flow duration than value stocks do. Dechow, Sloan and Soliman (2004) and Weber (2018) find that BM and DR are negatively correlated. We use BM as another measure of equity duration. BM is defined as the book value of equity divided by the December market value of equity, where the book value of equity is calculated as the book value of common share (CEQ) plus balance-sheet deferred taxes (ITCB) and investment tax credit (TXDB).

Chen and Li (2020) and Gormsen and Lazarus (2021) suggest that other firm characteristics and associated risk factors that explain the cross-sectional stock returns are also related to the cash flow duration, including profitability, investment and payout. We also examine whether the term structure of stock returns differ across these variables. We use the operating profit (OP) to measure profitability, which is defined as

$$\text{OP}_y^i = \frac{\text{REVT}_y^i - \text{COGS}_y^i - \text{XSGA}_y^i - \text{XINT}_y^i}{\text{BE}_\text{y}^\text{i}}, \tag{11}$$

where REVT is revenue, COGS is cost of goods sold (COGS), XSGA is sales, general and administrative expense, XINT is interest, and BE is the book value of equity. We measure the investment by the relative asset growth, defined as

$$\text{AG}_y^i = \text{AT}_y^i/\text{AT}_{y-1}^i - 1, \tag{12}$$

where AT_y^i is the total asset of firm i at the end of year y. We follow Gonçalves (2021) and use the payout yield, PY, to measure the payout,

$$\text{PY}_y^i = \log(1 + \text{PO}_y^i/\text{ME}_y^i) \tag{13}$$

where ME is the market value at the December end and PO is net payout amount, defined as,

$$\text{PO}_y^i = \text{DVC}_y^i + \text{PRSTKC}_y^i - \text{SSTK}_y^i + \Delta\text{BVPS}_y^i, \tag{14}$$

where DVC is the cash dividends, PRSTKC is the purchase of common and preferred stocks, and SSTK is the sale of common and preferred stock. $\Delta\text{BVPS}_y^i = \text{BVPS}_y^i - \text{BVPS}_{y-1}^i)$ is the net issuances of preferred stocks, where BVPS is either the total value of the preferred stock (PSTK), the liquidating value of the preferred stock (PSTKL), or the redemption value of the preferred stock (PSTKRV), depending on their availability in such an order.

Table 5 shows the summary statistics of the above variables and ME. We calculate the cross-sectional distribution of these stock characteristics first, and report the time-series averages. The cash flow duration is averaged at 19.5 years. The quantity varies across stocks and is skewed to the left in the cross section. The average BM is 0.345, and most of the stocks have a BM less than 1. The average AG and PY are 0.182 and 0.024, respectively, and both quantities are skewed to the right. The average market value of equity is about 28 billion USD, and its distribution is right skewed. The stocks with options traded are larger than the average stocks listed in NYSE, AMEX and NASDAQ.

[Table 5 here]

We examine the relations among these stock characteristics by calculating their cross-sectional correlations for each month, and report the time-series averages in Table 6. The correlation between DR and BM is -0.181. The negative correlation is consistent with that value stocks tend to have cash flows weighted more in the near term. However, the negative association between DR and BM is not very strong and the two variables contain distinctive information. The correlation between DR and OP is close to zero. In our sample, whether profitable firms tend to distribute cash flows in the near future (short duration) or invest heavily to generate high profits in the far future (long duration) is not clear. This can also be seen from the weak relation between OP and AG, a measure of investment. Longer duration firms tend to invest more and pay out less, indicated by a positive correlation between DR and AG and a negative correlation between DR and PY, respectively, however the magnitudes of correlations are small. Overall, the results suggest that in our sample, DR is only weakly correlated with the variables that are considered to be related to DR in the literature.

[Table 6 here]

4.2. Portfolio Analysis

We examine returns on the portfolios of dividend strips with various tenors and stocks sorted by cash flow duration and related variables defined earlier. At the end of each month, we sort stocks into tercile portfolios by the duration related variables, and calculate the market value weighted quarterly returns on the dividend strips and stocks. Note that the weights are calculated separately for each tenor of dividend strips and stock according to the price per share to reflect their different weights for the same stock. We only have three portfolios with low, medium, and high values of sorting variables because we require the stocks to have long maturity options (at least one year) in the sample which leads to a smaller number of stocks in the cross section.

