Expected Returns and Cash-Flow Growth*

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Abstract

We use the growth rates of firms' cash flows to explain cross-sectional differences in stock prices and returns. We show empirically that most characteristics that are known to predict high returns are associated with low cash-flow growth and thus short cash-flow duration. Accordingly, exposure to a duration factor explains the return to many anomalies, including factors based on valuation, profit, investment, low risk, and payout measures, both in the U.S. and globally. We show that a simple theoretical framework can reproduce these findings, and the model is further consistent with the empirical properties of the aggregate market portfolio and the equity term structure.

Keywords: asset pricing, cross-section of stock returns, cash-flow growth, duration, survey expectations.
JEL classification: G10, G12, G40.

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Dozens of risk factors, or firm characteristics, have been shown empirically to predict stock returns. But the economic mechanisms by which such characteristics relate to returns, and to each other, remain elusive. In this paper, we attempt to provide a unifying framework for understanding these relationships. We document that many characteristics that are known to predict high returns in fact share a common economic feature: they tend to be associated with low future cash-flow growth and thus short cash-flow duration.

Figure 1 illustrates our main empirical finding. It shows the relation between cash-flow growth rates and stock returns, measured using CAPM alpha, for 60 portfolios sorted on characteristics that are known to predict returns. There is a clear and striking negative relation between CAPM alpha and dividend growth rates for the firms in these portfolios. More importantly, realized dividend growth explains a strong majority of the variation in these portfolios' anomalous returns. We argue accordingly that cash-flow growth, and by implication cash-flow duration, provides a simple, unifying structure for understanding many seemingly disparate relationships in the cross-section of stocks.

The relation between cash-flow growth and the characteristics that predict returns is intuitive from a theoretical standpoint. Short-duration stocks tend to be in the profitable part of their life-cycle and thus not heavily investing in generating distant-horizon cash flows; they have low valuation ratios given their low growth rates; and they have low market betas because they are less exposed to the discount-rate shocks that account for much of the variation in aggregate prices, causing them to comove less with the market. And indeed, we find in the data that these short-duration stocks have low investment, high profits, high value, low beta, low volatility, and high payouts.

The first step in our analysis is to study the relation between duration and the characteristics that predict returns in an off-the-shelf asset pricing model. In the model, we show theoretically that the characteristics that are known to predict high returns, such as profit, value, low investment, and low risk, also predict a short cash-flow duration, in line with the arguments above. In addition, we specify our model such that short-duration cash flows are riskier and have a higher expected return than long-duration cash flows. Accordingly, equity risk factors based on profitability, investment, valuation, and low-risk all arise endogenously in our model: they are long short-duration stocks, which have higher expected returns than long-duration stocks.

We next verify empirically that the characteristics of profit, value, investment, beta, and payout indeed predict duration as in our model. We first look at ex post realized duration, which we measure using realized dividend growth rates. We verify that the

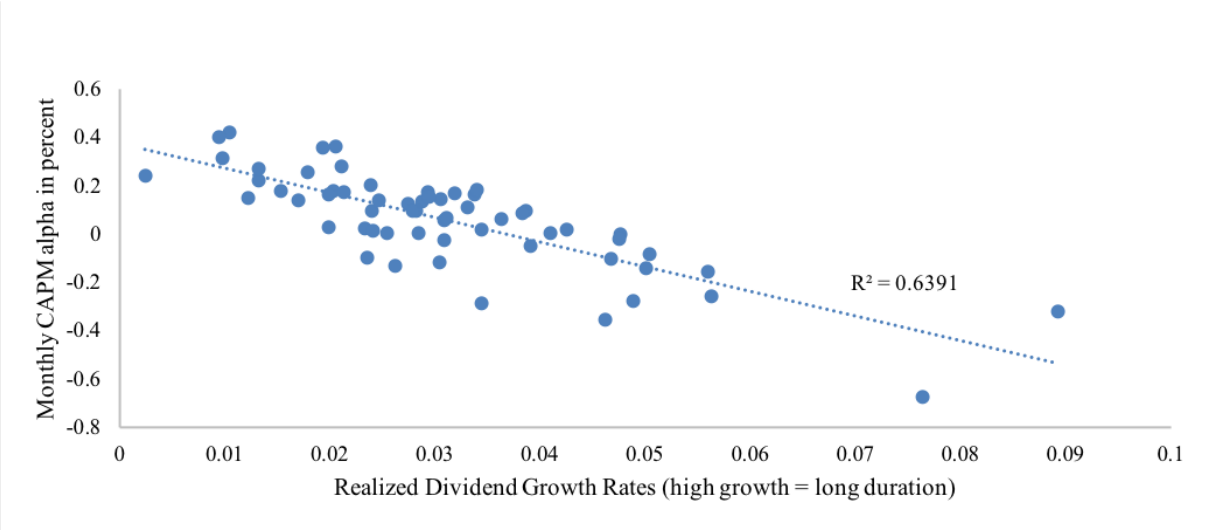


Figure 1: CAPM Alpha and Dividend Growth Rates for Characteristic-Sorted Portfolios

This figure shows the CAPM alpha and dividend growth rates for 60 portfolios sorted on profitability, investment, book-to-market, payout ratio, market beta, and idiosyncratic volatility. Alphas are estimated as the intercept in a monthly regression of excess return on the excess market returns. Alpha are in monthly percent and dividend growth rates are annualized dividend growth rates in the fifteen years following portfolio formation. The sample is the U.S. sample from 1963-2016.

characteristics that predict high returns all predict low dividend growth rates, both in univariate and multivariate regressions. In addition, we look not only at realized dividend growth rates, but also at expected long-run growth rates from the IBES database on analyst expectations. These expectations provide ex ante measures of expected cash flow duration of different stocks. We regress these firm-level expectations on contemporaneous firm-level characteristics. The expected growth rates load negatively on all the characteristics that predict high returns, suggesting that these characateristics all provide incremental information about future growth rates.

Based on this strong empirical and theoretical relation between duration and the characteristics that predict returns, we next study the relation between duration and stock returns directly. To study the relation between duration and expected returns, we need an ex ante measure of duration that we can construct for all stocks (the analyst expectations are only available for a subset of firms from 1982). We therefore create a new measure of expected cash flow duration. Following Dechow, Sloan, and Soliman (2004) and Fama and French (2015), we assume clean surplus accounting which means that cash-flow duration is a function of firm profitability and investment: a short duration firm has large profits and low investment. Importantly, our novel measure does not use any

pricing information and is therefore uncorrelated with the book-to-market characteristics. In addition, it is positively correlated with the forecasted growth rates from the IBES data, and more so than any of the individual characteristics on their own.

Using our new measure of duration, we create a duration factor that is long stocks with long cash-flow duration and short stocks with short cash-flow duration. As expected, the factor has negative expected returns and a negative CAPM alpha. More importantly, our duration factor can explain the return to equity risk factors based on profitability, investment, beta, issuance, and book-to-market. These risk factor all load negatively on our duration factor, which is to say that they behave more like short-duration stocks than long-duration stocks, and this negative loading on our duration factor explains almost all of their CAPM alpha in factor regressions. In the cases where there is remaining alpha after controlling for the market and our duration factor, the alpha is insignificant or has a t-statistic less than three, which has been suggested as the tresshold for statistical significance in the cross-section of stocks (Harvey, Liu, and Zhu, 2016). The results hold in the 1963 - 2016 U.S. sample, in the early U.S. sample and in a broad global sample covering 23 countries from 1990-2016, and the results are robust to various different ways of estimating cash flow duration, including using IBES forecasts.

The only significant anomalies that remain are after we control for duration are the momentum factor, the short-term reversal factor, which our model does not link to duration, and the size factor, which is resurrected once controlling for duration (small firms are long-duration firms, and therefore have low expected returns in our model). However, we note that the short term reversal factor, and to some extend the size factor, may arise from liquidity issues that our model abstracts from (Nagel, 2012).