The average returns on portfolios sorted by DR are reported in Panel A of Table 7. The t-statistics are adjusted using the Newey and West (1987) approach with 2 lags as the returns are overlapping. L, M, and H indicate the portfolios with the low, medium, and high values of DR. It can be seen that for all the portfolios, the average returns are positive, and most of them are statistically significant. The returns on dividend trips of short duration stocks are higher than those of long durations, and the difference is larger for dividend strips with shorter tenors. $H-L$ in the last column indicates the difference in the average returns between the high and low DR portfolios. The results suggest that the differences for dividend strips of all tenors are negative and statistically significant. The last row of Panel A shows that the average return on stocks with short durations is lower than that with long durations, consistent with the literature. The difference is not statistically significant, however. This is likely due to the different sample periods and weighting from the existing studies. The duration effect tends to be weaker in the recent period and for larger stocks. Panel B reports the average slope of the term structure, defined as the difference in the average returns on the stock and on the 1-quarter dividend strip, $R-R(1)$. The result suggests that the term structure of equity return is significantly downward sloped for low DR stocks, but not for high DR stocks. The column in $H-L$ indicates that the slope is significantly more negative for low DR stocks than for high DR stocks. When decomposing the slope of the term structure into the short-term component, i.e, $R(8)-R(1)$, and the long-term component, $R-R(8)$, it can be seen that the downward sloped term structure occurs in the short term. The results also indicate that for both short and long horizons, the slope of the term structure is significantly more negative for low DR stocks than for high DR stocks. Overall, in contrast with what has been implicitly assumed in the literature that the term structure is the same across stocks, we find that the term structure varies substantially in the cross section. The term structure of short cash flow duration stocks is not only higher in level, but also more downward sloped than that of long cash flow duration stocks.

[Table 7 here]

Table 8 shows the average returns on portfolios of dividend strips and stocks and the average slopes of the term structure sorted by BM. Similar to the portfolios sorted by DR, the average returns are all positive, regardless the tenors and the value of BM. The returns on dividend trips of high BM stocks tend to be higher than those of low BM stocks, and the difference is larger for dividend strips with shorter tenors. The differences are negative and statistically significant for dividend strips of all tenors. The average return on stocks is lower for the high BM portfolio than for the low BM portfolio, however, the difference is statistically insignificant. The value premium is lower in our sample period and for larger stocks. The results of the term structure of equity returns reported in Panel B are also remarkably similar to those reported in Table 7 for the DR sorted portfolios. The term structure is generally downward sloped, especially for the short horizon. The term structure is significantly downward sloped for high BM stocks, but not for low BM stocks. The slope is significantly more negative for high BM stocks than for low BM stocks. Again, the results indicate that the term structure varies substantially in the cross section.

[Table 8 here]

Table 9 shows the results for portfolios sorted by operating probability, OP. The average returns on OP sorted portfolios of dividend strips of various tenors are all positive, similar to the DR and BM sorted portfolios. However, the cross-sectional differences are not as salient as those for the DR and BM sorted portfolios. The difference in the average returns on dividend strips is statistically significant only for the 1-quarter dividend strips. The term structure is generally downward sloped. The cross-sectional difference in the slopes is still highly significant, where the slopes of high OP stocks are more negative than those of low OP stocks. In our sample, the average return on high OP stocks is higher than low OP stocks, consistent with the finding in the literature, but the difference is not statistically significant.

[Table 9 here]

Table 10 reports the results for portfolios sorted by investment, measured by asset growth, AG. Low AG stocks tend to have higher average returns on dividend strips and more downward sloped term structure than high AG stocks do, and the differences are mostly statistically significant. Table 11 reports the results for portfolios sorted by payout yield, PY. High PY stocks tend to have higher average returns on dividend strips than low PY stocks do, and the differences are statistically significant for 1-quarter and 8-quarter dividend strips. The term structure of high PY stocks is downward sloped, whereas the term structure of low PY stocks is basically flat.

[Table 10 here]

[Table 11 here]

To summarize, our analysis suggests that the term structure of equity returns varies in the cross section. The average returns on short-term dividend strips for stocks increase with book-to-market ratio, operating profitability, and payout yield, and decrease with cash flow duration and asset growth. For the portfolios with higher levels of the term structure, slopes of term structure are more negative. The duration based explanation attributes the cross-sectional variation in the stock returns to the differences in the cash flow durations as the term structures of equity for all stocks are assumed to be the same. Our results in the paper suggest that the cash flow differences alone cannot fully account for cross-sectional differences in average stock returns because the term structure also varies across stocks.

5. Conclusion

We examine the term structure of equity returns in the cross-sectional stocks. Using the options on about 1500 stocks in the US market from January 1996 to June 2019, we synthetically construct short-term dividend strips with various tenors from 1 quarter to 2 years, and calculate the quarterly returns on the dividend strips. Under the condition that the term structure of a given stock does not change in a short period of time, the term structure of equity returns can be estimated from short-term holding period returns on dividend strips and on stocks. we find that the term structure of equity returns aggregated across stocks is downward sloped, which provides additional evidence regarding the robustness of the downward sloped term structure at the market level documented using derivatives on market indexes. We also find that the term structure varies substantially at the individual stock level. While the majority of stocks have flat or download sloped term structures, quite a few stocks have significantly upward sloped term structures.

We examine whether the term structure varies in the cross section with cash flow duration and stock characteristics related to duration, including book-to-market ratio, operating profitability, payout yield, and investment. We assign stocks to one of the low, medium and high portfolios according to these variables, and calculate the time-series average level and slope of the term structure for each portfolio. We find that portfolios of stocks with shorter duration, higher book-to-market ratio, operating profitability, payout yield, or lower investment earn higher average returns on short-term dividend strips, and the slopes of the term structure of these portfolios are more downward sloped. This result is in contrast with that in Gormsen and Lazarus (2021) who examine returns on dividend strips using 190 single-stock dividend futures from 2010 to 2019. They do not find that returns on dividend strips vary across stocks with different cash flow durations. One reason for the difference between theirs and this paper is that we focus on dividend strips with relatively short tenors, up to two years, whereas Gormsen and Lazarus (2021) examine longer tenors. We do find that the cross-sectional difference in the term structure is more salient for shorter tenors. Another possible reason is that we use a larger number of stocks in the cross section and a longer sample period, which increases the power of the test.

The findings in our paper suggest that the fact that firms with shorter durations earn higher average stock returns cannot be solely due to the shorter cash flow durations of these stocks. Both differences in the duration and term structure contribute to the differences in average returns on stocks. We do not rule out the alternative behavioral explanation that investors overestimate the expected growths of growth stocks and are subsequently disappointed by low returns on these stocks. Nevertheless, the results in this paper provide a fresh perspective to understand the well documented short duration premium and value premium.

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Table 1
Summary Statistics: Option Characteristics

This table presents the time-series averages of cross-sectional distribution of characteristics of options used to construct synthetic dividend strips. $K/S-1$ is the moneyness, where K is the strike price and S is the underlying stock price, T is the number of days until option maturity date, IV^c and IV^p are the implied volatilities of calls and puts, respectively. Mean, standard deviation (std), the 5^{th} (p5), 25^{th} (p25), 50^{th} (p50), 75^{th} (p75), and 95^{th} (p95) percentiles are reported. The sample period is from January 1996 to June 2019.

	mean	std	p5	p25	p50	p75	p95
K/S	0.001	0.050	-0.076	-0.022	0.001	0.024	0.083
T	312	237	49	118	230	545	730
IV^c	0.349	0.121	0.194	0.262	0.326	0.415	0.574
IV^p	0.360	0.118	0.214	0.276	0.336	0.423	0.583

Table 2
Time-series Correlations of Returns on Dividend Strips
This table reports the cross-sectional averages of time-series correlations among quarterly returns on short-term dividends strips and stock returns. $R(1)$, $R(2)$, $R(4)$, $R(6)$, and $R(8)$ are returns on dividend strips with tenors of 1 quarter, 2 quarters, 4 quarters, 6 quarters, and 8 quarters, respectively, and R is the stock return. The sample period is from January 1996 to June 2019.