As the final part of our paper, we study the relation between our duration characteristic and stock *prices*. Just like duration helps us understand cross-sectional variation in stock returns, duration also helps us understand cross-sectional variation in prices, or book-to-market ratios. Indeed, the book-to-market ratios of duration-sorted portfolios can be interpreted as an equity yield curve: the book-to-market ratio of the short-duration portfolio is the short yield, and the the book-to-market ratio of the long-duration portfolio is the long yield. This equity yield curve reflects three things: (1) the expected relative return to long- and short duration stocks, (2) the expected relative long- and short-term return on the market portfolio, and (3) the expected relative growth rates on long- and short duration stocks. Regarding the first, theory suggests that a more upward sloping yield curve predicts higher returns to long- relative to short-duration stocks, meaning it

predicts higher returns to our duration factor. We find strong empirical support for this prediction. Empirically, the slope of the equity yield curve predicts the annual returns to our duration risk factor with an R^2 of .07, and it predicts the return to the other risk factors with an R^2 of 0.05 on average. Regarding the second, theory also suggests that the level of the yield curve predicts long-run returns and the slope of the yield curve predicts the timing of these returns: a higher level of the yield curve predicts higher returns, and for a given price level, a more downward sloping equity yield curve predicts higher returns in the near future (and thus lower returns in the distant future). We also find strong evidence of this prediction. Empirically, the slope of the yield curve helps predict market returns with an R^2 as high as 40% for the 5-year return.

In conclusion, most of the cross-sectional variation in stock returns and prices can be explained by the duration of firms cash-flows. Focusing on cash-flow duration has two main advantages. First, unlike many of the other charateristics known to predict returns, duration is a tangible economic entity that matters to asset prices in most models. Second, the notion that short-duration stocks have high average returns is consistent with the evidence on the equity term structure of the market portfolio (see Binsbergen, Brandt, and Koijen, 2012; Binsbergen and Koijen, 2017), on which claims with short duration have high Sharpe ratios.

We stress, however, that cash-flow duration is only the symptom and not the source of cross-sectional variation in expected returns. Stocks do not have high returns *because* they have short cash-flow duration. Rather, we argue that cash-flow duration proxy well for the underlying economic drivers of expected returns. In our model, these underlying drivers are shocks to dividend growth and discount rates, but any risk factor related to cash-flow duration would in principle do. Similarly, behavioral biases that are more pronounced for either long- or short-duration stocks may also be useful for explaining the results. In this paper, we are deliberately vague about the underlying economic driver. Our contribution is to organize the previous zoo of characteristics into one, tangible characteristic, thereby allowing the cross-section of stock returns to be explained by one simple economic mechanism. We do, however, end the paper with a discussion of the possible economic drivers.

Our duration based explanation of the cross-section of stock returns differs from competing models by Fama and French (2015) (FF) and Hou, Xue, and Zhang (2015) (HXZ). Similarly to our paper, these authors use profitability and investment to explain stock returns, but our paper differs on multiple grounds. First, our framework is more general.

Indeed, FF and HXZ motivate the investment and profitability characteristics as measures of expected returns: for a given price, higher profitability or lower investment imply a higher rate of return. Empirically, higher profitability or lower investment indeed imply higher returns, but only because the equity term structure is downward sloping: had the equity term structure been upward sloping, higher investment and lower profitability would have lead to lower expected returns, which would come about through lower prices. As such, their models hold as a special case of ours, namely the case there the equity term structure is downward sloping. Second, and relatedly, our framework explains more factors than FF and HXZ. For instance, our framework explains why stocks with high betas, high idiosyncratic volatility, and low payout has low expected return, which FF and HXZ do not. Third, the FF and HXZ factors summarize expected returns, but their frameworks do not explain where these expected returns come from.[1] In contrast, our duration characteristic can be linked to economic drivers of returns and be embedded in a general equilibrium framework that explains the high returns to short-duration stocks. Finally, the importance of the duration characteristics is supported by the empirical evidence on the downward sloping equity term structure.

Our paper relates to a literature on duration and stock returns. Most of the previous literature has used duration as an explanation of the value premium: Dechow, Sloan, and Soliman (2004) study cash-flow duration in the cross-section of US stock returns, finding that high-duration stocks have low returns and arguing that the duration measure explains the value premium. Lettau and Wachter (2007) provide a theoretical foundation for this claim, and Chen (2017) shows that the growth rates of value firms is higher than that of growth firms in the late U.S. sample.[2] In a similar vein, Hansen, Heaton, and Li (2008) argue that value premium can be explained by the fact that value stocks are more exposed to long run consumption shocks. More recently, Weber (2018) shows that the relation between duration and stock returns is stronger when sentiment is higher, and Goncalves (2018) argues that both the value and profitability premium can be explained by the fact that short-duation stocks have high reinvestment risk. We contribute to the literature by: (1) showing that duration also explains the investment, low beta, high payout, and ivol premium; (2) explictly linking these characteristics to growth rates and

[1] HXZ argue their results are consistent with firms profit maximizing firms that invest less when the cost of capital is high. However, while this relation confirms that firms respond to their cost of capital, it does not explain *why* there are cross-sectional differences in expected returns in the first place (see Cochrane 1991, 1995 for a derivation of the expected return in the investment CAPM).

[2] Chen also finds that the growth rates on value firms are relatively *high* in the early sample, suggesting thatvalue firms were long-duration stocks in the early sample.

duration, both empirically and theorecically; (3) showing that the risk factors are priced in a simple model of a downward sloping term struture; (4) studying the equity yield curve that arise from book-to-market ratios and (5) by providing global evidence.

Our paper also relates to a recent literature on taming the factor zoo.[3] The goal of this literature is to determine which characteristics that are most important for predicting stock returns. The literature achieves this goal mainly through statistical analysis. We differ in our approach and shrink the cross-section based on economic intutition: we use basic economic arguments, coupled with analysis of dividend growth rates, to argue that many of the most prominent characteristics are symptoms of cash-flow duration, and that most of the cross-section thus can be explained by a duration characteristic, which in turn is consistent with the evidence on the equity term structure of the market portfolio.

Our paper proceeds as follows. Section I studies cross-section of stock returns in the Lettau and Wachter (2007) model and shows that prominent equity risk factors are priced in the model. Section II describes data and methodology. Section III studies the empirical relation between growth rates and the characteristics that predict returns. Section IV studies the empirical relation between cash flow duration and expected returns and the ability of the duration sorted portfolio to explain known risk factors. Section V studies the equity yield curve that arises in the cross-section of stocks. Section VI discusses the ability of various theories to explain the empirical results. Section VII concludes

1 Theory

We study the cross-sectional effects of duration on stock returns and prices in the Lettau and Wachter (2007) model.

1.1 Model

The economy has an aggregate equity claim with dividends at time t denoted by D_t, where $d_t = \ln(D_t)$ evolves as

$$\Delta d_{t+1} = \mu_g + z_t + \sigma_d \epsilon_{d,t+1} \tag{1}$$

[3]See, for instance, Feng, Giglio, and Xiu (2017); Giglio, Liao, and Xiu (2018); Harvey and Liu (2017); Harvey, Liu, and Zhu (2016); Freyberger, Neuhierl, and Weber (2017); Kozak, Nagel, and Santosh (2017).

Here $\mu_g \in \mathbb{R}$ is the unconditional mean dividend growth and z_t drives the conditional mean:

$$z_{t+1} = \varphi_z z_t + \sigma_z \epsilon_{z,t+1} \tag{2}$$

where $0 < \varphi_z < 1$. Further, $\epsilon_{d,t+1}$ and $\epsilon_{z,t+1}$ are normally distributed mean-zero shocks with unit variance and σ_d, σ_z are their volatilities.