	$R(2)$	$R(4)$	$R(6)$	$R(8)$	R
$R(1)$	0.655	0.378	0.284	0.245	0.043
$R(2)$		0.629	0.430	0.369	0.069
$R(4)$			0.836	0.657	0.110
$R(6)$				0.902	0.136
$R(8)$					0.149

Table 3
Summary Statistics: Returns on Dividend Strips and Stocks
This table reports the cross-sectional distributions of time-series averages of returns on short-term dividend strips of various tenors and returns on stocks. $R(1)$, $R(2)$, $R(4)$, $R(6)$, and $R(8)$ are returns on dividend strips with tenors of 1 quarter, 2 quarters, 4 quarters, 6 quarters, and 8 quarters, respectively, and R is the stock return. p5, p25, p50, p75 and p95 denote the 5^{th}, 25^{th}, 50^{th}, 75^{th}, and 95^{th} percentiles of average returns across all stocks. AGG is for the aggregate portfolio of all stocks in the sample, and SPX is for the S&P 500 index. Returns are in quarterly terms. t-statistics are reported in parentheses. The sample period is from January 1996 to June 2019.

	Individual Stocks					AGG	SPX
	p5	p25	p50	p75	p95	mean	mean
$R(1)$	-0.719	-0.365	0.126	0.560	1.591	0.128	0.121
	(-5.95)	(-2.21)	(0.72)	(1.83)	(3.30)	(4.84)	(3.55)
$R(2)$	-0.417	-0.046	0.133	0.480	1.414	0.080	0.085
	(-3.24)	(-0.13)	(2.61)	(1.41)	(2.19)	(5.16)	(3.26)
$R(4)$	-0.279	0.015	0.129	0.395	1.139	0.056	0.045
	(-1.97)	(0.07)	(3.87)	(1.53)	(2.07)	(5.26)	(3.42)
$R(6)$	-0.234	0.021	0.111	0.370	1.239	0.037	0.034
	(-2.33)	(2.39)	(1.44)	(0.82)	(1.38)	(3.68)	(3.28)
$R(8)$	-0.267	0.014	0.091	0.354	1.247	0.024	0.031
	(-3.76)	(0.20)	(0.91)	(2.87)	(1.16)	(2.55)	(3.10)
R	-0.028	0.013	0.028	0.045	0.081	0.026	0.024
	(-0.60)	(0.95)	(1.25)	(1.07)	(2.79)	(4.01)	(3.59)

Table 4
Summary Statistics: Term Structure of Returns
This table reports the cross-sectional distributions of time-series averages of the term structure of returns. $R - R(1)$ is the difference between returns on stock and returns on dividend strips with a tenor of 1 quarter, $R(8) - R(1)$ is the difference between returns on dividend strips with tenors of 1 quarter and 8 quarters, and $R - R(8)$ is the difference between returns on stock and returns on dividend strips with a tenor of 8 quarters. p5, p25, p50, p75 and p95 denote the 5th, 25th, 50th, 75th, and 95th percentiles of average return differences across all stocks. AGG is for the aggregate portfolio of all stocks in the sample, and SPX is for the S&P 500 index. Returns are in quarterly terms. t-statistics are reported in parentheses. The sample period is from January 1996 to June 2019.

	Individual Stocks					AGG	SPX
	p5	p25	p50	p75	p95	mean	mean
$R - R(1)$	-1.565	-0.522	-0.106	0.403	0.752	-0.101	-0.097
	(-1.29)	(-1.90)	(-1.04)	(4.41)	(5.90)	(-3.79)	(-2.77)
$R(8) - R(1)$	-1.291	-0.365	-0.015	0.466	1.401	-0.104	-0.090
	(-1.36)	(-2.91)	(-0.02)	(1.08)	(3.54)	(-4.31)	(-2.93)
$R - R(8)$	-1.239	-0.319	-0.072	0.010	0.289	0.003	-0.007
	(-1.26)	(-1.02)	(-0.92)	(0.30)	(1.82)	(0.33)	(-0.66)