The risk-free rate r^f is constant and the stochastic discount factor is given by

$$M_{t+1} = \exp\left(-r^f - \frac{1}{2}x_t^2 - x_t \epsilon_{d,t+1}\right) \tag{3}$$

where the state variable x_t drives the price of risk:

$$x_{t+1} = (1 - \varphi_x)\bar{x} + \varphi_x x_t + \sigma_x \epsilon_{x,t+1} \tag{4}$$

The parameter $\bar{x} \in \mathbb{R}^+$ is the long-run average, $0 < \varphi_x < 1$, and $\epsilon_{x,t+1}$ is a normally distributed mean-zero shock with unit variance and σ_x is the volatility. The three shocks have correlations denoted ρ_{dx}, ρ_{dz}, and ρ_{zx}, where $\rho_{zx} = 0$, $\rho_{dx} = 0$, and $\rho_{dz} < 0$, meaning that there is long-run insurance in dividend growth: a negative shock to dividends is over time partly offset by a higher dividend growth.

To understand the stochastic discount factor, note that investors are averse towards shocks to dividends, $\epsilon_{d,t+1}$. A negative shock to dividends increases the marginal utility and thus increases the value of the stochastic discount factor. The effect of a given shock on the stochastic discount factor depends on the price-of-risk variable x_t, which in this sense can be interpreted as a risk aversion variable. In addition, shocks to the price of risk and the conditional growth rate z_t are only priced to the extent that they are correlated with the dividend shock.

1.2 Prices and Returns

The analysis is centered around the prices and returns on n-maturity dividend claims. The price of an n-maturity claim at time t is denoted P_t^n and the log-price is denoted $p_t^n = \ln(P_t^n)$. Since an n-maturity claim becomes and $n-1$ maturity claim next period, we have the following relation for prices:

$$P_t^n = E_t\left[M_{t+1} P_{t+1}^{n-1}\right] \tag{5}$$

with boundary condition $P_t^0 = D_t$ because the dividend is paid out at maturity. To solve the model, we conjecture and verify that the price dividend ratio is log-linear in the state variables z_t and x_t:

$$\frac{P_t^n}{D_t} = \exp\left(A^n + B_z^n z_t + B_x^n x_t\right) \tag{6}$$

The price dividend ratio can then be written as

$$\frac{P_t^n}{D_t} = E_t\left[M_{t+1}\frac{D_{t+1}}{D_t}\frac{P_{t+1}^{n-1}}{D_{t+1}}\right] = E_t\left[M_{t+1}\frac{D_{t+1}}{D_t}\exp\left(A^{n-1} + B_z^{n-1} z_{t+1} + B_x^{n-1} x_{t+1}\right)\right] \tag{7}$$

Matching coefficients of (6) and (7), using (1) and (4), gives

$$\begin{aligned}
A^n &= A^{n-1} - r^f + \mu_g + B_x^{n-1}(1-\varphi_x)\bar{x} + \frac{1}{2}V^{n-1} \\
B_x^n &= B_x^{n-1}\left(\varphi_x - \rho_{dx}\sigma_x\right) - \sigma_d + B_z^{n-1}\rho_{dz}\sigma_z \\
B_z^n &= \frac{1-(\varphi)_z^n}{1-\varphi_z}
\end{aligned}$$

where $B_x^0 = 0$, $A^0 = 0$, and

$$V^{n-1} = \text{var}\left(\sigma_d \epsilon_{d,t+1} + B_z^{n-1}\sigma_z \epsilon_{z,t+1} + B_x^{n-1}\sigma_x \epsilon_{x,t+1}\right),$$

which provides the solution to the model and verifies the conjecture.

The term B_z^n is positive for all values of $n > 0$, meaning that the price increases relative to dividends when the expected growth rate of dividends increases. Similarly, B_x^n is negative for all values of $n > 0$, meaning that the price relative to dividends decrease when the price of risk is higher.

The simple return on the n maturity claim is denoted $R_{t+1}^n = P_{t+1}^{n-1}/P_t^n - 1$ and the log-return is $r_{t+1}^n = \ln\left(1 + R_{t+1}^n\right)$. The expected excess return is

$$\begin{aligned}
E_t\left[r_{t+1}^n - r^f\right] + \frac{1}{2}\text{var}_t(r_{t+1}^n) & \qquad (8) \\
= -\text{cov}_t(r_{t+1}^n; m_{t+1}) & \qquad (9) \\
= (\sigma_d + B_z^{n-1}\rho_{dz}\sigma_z)x_t & \qquad (10)
\end{aligned}$$

Because $\rho_{dz} < 0$ and B_z^n is strictly increasing in maturity n, the expected return decreases in maturity. Accordingly, the term structure of expected equity returns is downward

sloping.

1.3 The Cross Section of Stock Returns

Following Lettau and Wachter (2007), we introduce a cross section of stocks by assuming the existence of $i = 1, \ldots, N$ firms that each produce a share s_t^i of the aggregate dividends. The share produced by each firm varies deterministically over time as the firms move through their life cycles. The share starts at $\underline{s}$ and grows at g_s each period until the share hits $\bar{s} = \underline{s} \times (1 + g_s)^{N/2}$ after which it decreases by g_s until the share hits $\underline{s}$ and the cycle repeats. The lower bar is set such that the shares sum to one cross-sectionally, meaning that $\underline{s} + \underline{s}(1 + g_s)^{N/2} + \sum_{i=1}^{N/2-1}(1 + g_s)^i \underline{s} = 1$. We assume $N = 200$ firms, meaning each firm has a lifecycle of 50 years. The firms are identical except that they are at different points in their life cycle: the first firm starts at $\underline{s}$, the next firm has grown for one quarter, and so forth.

Given no arbitrage, the price of each firm is its share of future dividends times their present value,

$$P_t^i = \sum_{n=1}^{\infty} s_{t+n}^i P_t^n \tag{11}$$

and the one-period return is given by end-of-period price plus the share of the aggregate dividend received at the end of the period, divided by beginning of period price:

$$R_{t+1}^i = \frac{P_{t+1}^i + s_{t+1}^i D_{t+1}}{P_t^i} \tag{12}$$

To construct equity risk factors, we must calculate the book value of equity. We consider book value of equity as a measure of fundamental value that does not account for time-varying discount rates. Accordingly, we calculate book value as the present value of future dividends discounted using the unconditional average market risk premium. We then calculate investment as quarterly changes in book value, we calculate profitability as the dividends currently earned by the firm dividend by lagged bok value of equity, and we calculate book-to-market as the book value divided by market value of equity. In addition, we calculate momentum as the running one-year return (skipping the most recent month), and we calculate betas as rolling three year betas.

1.4 Results in Simulated Data

To study the cross-section of stock returns, we simulate 1000 simulations of 200 years of artificial data. For each simulation, we sort at each period stocks into equal-weighted quintile portfolios based on profitability, investment, book-to-market, market capitalization, and market beta. We then construct risk factors as long short portfolios based on the first and fifth quintile. For each simulation, we run CAPM regressions and calculate median intercepts and parameter estimates accross the simulations. The results are similar if we instead run one long regression.

The results of the CAPM regressions are reported in Panel A of Table 1. The risk factors based on valuation, profitability, investment, and beta all have positive CAPM alpha of 0.2 to 0.6 percent per month. Accordingly, our model of the downward sloping equity term structure is able to explain the well known CAPM alpha associated with these characteristics.

The factors have positive alpha because they are all long short-duration stocks and short long-duration stocks. In our model, the link between the risk factors and duration is as follows:

- *Profitability*: In our setting, a high profitability firm has high dividends relative to book value, which summarizes the total value of future dividends. If dividends are high today relative to future dividends, it means that the firm is on the peak of its life cycle and therefore has relatively short duration.
- *Investment*: A high investment firm has large growth in book value, meaning it has a large growth in the value of future dividends. Firms with large growth in the value of future dividends are usually in the beginning of their life cycle, and are therefore long-duration stocks.
- *Book-to-market (value)*: A value firm has a low price of future dividends, meaning their discount rate is high. Discount rates are higher for short-duration claims because the equity term structure is downward sloping. Accordingly, value firms tend to have short cash-flow duration. It is worth noting that value firms have short duration only because the equity term structure is downward sloping: had it been upward sloping, value firms would have had long duration (as long duration stocks would have had high discount rates and endogenously become value stocks).
- *Size*: Small firms have long duration because they are at the beginning of their life-cycle and are expected to experience a large growth in dividends.

- *Low-beta*: In our model, long-duration stocks have high betas because they are more exposed to the discount rate shock, $\epsilon_{x,t+1}$, and the growth rate shock $\epsilon_{z,t+1}$ as seen in equation 8 (the loading on the shocks, B_x^n and B_z^n, both increase in absolute terms in maturity n, although B_x^n increases non-monothonically). Accordingly, a low-beta stock tends to be a short duration stock.

While the Lettau and Wachter (2007) model of a downward sloping term structure is proposed to explain the value premium, the model appears better suited to explain the profitability and investment premium for multiple reasons. First, the profit and investment factors have larger alphas in our model than the value factor. In addition, the return to the profit and investment factors are more directly related to the slope of the equity term structure. Indeed, in a hypothetical upward sloping model, the profit and investment factors have negative expected returns, whereas the value factor still has positive expected returns. The positive expected returns to the value factor remains because the factor now goes long the long-duration stocks (the book-to-market ratio now identifies the long-duration stocks as endogenously cheap stocks with high expected returns). In the empirical section, we take care not to use market prices when estimating duration, exactly to avoid this problem of endogenously identifying firms with high expected returns as short-duration stocks.

Panel A in Table 1 also shows the CAPM beta of the different factors. The profit and investment factors both have negative betas. The negative betas arise because the factors are long short-duration stocks, which tend to be low-beta stocks as discussed above. Similarly, the size factor has a positive beta because it is long small long-duration stocks, which tend to have high betas. The value factor has positive market beta, which is suprising given that it is long short-duration stocks. Indeed, to the extent that the value factor is long short-duration stocks, we should expect it to have a negative betas because the short-duration stocks load less on discount rate shocks and growth rate shocks. However, the value factor is also long cheap stocks, which are cheap because they have a high loading on the dividend shock (the dividend shock is the priced source of risk). This high loading on the dividend shocks makes the beta of the value factor higher. Whether the positive effect of dividend shock or the negative effect of the growth and discount rate shock dominate depends on the calibration of the model, but in our calibration (which is based on Lettau and Wachter (2007)), the loading on the short-run dividends dominates and the value factor therefore has a positive alpha.

In the last column of Panel A, we study the return to a duration factor. In our model,

we define the duration factor as the return to a long-duration claim (fifty years) minus the return to a short-duration claim (one year). Given that the equity term structure is downward sloping, the duration factor has negative alpha. In addition, our duration factor load positively on the market portfolio, consistent with long-duration stocks having positive market betas.

In Panel B of Table 1, we augment the CAPM model with our duration factor. As expected, the profit, investment, value, and low-risk factor all load negatively on our duration factor. Indeed, these factors are all long short-duration stocks, and therefore negatively exposed to the duration factor. The negative loading on the duration factor explains most of the CAPM alpha to these risk factors. However, the factor is not able to explain all the variation in the expected returns.

In conlcusion, many prominent equity risk factors arise from a downward sloping equity term structure. The equity risk factors have positive expected return because they are long short-duration stocks. Accordingly, they load negatively on a duration factor, which explains part but not all of the factor's returns. We next study these predictions empirically.

2 Data and Methodology

We study stocks in a global sample coverying 58.135 stocks in 23 countries between August 1963 and December 2016. The 23 markets in our sample correspond to the countries belonging to the MSCI World Developed Index as of October 1, 2018. Stock returns are from the union of the CRSP tape and the XpressFeed Global Database. All returns are in USD and do not include any currency hedging. All excess returns are measured as excess returns above the U.S. Treasury bill rate.

We consider both the US sample and a broad global sample. Our broad sample of global equities contains all available common stocks on the union of the CRSP tape and the XpressFeed Global database from 1990 until 2016. For companies traded in multiple markets we use the primary trading vehicle identified by XpressFeed.

2.1 Measuring Cash Flow Duration Empirically

Following Dechow, Sloan, and Soliman (2004), we estimate cash-flow duration Dur_t as the weighted average time to duration of the firm's cash flows:

$$Dur_t = \sum_{i=1}^{\infty} i \times w_{i,t} \tag{13}$$

where the weight $w_{i,t}$ is the present value of the given cash flow relative to the total value of the firm. More precisely, we measure the weights as

$$w_{i,t} = \frac{E_t[CF_{t+i}]/(1+r)^i}{EQ_t} \tag{14}$$

where CF_{t+i} is the realized cash flow in period $t+i$, r is the expeccted return on equity, which is assumed to be constant over time and accross firms, and EQ_t is the book value of equity. We deviate from the existing litertaure in using book value of equity rather than market value of equity to measure the value of the firm. We do so to avoid sorting stocks based on market prices, which may contain risk premia corrections and therefore predict returns for reasons unrelated to duration, as explained in the theory section. We note that when using book rather than market value, the relation between cash flow duration and average returns is weaker, consistent with market prices picking up variation in discount rates unrelated to duration.

Following Dechow, Sloan, and Soliman (2004), we make two assumptions to calculate duration. First, we assume that after T periods, future cash flows consist of a level perpetuity, meaning we can write duration as

$$Dur_t = \sum_{i=1}^{T} i \times w_t^i + \left(1 - \sum_{i=1}^{T} w_t^i\right)\left(T + \frac{1+r}{r}\right) \tag{15}$$

Second, to calculate the weights we must forecast the cash flows between period t and T. To do so, we assume clean surplus accounting, meaning that the cash flows can be written as

$$CF_{t+1} = NI_{t+1} - (EQ_{t+1} - EQ_t) \tag{16}$$

where NI_t are earnings in period t. Rewriting gives

$$CF_{t+1} = EQ_t \left(1 + ROE_{t+1} - \Delta EQ_{t,t+1}\right) \tag{17}$$

where $ROE_{t+1} = NI_{t+1}/EQ_t$ is the return on equity in period $t+1$ and $\Delta EQ_{t,t+1}$ is the percentage change in book value of equity between period t and $t+1$, i.e. $\Delta EQ_{t,t+1} = (EQ_{t+1} - EQ_t)/EQ_t$. Accordingly, the weights on the future cash flows are given by

$$w_{i,t} = E_t \left[\Delta EQ_{t,t+i-1} \times (1 + ROE_{t+i}) - \Delta EQ_{t,t+i})\right] / (1+r)^i \tag{18}$$

To calculate expected return on equity and investment rates, we follow Dechow, Sloan, and Soliman (2004) and assume that both develop according to AR(1) procceses and solve for expected future values. Accordingly, at any given time, the weights on future cash flows, and thus their duration, can be calulated using only time t book equity, return on equity, and equity growth.

We follow Fama and French (2015) and use operating profitability to measure return on equity and asset expansion to measure growth in book value of equity. Both have an in-sample AR(1) coefficient of .13 and a long-run mean of .12. We assume a forecasting period of 20 years and a discount rate r of 8%. Our results are robust to other choices of input assumptions and to using other variables as measures of return on equity and growth in equity.