Table 5
Summary Statistics: Stock Characteristics
This table presents the time-series averages of cross-sectional distribution of stock characteristics. DR is the cash flow duration, BM is the book-to-market ratio, OP is the operating profit, AT is the asset growth, PY is the payout yield, and ME is the market value of equity in billion USD. Mean, standard deviation (std), the 5^{th} (p5), 25^{th} (p25), 50^{th} (p50), 75^{th} (p75), and 95^{th} (p95) percentiles are reported. The sample period is from January 1996 to June 2019.

	mean	std	p5	p25	p50	p75	p95
DR	19.473	6.329	6.880	19.097	20.951	22.176	23.888
BM	0.345	0.919	0.073	0.191	0.326	0.539	1.039
OP	0.318	1.548	-0.050	0.195	0.312	0.447	0.886
AT	0.182	0.652	-0.126	0.000	0.075	0.197	0.776
PY	0.024	0.091	-0.039	0.004	0.023	0.048	0.104
ME	28.645	49.395	1.333	4.571	10.847	28.916	125.284

Table 6
Cross-sectional Correlations of Stock Characteristics
This table reports the cross-sectional averages of time-series correlations among stock characteristics. DR is the cash flow duration, BM is the book-to-market ratio, OP is the operating profit, AT is the asset growth, PY is the payout yield, and ME is the market value of equity. The sample period is from January 1996 to June 2019.

	BM	OP	AG	PY	ME
DR	-0.181	0.026	0.049	-0.022	0.029
BM		0.391	-0.012	-0.056	-0.045
OP			-0.034	0.079	0.056
AG				-0.219	-0.034
PY					0.113

Table 7
Portfolios Sorted by Duration
This table shows the average returns on dividend strips and stocks sorted by cash flow duration (DR). L, M, and H indicate the portfolios with the low, medium, and high DR, and $H - L$ indicates the difference between the high and low DR portfolios. $R(1)$, $R(2)$, $R(4)$, $R(6)$, and $R(8)$ are returns on dividend strips with tenors of 1 quarter, 2 quarters, 4 quarters, 6 quarters, and 8 quarters, respectively, and R is the stock return. $R - R(1)$ is the difference between returns on stock and returns on dividend strips with a tenor of 1 quarter, $R(8) - R(1)$ is the difference between returns on dividend strips with tenors of 1 quarter and 8 quarters, and $R - R(8)$ is the difference between returns on stock and returns on dividend strips with a tenor of 8 quarters. Returns are in quarterly terms. t-statistics are reported in parentheses. The sample period is from January 1996 to June 2019.

A. Returns on dividend strips				
	L	M	H	$H - L$
$R(1)$	0.199	0.118	0.066	-0.133
	(5.78)	(4.08)	(1.99)	(-3.65)
$R(2)$	0.102	0.083	0.047	-0.055
	(5.22)	(3.73)	(2.05)	(-2.21)
$R(4)$	0.075	0.049	0.041	-0.034
	(5.61)	(3.54)	(2.76)	(-2.22)
$R(6)$	0.057	0.035	0.024	-0.033
	(4.88)	(3.16)	(1.70)	(-2.74)
$R(8)$	0.042	0.024	0.008	-0.034
	(4.24)	(2.36)	(0.69)	(-3.51)
R	0.029	0.028	0.026	-0.003
	(4.36)	(4.21)	(3.64)	(-0.64)
B. Term structure of returns				
	L	M	H	$H - L$
$R - R(1)$	-0.170	-0.090	-0.040	0.130
	(-4.95)	(-2.99)	(-1.20)	(3.58)
$R(8) - R(1)$	-0.157	-0.093	-0.058	0.099
	(-5.31)	(-3.33)	(-1.93)	(3.09)
$R - R(8)$	-0.013	0.004	0.018	0.031
	(-1.35)	(0.39)	(1.67)	(3.37)

Table 8
Portfolios Sorted by Book-to-market Ratio
This table shows the average returns on dividend strips and stocks sorted by book-to-market ratio (BM). L, M, and H indicate the portfolios with the low, medium, and high BM, and $H-L$ indicates the difference between the high and low BM portfolios. $R(1)$, $R(2)$, $R(4)$, $R(6)$, and $R(8)$ are returns on dividend strips with tenors of 1 quarter, 2 quarters, 4 quarters, 6 quarters, and 8 quarters, respectively, and R is the stock return. $R-R(1)$ is the difference between returns on stock and returns on dividend strips with a tenor of 1 quarter, $R(8)-R(1)$ is the difference between returns on dividend strips with tenors of 1 quarter and 8 quarters, and $R-R(8)$ is the difference between returns on stock and returns on dividend strips with a tenor of 8 quarters. Returns are in quarterly terms. t-statistics are reported in parentheses. The sample period is from January 1996 to June 2019.