2.2 Measuring Dividend Growth Rates

We calculate realized dividend growth rates following Chen (2017). Each June, we construct portfolio breakpoints based on the most recent characteristics. We then calculate value-weighted portfolio weights for the subsequent 180 months based on each months ex ante market prices. Using these weights, we calculate sans and cum dividend returns of the portfolio in each month. Using the sans dividend dividend return, we calculate how the value of a \$1 investment in each portfolio develops over time, inclduding delisting returns. Using the value of the portfolio, and the difference between the cum and sans dividend return, we calculate the monthly dividends to the portfolio.

More precisely, the value at time $t+s$ of the portfolio formed at period t is given by:

$$V^t_{t+s} = V^t_{t+s-1}(1 + retx^t_{t+s}) \tag{19}$$

where $retx^t_{t+s}$ is the sans dividend return between period $t+s-1$ and $t+s$ to the portfolio formed at time t. The dividends in period $t+s$ of the portfolio formed at period t is then given by:

$$D^t_{t+s} = V^t_{t+s-1}(ret^t_{t+s} - retx^t_{t+s}) \tag{20}$$

where ret^t_{t+s} is the cum dividend return between period $t+s-1$ and $t+s$ to the portfolio formed at time t.

Note that we assign stocks to portfolios based on the formation month measure of duration and portfolios weights are also calculated based on formation month market capitalization. Accordingly, each stock remain in the same portfolio over time, but the portfolio weights are rebalanced each month to maintain weights based on formation period market capitalization (the portfolio weights may chance as firms are delisted).

For each formation period, we calculate the average dividends per \$1 initial investment in each year after formation until year fifteen. To calculate the dividend growth rate, we calculate the average dividends per year after formation across the different formation periods, and finally calculate dividend growth rates as the growth in the average dividends over the fifteen years after formation.

3 Which Characteristics Predict Growth Rates and Duration?

We start our empirical analysis by studying the relation between growth rates and the major characteristics that have been proven to predict returns in the literature. We create 70 characteristics-sorted portfolios, ten sorted on each of the following: market capitalization, book-to-market, profitability, investment, beta, idiosyncratic volatility, and payout. We calculate the average fifteen year dividend growth rates for these portfolios as explained above. We also calculate the sample average of the above characteristics for each of the portfolios. This gives us 70 observations of dividend growth rates and characteristics.

Table 2 Panel A shows the parameter estimates and t-statistics from the following regression of average growth rates on average characteristics:

$$\overline{\text{Growth rates}}_i = \beta_0 + B\overline{X}'_i + \epsilon_i \tag{21}$$

where $\overline{\text{Growth rates}}_i$ is the average growth rate for portfolio i and $\overline{X}'_i$ is a vector of the

following average characteristics for portfolio i: book-to-market value of equity, operating profitability over book equity, eannual growth in total assets times minus one, market beta times minus one, idiosyncratic times minus one, and the payout ratio. These characteristics are all signed such that a higher characteristic implies a higher expected CAPM alpha. All characteristics are measured in cross-sectional percentages.

The results show that the average dividend growth rates loads positively on all of the six characteristics, although the effect is statistically insignificant for some of the parameter estimates. These results suggest that firms that have characteristics that predict high return also have low realized growth rates, which means that they have short duartion.

The regression in (21) relates the average realized dividend growth rates to average characteristics. Ideally, we would relate expected growth rates to contemporaneous charcteristics. In principle, we could regress rolling realized dividend growth rates of the portfolios on ex ante characteristics. However, because we use fifteen years to calculate dividend growth rates, we do not have many non-overlapping observations of divivdend growth rates and characteristics, and we therefore refrain from this exercise here.

Instead, we study the relation between expected growth rates and the contemporaneous firm characteristics by using analyst expectations from IBES. More precisely, we use the long term growth expectations (LTG) from IBES to measure the long term growth expectations. These are defined as the analysts' expected growth rate for the firm over the next business cycle. The business cyclce is not defined in years, which means that the LTG expectations cannot easily be stated in terms of expected growth per year. Given that the abosolute value of the growth rates are difficult to interpret, we instead transform them into cross-sectional percentiles and focus on the cross-sectional ranking of growth rates.

Panel B of Table 2 shows the univariate correlation bewteen the LTG and the contemporaneuos characteristics of the given firm. All characteristics are again signed such that a higher characteristic predicts a higher return (CAPM alpha). LTG is negatively corelated with all the characteristics, again emphasizing that firms with characteristics that predict high returns also have low growth rates.

We next regress the LTG expectations on all the characteristics in a multivariate regression. This regression tells us whether the individual characteristics contain incremental predictive power over LTG expectations, or if one of the characteristics are driven out by the other. We conduct this analysis using a panel regression that includes firm and time fixed effects.

The results of the Panel regression are presented in Table 1 Panel C. The LTG expectations load negatively on all the characteristics that predict returns. This results holds both if we do sample splits and and if we exclude either the firm or time fixed effects. In addition, the R^2 are high, even when we exlcude firm fixed effects (time fixed effects are, unsuprisingly, not very informatiive, as both the LTG expecations and the characteristics are measured in cross-sectional percentiles).

In conlusion, all of the above mentioned characteristics that predict returns are negatively correlated with growth expectations. This common denominator suggests that these characteristics may all predict returns exactly because they predict duration. To test this hypothesis, we next study the relation between duration and stock returns.

4 Duration and Stock Returns

Table 2 studies ten portfolios sorted on our measure of ex ante duration. The portfolio breakpoints are based on NYSE firms and refreshed every year, and the portfolio weights are value-weighted and rebalanced each calendar month. As can be seen in the first row, the average monthly excess returns decrease in duration. The effect is economically and statistically significant: the monthly return to the long-short portfolio is minus 0.28 percent and the t-statistic is -2.33. These results are consistent with prior research by Dechow, Sloan, and Soliman (2004) and the notion that the equity term structure is downward sloping. The table also reports the market betas and CAPM alphas. Consistent with our model, the market betas increase monotonically in duration. Given that expected returns decrease in duration and market betas increase, the alphas also decrease as duration increases. The excess return and alphas of the duration sorted portfolios are plotted in Figure 1.

We next verify that our ex ante measure of cash-flow duration indeed predicts realized cash-flow duration. To do so, we calculate the realized dividend growth rates of buy and hold portfolios following Chen (2017). Every June, when new portfolios are constructed, we calculate the real dividends one would receive each year if one where to invest \$1 in the portfolio and hold it for fifteen years. We then average accross the different formation years to get the average dividends received per year after portfolio formation. Based on these, we calculate the annualized dividend growth rate for each of the ten duration sorted portfolios.

As can be seen in the bottom of Table 2, the dividend growth rates increase as duration increases. The portfolios with the longest cash-flow duration has a realized dividend

growht rate of 3.0% whereas the portfolio with the shortest duration has a growth rate of 1.0%. Figure 2 further plots the cumulative dividend growth rate per year after formation period for long- and short-duration stocks. The figure consider the average rate for the five high-duration portfolios and the average rate for the five low-duration portfolios, measued in excess of the average of all ten portfolios. As can be seen in the figure, the long-duration stocks grows faster than the short-duration stocks, and the difference in growth rates increases as we get further away from the formation period.

To put the growth rates in perspective, we calculate realized duration under the assumption that the dividend growth rates continue forever and that the discount rate is the same for all stocks. As shown in the bottom of Table 2, the realized duration varies from 20 years for the short-duration portfolios to 32 years for the long-duration portfolio. In addition, Figure 3 plots the ex post realized duration and Sharpe ratios of the ten portfolios. The two are strongly negatively correlated with a correlation estimate of -0.9, underlining that the price of risk is closely related to the duration of the firms' cash flows.

We next study the relation between cash-flow duration and other characteristics known to predict return. To do so, we create equity risk factors for different characteristics based on the Fama and French (1993) method. That is, each June, we sort stocks into six portfolios based on the median market capitalization and the 30th and 70th percentile of the given characteristic. The portfolio breakpoints are unconditional and based on NYSE firms. Portfolio weights are value-weighted and rebalanced at the end of each calendar month. All factors are set up to have positive CAPM alpha, except for our duration factor which is long long-duration stocks and short short-duration stocks and thus have a negative average return.

Table 3 analyzes our Fama and French duration factor in detail. The results are largely similar to the results in Table 2: the short duration portfolios have lower average returns than the long duration portfolios, meaning that our duration factor has negative average returns. This negative return is both economically and statistically significant at -0.29 percent per month. In addition, the long-duration portfolios have higher betas than the short-duration portfolios, meaning that the duration factor has a positive market beta and negative alpha of -0.42 percent per month. Importantly, the effect is neither driven by the short cap firms nor driven by the short-leg of the portfolio.

Figure 4 shows the excess return and alpha to our duration sorted portfolio. The y-axis is inverted, meaning that a higher value means lower cumulative return to the duration factor. Both the CAPM alpha and excess return trend steadily upwards in the

sample, which is to say that the duration factor steadily loses money. The only substantial deviation from the trend occurs around the dot-com bubble where long-duration stocks experience a high return, and the duration factor thus becomes profitable. The high returns to the long-duration portfolio are consistent with the high surge in prices that it and growth firms experiences during the bubble.

Before anlayzing the relation between our duration factor and other equity risk factors, we study the CAPM performance of these risk factors. Panel A in Table 4 report the excess return and CAPM alphas for the size, value, profitability, and investment factor of Fama and French (2015), a low-beta factor, a low-idiosyncratic volatility factor, and a payout factor. Consistent with previous research, these factors all have positive CAPM alphas and negative market betas.

In Panel B of Table 4, we control for our duration factor on the right hand side. All the risk factors load on our duration factor as predicted by theory. Except for size, the factors all load negatively on our duration factor. Given that the duration factor has negative return on average, the negative loadings on the duration factor helps explain the alpha to these risk factors. For the value, profitability, and low-beta factors, the duration factor explains allmost all the alpha, leaving the intercept statistically indistinguishable from zero. For the investment factor, the alpha remains statistically significant after controlling for duration, but the duration factor explains more than half of the original CAPM alpha, leaving the factor with a residual alpha of 14 basis points per month and t-statistic of 2.17, which is well below the thresshold of 3 suggested by Harvey, Liu, and Zhu (2016).

Regarding the size factor, it loads on our duration factor as predicted by the model: small firms have longer duration. However, the size factor has positive and statistically significant alpha once controlling for duration, which is inconsistent with our model. Indeed, in our model, we would expect the size factor to have negative CAPM alpha and zero alpha once controlling for duration. The positive alpha could, however, arise from liquidity issues in small cap firms that our model abstracts from.

We next study the effect of duration on stock returns in the global sample. We construct a duration factor in each country in our sample as well as a global duration factor, which is the market capitalization weighted average of the country specific duration factors. Figure 5 shows the CAPM alpha and information ratios by country. The duration factor has positive CAPM alphain each country in our sample except New Zealand.

We next address the global sample in more detail in Table 5. Panel A shows the

CAPM regressions for the size, value, profit, investment, beta, ivol, and payout factors. All factors have positive CAPM alphas but the alpha is insignificant for the size and payout factors. As in the US, all factors have negative and statistically significant market betas. In Panel B, we augment the CAPM model with our global duration factor. All factors except size load highly negatively on our duration factor. Accordingly, our duration factor explain most of the CAPM alpha to these factors. The only factors that have alpha after controlling for duration is size and the profitability factor, but both factors has a t-statistic below the threshold of three set by Harvey, Liu, and Zhu (2016).

5 Duration and Stock Prices: The Equity Yield Curve

We next study the book-to-market ratios of long- and short-duration firms. These book-to-market ratios together constitute the equity yield curve. Indeed, Binsbergen, Hueskes, Koijen, and Vrugt (2013) define equity yields as the hold-to-maturity return minus hold to maturity growth rates of dividends with different maturity. Similarly, book-to-market ratios of duration sorted portfolios measures the future expected return and growth rate of firms with different cash-flows maturity (Vuolteenaho, 2002).

We calculate the level of the equity yield curve as the average log book-to-market ratio of the four portfolios that constitute the duration factor. Similarly, we calculate the slope of the equity yield curve as the average log book-to-market ratio of the two long-duration portfolios in the duration factor (i.e. its long leg) minus the average log book-to-market ratio of the two short-duration portfolios in the duration factor (i.e. its short leg).

Figure 6 plots the level and the slope of the equity yield curve. As can be seen from the figure, the slope is positive in most of the sample, which may be surprising given that long-duration stocks have lower return than short-duration stocks. However, the long-duration stocks also have higher growth rates than short duration stocks, pushing up the yield, or book-to-market ratio, of the long-duration portfolio thus making the yield curve upward sloping (recall, long-duration stocks are long-duration stocks exactly because they have high growth rates).

We use the slope of the equity yield curve to predict returns. As shown in Gormsen (2018), the slope of the equity yield curve predicts either expected future changes in yields or the relative return between long- and short-duration stocks. We find evidence that both is the case.

We first test if the slope of the equity yield curve predict the returns to the duration factor and other risk factors. Table 7 shows the results of predictive regressions. The

dependent variables are the future realized one-year return to the equity risk factors and the dependent variable are the ex ante level and slope of the yield curve. We run rolling monthly regressions and use Newey West standard errors corrected for 18 lags.

As can be seen in the leftmost column of Table 7, the slope of the yield curve predicts future returns to the duration factor. When the yield curve is more upward sloping, long duration stocks have relatively higher returns and the duration factor thus has higher returns. The effect is statistically significant. The level of the yield curve does not predict the return to duration factor. The R^2 is 0.07.

The slope of the yield curve also predict the return to other risk factors as expected. The risk factors that are long short-duration stocks load negatively on the slope of the yield curve, which is to say that the have lower return when the yield curve is more upward sloping, although the effect is insignificant for all factors except the investment factor. Similarly, the size factor, which is long long-duration stocks, loads positively on the slope of the yield cureve. The effect of the level of the yield curve varies from factor to factor. The R^2 ranges from 0.03 to 0.09.

We next test if the equity yield curve predicts the return to the market portfolio. A higher level of the equity yield curve should ceteris paribus predict a higher return to the market portfolio over the long run. In addition, if the equity yield curve is more upward sloping, it suggests that this return is expected to be earned in the more distant future rather than the closer future. Accordingly, we expect a higher level to predict higher returns over the one-five year horizon and a more upward sloping curve to predict lower returns over the one- to five-year horizon. The results in Panel B of Table 7 are consistent with this: a higher yield curve predicts higher returns and a more upward sloping yield curve predicts lower returns. The effect is both statistically and economically significant with the R^2 as high as 41% for the 5-year return.

Accordingly, the slope of the yield curve predicts both future returns and the relative return between long- and short-duration stocks. To furter understand the yield curve, and thus cross-sectional variation in valution ratios, we next test what more the yield curve predicts.

In Table 8, we find that the yield curve is largely unrealted to the level of the yield curve, but it is strongly negatively related to cay (Lettau and Ludvigson, 2001): a higher cay implies a more downward sloping yield curve. This result is consistent with Cochrane (2011) who finds that the cay variable predominantly predicts term structure effects: when cay is high, the long-run market return is not necessarily high, but the return over the

next couple of years is high. This similarity between Cochrane's results and ours lends further confidence to our methdology and the notion that the book-to-market ratios of the duration sorted portfolios indeed reflect the equity yield cruve.