A. Returns on dividend strips				
	L	M	H	$H-L$
$R(1)$	0.073	0.114	0.229	0.157
	(2.27)	(4.13)	(5.80)	(4.04)
$R(2)$	0.040	0.083	0.131	0.090
	(1.95)	(3.71)	(5.29)	(3.28)
$R(4)$	0.033	0.054	0.091	0.059
	(2.47)	(3.66)	(5.35)	(3.50)
$R(6)$	0.022	0.039	0.060	0.038
	(1.64)	(3.60)	(4.68)	(3.16)
$R(8)$	0.010	0.028	0.042	0.032
	(0.83)	(2.88)	(3.87)	(3.20)
R	0.027	0.027	0.026	-0.001
	(3.90)	(4.00)	(3.90)	(-0.23)
B. Term structure of returns				
	L	M	H	$H-L$
$R-R(1)$	-0.045	-0.088	-0.203	-0.158
	(-1.40)	(-3.10)	(-5.19)	(-4.13)
$R(8)-R(1)$	-0.063	-0.087	-0.188	-0.125
	(-2.21)	(-3.25)	(-5.48)	(-3.78)
$R-R(8)$	0.018	-0.001	-0.016	-0.033
	(1.53)	(-0.10)	(-1.56)	(-3.56)

Table 9
Portfolios Sorted by Operating Profitability
This table shows the average returns on dividend strips and stocks sorted by operating profitability (OP). L, M, and H indicate the portfolios with the low, medium, and high OP, and $H-L$ indicates the difference between the high and low OP portfolios. $R(1)$, $R(2)$, $R(4)$, $R(6)$, and $R(8)$ are returns on dividend strips with tenors of 1 quarter, 2 quarters, 4 quarters, 6 quarters, and 8 quarters, respectively, and R is the stock return. $R-R(1)$ is the difference between returns on stock and returns on dividend strips with a tenor of 1 quarter, $R(8)-R(1)$ is the difference between returns on dividend strips with tenors of 1 quarter and 8 quarters, and $R-R(8)$ is the difference between returns on stock and returns on dividend strips with a tenor of 8 quarters. Returns are in quarterly terms. t-statistics are reported in parentheses. The sample period is from January 1996 to June 2019.

A. Returns on dividend strips				
	L	M	H	$H-L$
$R(1)$	0.068	0.093	0.163	0.095
	(1.58)	(3.18)	(5.43)	(2.46)
$R(2)$	0.081	0.079	0.075	-0.006
	(1.57)	(3.97)	(4.49)	(-0.11)
$R(4)$	0.067	0.067	0.045	-0.022
	(2.12)	(4.42)	(4.12)	(-0.67)
$R(6)$	0.040	0.037	0.035	-0.005
	(1.86)	(2.91)	(3.49)	(-0.24)
$R(8)$	0.017	0.021	0.027	0.010
	(0.94)	(1.79)	(2.97)	(0.61)
R	0.022	0.027	0.028	0.006
	(2.63)	(3.82)	(4.75)	(1.36)
B. Term structure of returns				
	L	M	H	$H-L$
$R-R(1)$	-0.045	-0.066	-0.134	-0.089
	(-1.09)	(-2.18)	(-4.47)	(-2.34)
$R(8)-R(1)$	-0.051	-0.073	-0.136	-0.085
	(-1.33)	(-2.71)	(-5.05)	(-2.47)
$R-R(8)$	0.006	0.006	0.002	-0.004
	(0.37)	(0.59)	(0.19)	(-0.25)