In addition, Table 8 also studies if the yield curve predicts future changes in yields. In the three right-most columns of the table, the dependent variable is the future change in the level of the yield curve over different horizons. The parameter estimate on the slope is negative for the one-year change, but it is positive at longer horizons. The results are, however, statistically insignificant.

6 Economic Drivers of Duration Based Asset Pricing

We have presented cash-flow duration as the unifying characteristic for understanding cross-sectional variation in expected stock return and prices. Focusing on duration has multiple advantages: First, by distilling the cross-section to a single characteristic it becomes easier to write economic models explaining it. Second, and relatedly, duration is a tangible economic characteristic which it is easily incorporated in economic model. Third, the high return to short-duration stocks is consistent with, and easily mapped to, the downward sloping equity term structure documented by Binsbergen, Brandt, and Koijen (2012); Binsbergen and Koijen (2017).

We stress, however, that duration is only the sympton and not the source of cross-sectional variation in expected returns. In the rational framework, expected returns arise due to covariance with the stochastic discount factor, not due to the timing of ca sh-flows. I2n our model, it is covariance with the cash-flow shock and not duration that generates expected returns, but duration is a good proxy for this covariance: near-future cash-flows covary more with the cash-flow shock; distant future cash-flows covary less with the cash-flow shock because changes in the long-run growth rate partly offset shocks to the cash-flows.

One can imagine other mechanisms that relate expected returns to the maturity of cash flows. The model we have studied thus far is a general model based on an exogenous stochastic discount factor without a microfoundation. We deliberately chose as general a model as possible to illustrate the generality of our main result: most of the cross-section of stocks can be explained by a simple model that relates expected returns to duration.

7 Conclusion

We study the relation between cash-flow duration and stock prices and returns. Accross a broad global sample of 23 countries, stock with short duration have higher average return than stocks with long duration. More importantly, other characteristics that are known to predict returns also predict a short cash-flow duration, and we thus argue that these characteristics only predict returns because they predict a short cash-flow duration. Consistent with this argument, our duration factor explains most of the cross-section of stock returns in both the U.S. and global sample. In addition, the book-to-market ratios of the duration-sorted portfolios constitute an equity yield curve that intuitively predicts the relative return to long- and short-duration stocks and the timing of the expected return to the market portfolio. These results are all consistent with a simple model of a downward sloping equity term structure.

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Table 1

Theory: Equity Risk Factors in a Model with a Downward Sloping Equity Term Structure

This table show the CAPM alpha and duration of equity risk factors in our asset pricing model. The CAPM alpha is the intercept in a regression of return to the risk factor on the market portfolio. Duration is measured the difference in value-weighted years to maturity of the cash flows of the firms in the long- and short leg of the risk factors. The table shows the median estimates of 1000 simulations of 700 quarters of data. Alphas are in monthly percent.

	SMB	HML	RMW	CMA	Low Risk	DUR
Long leg:	Small firms	High B/M	High profit	Low investment	Low beta	High duration
Short leg:	Big firms	Low B/M	Low profit	High investment	High beta	Low duration
CAPM alpha	-0.34	0.23	0.60	0.43	0.39	-1.35
Duration (years)	-8	-8	-8	-8	-8	12

Table 2
Growth Rates and the Characteristics that Predict Returns

This table show the relation between future growth rates and the characteristics that predict returns. Panel A shows the results of a regression analysis for 70 characteristics sorted portfolios. The dependent variable is the realized 15-year dividend growth rates and the explanatory variables are the average characteristics of the portfolios 70 portfolios. Panel B reports the univariate correlations between the expected growth rates in survey data and firm characteristics. The expected survey growth rates are the median long-term growth (LTG) estimate in IBES. Panel C reports results from monthly firm level panel regressions. The dependent variable is the long-term growth rates from survey data and the explanatory variables are contemporaneous firm characteristics. Standard errors are two-way clustered across firm and date. All characteristics and survey growth rates are measured in cross-sectional percentiles.

Panel A: Portfolio level regressions

Dependent variable:	Explanatory variables					
	High value	High profit	Low inv	Low beta	Low IV	High pay
Realized 15-year	**-0.08**	**-0.06**	-0.01	**-0.04**	-0.06	-0.01
dividend growth rate	(-5.84)	(-3.90)	(-0.58)	(-2.50)	(-1.96)	(-0.77)

Panel B: Firm-level univariate correlations between characteristics and survey expectations of growth rates

	High BM	High profit	Low inv	Low beta	Low IV	High pay
Survey growth rates	-0.42	-0.10	-0.26	-0.30	-0.37	-0.38

Panel C: Firm-level regressions of survey expected growth rates on different characteristics

	Dependent variable: survey expected growth rates (LTG)					
	(1)	(2)	(3)	(4)	(5)	(6)
High value	**-0.25**	**-0.23**	**-0.26**	**-0.39**	**-0.27**	**-0.39**
	(-18.70)	(-13.09)	(-12.76)	(-26.33)	(-19.26)	(-26.33)
High profit	**-0.09**	**-0.04**	**-0.13**	**-0.22**	**-0.10**	**-0.22**
	(-8.000)	(-4.649)	(-8.005)	(-14.06)	(-9.942)	(-14.08)
Low investment	**-0.06**	**-0.07**	**-0.05**	**-0.12**	**-0.07**	**-0.12**
	(-13.23)	(-9.182)	(-11.29)	(-12.42)	(-14.19)	(-12.51)
Low beta	**-0.06**	-0.02	**-0.05**	**-0.11**	**-0.05**	**-0.11**
	(-5.850)	(-1.818)	(-3.119)	(-6.285)	(-4.901)	(-6.318)
Low IV	**-0.02**	0.00	**-0.02**	**-0.25**	**-0.04**	**-0.25**
	(-4.020)	(-0.513)	(-3.108)	(-17.15)	(-6.785)	(-17.29)
High payout	**-0.14**	**-0.14**	**-0.12**	**-0.16**	**-0.15**	**-0.16**
	(-18.39)	(-16.02)	(-10.47)	(-15.62)	(-18.43)	(-15.57)
Firm FE	YES	YES	YES		YES	
Time FE	YES	YES	YES	YES		
Sample	Full	Early	Late	Full	Full	Full
Observations	45150	20814	23820	46078	45150	46078
R2	0.71	0.76	0.71	0.38	0.70	0.38

Table 3
Risk and Return for Portfolios Sorted on Duration

This table shows the risk and return characteristics for ten long-only portfolios sorted on duration and a long-short portfolio. We sort stocks intro ten groups based on our measure of ex ante duration. Portfolio weights are value-weighted and rebalanced monthly and the breakpoints are refreshed each June and based on NYSE firms. CAPM alpha is the intercept in a regression of the excess return to the portfolio on the excess return to the market portfolio. We report *t*-statistics in parenthesis under parameter estimates and statistical significance at the five percent level is marked in bold. Sharpe ratios and information ratios are annualized. Excess return and alphas are in monthly percent. Realized duration is calculated based on the assumption that dividend growth rates of the portfolios continue forever and a constant discount rate of 6% per year for all portfolios.