Table 10
Portfolios Sorted by Asset Growth
This table shows the average returns on dividend strips and stocks sorted by asset growth (AT) as a measure of investment. L, M, and H indicate the portfolios with the low, medium, and high AT, and $H-L$ indicates the difference between the high and low AT portfolios. $R(1)$, $R(2)$, $R(4)$, $R(6)$, and $R(8)$ are returns on dividend strips with tenors of 1 quarter, 2 quarters, 4 quarters, 6 quarters, and 8 quarters, respectively, and R is the stock return. $R-R(1)$ is the difference between returns on stock and returns on dividend strips with a tenor of 1 quarter, $R(8)-R(1)$ is the difference between returns on dividend strips with tenors of 1 quarter and 8 quarters, and $R-R(8)$ is the difference between returns on stock and returns on dividend strips with a tenor of 8 quarters. Returns are in quarterly terms. t-statistics are reported in parentheses. The sample period is from January 1996 to June 2019.

A. Returns on dividend strips				
	L	M	H	$H-L$
$R(1)$	0.168	0.136	0.059	-0.109
	(5.34)	(4.48)	(1.51)	(-3.16)
$R(2)$	0.109	0.074	0.051	-0.058
	(3.91)	(3.67)	(2.27)	(-1.71)
$R(4)$	0.074	0.055	0.029	-0.044
	(4.27)	(4.51)	(1.84)	(-2.13)
$R(6)$	0.050	0.043	0.009	-0.040
	(4.27)	(4.08)	(0.55)	(-2.57)
$R(8)$	0.036	0.031	-0.010	-0.046
	(3.65)	(3.30)	(-0.67)	(-3.85)
R	0.024	0.025	0.032	0.008
	(4.21)	(3.98)	(3.66)	(1.39)
B. Term structure of returns				
	L	M	H	$H-L$
$R-R(1)$	-0.144	-0.112	-0.027	0.117
	(-4.51)	(-3.70)	(-0.66)	(3.33)
$R(8)-R(1)$	-0.131	-0.105	-0.069	0.063
	(-4.48)	(-3.87)	(-1.92)	(2.00)
$R-R(8)$	-0.012	-0.007	0.042	0.054
	(-1.22)	(-0.76)	(3.12)	(4.33)

Table 11
Portfolios Sorted by Payout Yield
This table shows the average returns on dividend strips and stocks sorted by payout yield (PY). L, M, and H indicate the portfolios with the low, medium, and high PY, and $H-L$ indicates the difference between the high and low PY portfolios. $R(1)$, $R(2)$, $R(4)$, $R(6)$, and $R(8)$ are returns on dividend strips with tenors of 1 quarter, 2 quarters, 4 quarters, 6 quarters, and 8 quarters, respectively, and R is the stock return. $R-R(1)$ is the difference between returns on stock and returns on dividend strips with a tenor of 1 quarter, $R(8)-R(1)$ is the difference between returns on dividend strips with tenors of 1 quarter and 8 quarters, and $R-R(8)$ is the difference between returns on stock and returns on dividend strips with a tenor of 8 quarters. Returns are in quarterly terms. t-statistics are reported in parentheses. The sample period is from January 1996 to June 2019.

A. Returns on dividend strips				
	L	M	H	$H-L$
$R(1)$	0.019	0.093	0.169	0.150
	(0.39)	(2.57)	(6.59)	(3.53)
$R(2)$	0.066	0.055	0.106	0.040
	(1.89)	(2.59)	(4.96)	(1.09)
$R(4)$	0.070	0.043	0.067	-0.002
	(2.52)	(2.98)	(5.22)	(-0.08)
$R(6)$	0.027	0.030	0.048	0.021
	(0.97)	(2.42)	(5.27)	(0.81)
$R(8)$	-0.024	0.019	0.037	0.061
	(-1.08)	(1.68)	(4.63)	(3.30)
R	0.030	0.024	0.028	-0.002
	(2.95)	(3.71)	(4.73)	(-0.32)
B. Term structure of returns				
	L	M	H	$H-L$
$R-R(1)$	0.011	-0.069	-0.141	-0.152
	(0.21)	(-1.87)	(-5.43)	(-3.46)
$R(8)-R(1)$	-0.044	-0.074	-0.132	-0.089
	(-0.95)	(-2.25)	(-5.44)	(-2.27)
$R-R(8)$	0.054	0.005	-0.009	-0.064
	(2.70)	(0.49)	(-1.11)	(-3.59)