	Portfolios sorted on duration										Long/short
	1	2	3	4	5	6	7	8	9	10	10 minus 1
Excess return	**0.63**	**0.62**	**0.57**	**0.55**	**0.57**	**0.52**	**0.58**	**0.51**	0.42	0.35	**-0.28**
	(3.70)	(3.80)	(3.33)	(3.25)	(3.26)	(2.85)	(3.11)	(2.51)	(1.94)	(1.51)	(-2.33)
CAPM alpha	**0.19**	**0.20**	**0.11**	0.10	0.11	0.04	0.08	-0.03	**-0.16**	**-0.26**	**-0.45**
	(2.86)	(3.05)	(2.12)	(1.74)	(1.77)	(0.58)	(1.36)	(-0.53)	(-2.14)	(-3.45)	(-4.20)
CAPM beta	**0.89**	**0.85**	**0.92**	**0.91**	**0.93**	**0.97**	**0.99**	**1.09**	**1.16**	**1.22**	**0.33**
	(61.11)	(58.34)	(78.90)	(69.76)	(69.46)	(67.19)	(72.91)	(76.57)	(71.19)	(71.60)	(13.92)
Sharpe ratio	0.51	0.52	0.46	0.45	0.45	0.39	0.43	0.35	0.27	0.21	-0.32
Information ratio	0.40	0.42	0.29	0.24	0.25	0.08	0.19	-0.07	-0.30	-0.48	-0.58
Adjusted-R^2	0.86	0.84	0.91	0.89	0.88	0.88	0.89	0.90	0.89	0.89	0.23
# of observations	630	630	630	630	630	630	630	630	630	630	630
Annualized 15-year dividend growth	1.0%	1.9%	2.0%	1.6%	2.2%	2.4%	2.3%	2.4%	3.2%	3.0%	
Survey expectations on LTG	2.0%	1.9%	1.9%	1.9%	1.9%	2.1%	2.1%	2.4%	2.7%	3.2%	
Realized duration	20	24	24	22	25	27	26	26	33	32	

Table 4
The Duration Factor

This table shows the risk and return characteristics for the portfolios that constitute our duration factor. We sort stocks into six portfolios based on ex ante size and duration. The breakpoints are the median market capitalization and the 30th and 70th percentile of duration. Portfolio weights are value-weighted and rebalanced monthly and the breakpoints are refreshed each June and based on NYSE firms. The duration factor is long 50 cent in the two high-duration portfolios and short 50 cent in each of the two short duration portfolios. CAPM alpha is the intercept in a regression of the risk factor on the excess return to the market portfolio. We report *t*-statistics in parenthesis under parameter estimates and statistical significance at the five percent level is marked in bold. Sharpe ratios and information ratios are annualized. Excess return and alphas are in monthly percent.

	Long duration		Short duration		Duration factor
	Large cap	Small cap	Large cap	Small cap	
Excess return	0.39 (1.89)	**0.61** (2.39)	**0.57** (3.55)	**1.02** (4.76)	**-0.29** (-3.74)
CAPM alpha	**-0.16** (-3.18)	0.00 (-0.03)	**0.15** (3.15)	**0.50** (4.84)	**-0.41** (-6.15)
CAPM beta	**1.13** (101.15)	**1.27** (45.71)	**0.87** (81.82)	**1.05** (45.20)	**0.24** (16.06)
Sharpe ratio	0.26	0.33	0.49	0.66	-0.52
Information ratio	-0.44	0.00	0.44	0.67	-0.86
Adjusted-R^2	0.94	0.77	0.91	0.76	0.29
# of observations	630	630	630	630	630

Table 5
Explaining Equity Risk Factors with Duration

This table shows the results of factor regressions in the U.S. sample. Each factor is on six portfolios based on ex ante size and the characteristic the portfolio is sorted on. The breakpoints are the median market capitalization and the 30th and 70th percentile of duration. Portfolio weights are value-weighted and rebalanced monthly and the breakpoints are refreshed each June and based on NYSE firms. Each factor is long 50 cent in the two high-characteristic portfolios and short 50 cent in each of the two low-characteristic portfolios. Two-factor alpha is in the intercept in a regression of the given equity risk factor on the market portfolio and the duration factor. CAPM alpha is the intercept in a regression of the risk factor on the excess return to the market portfolio. We report *t*-statistics in parenthesis under parameter estimates and statistical significance at the five percent level is marked in bold. Sharpe ratios and information ratios are annualized. Excess return and alphas are in monthly percent. The sample is from 1963-2016.

Panel A: CAPM alpha	SMB	HML	RMW	CMA	BETA	IVOL	PAY
CAPM alpha	0.16 (1.38)	**0.43** (3.91)	**0.30** (3.57)	**0.39** (5.20)	**0.55** (4.31)	**0.58** (4.35)	**0.28** (3.43)
CAPM beta	**0.20** (7.46)	**-0.19** (-7.70)	**-0.10** (-5.45)	**-0.17** (-10.48)	**-0.81** (-28.29)	**-0.65** (-21.90)	**-0.19** (-10.41)
# of observations	630	630	630	630	630	630	630

Panel B: Two-factor model	SMB	HML	RMW	CMA	Low Risk	Low TV	Payout
CAPM alpha	**0.42** (3.71)	0.08 (0.81)	0.01 (0.18)	**0.14** (2.17)	0.13 (1.19)	0.03 (0.26)	0.11 (1.44)
Market beta	0.05 (1.56)	0.02 (0.65)	**0.06** (3.49)	-0.03 (-1.82)	**-0.57** (-19.62)	**-0.33** (-12.61)	**-0.09** (-4.56)
Duration beta	**0.63** (9.55)	**-0.86** (-15.26)	**-0.70** (-16.69)	**-0.60** (-16.03)	**-1.02** (-15.71)	**-1.35** (-22.88)	**-0.40** (-8.74)
Sharpe ratio	0.29	0.41	0.40	0.52	0.11	0.21	0.29
Information ratio	0.53	0.12	0.03	0.31	0.17	0.04	0.21
Adjusted-R^2	0.20	0.33	0.34	0.39	0.68	0.69	0.24
# of observations	630	630	630	630	630	630	630

Table 6
Explaining Equity Risk Factors with Duration: Global Evidence

This table shows the results of factor regressions in our broad global sample. We construct global factors as the market-cap weighted average of country specific factors. Each country specific factor is based on six portfolios formed on ex ante size and the characteristic the portfolio is sorted on. The breakpoints are the median market capitalization and the 30th and 70th percentile of duration. Portfolio weights are value-weighted and rebalanced monthly and the breakpoints are refreshed each June and based on NYSE firms. Each factor is long 50 cent in the two high-characteristic portfolios and short 50 cent in each of the two low-characteristic portfolios. Two-factor alpha is in the intercept in a regression of the given equity risk factor on the market portfolio and the duration factor. CAPM alpha is the intercept in a regression of the risk factor on the excess return to the market portfolio. We report *t*-statistics in parenthesis under parameter estimates and statistical significance at the five percent level is marked in bold. Sharpe ratios and information ratios are annualized. Excess return and alphas are in monthly percent. The sample is from 1990-2016.

Panel A: CAPM alpha	SMB	HML	RMW	CMA	BETA	IVOL	PAY
CAPM alpha	0.05 (0.39)	**0.33** (2.50)	**0.42** (5.30)	**0.31** (3.10)	**0.45** (3.13)	**0.55** (3.32)	0.11 (1.26)
CAPM beta	-0.01 (-0.57)	**-0.07** (-2.36)	**-0.15** (-8.70)	**-0.16** (-7.37)	**-0.71** (-22.45)	**-0.53** (-14.42)	**-0.09** (-4.81)
# of observations	630	630	630	630	630	630	630
Panel B: Two-factor model	**SMB**	**HML**	**RMW**	**CMA**	**Low Risk**	**Low TV**	**Payout**
CAPM alpha	**0.32** (2.95)	0.06 (0.46)	**0.15** (2.59)	0.10 (1.10)	-0.03 (-0.23)	-0.09 (-0.86)	-0.03 (-0.32)
Market beta	**-0.16** (-5.66)	**0.07** (2.27)	-0.01 (-0.99)	**-0.06** (-2.38)	**-0.47** (-16.94)	**-0.20** (-7.55)	-0.02 (-1.01)
Duration beta	**0.75** (9.44)	**-0.74** (-8.21)	**-0.72** (-16.88)	**-0.57** (-8.22)	**-1.31** (-16.26)	**-1.75** (-22.98)	**-0.38** (-5.98)
Sharpe ratio	0.07	0.45	0.81	0.45	0.15	0.32	0.16
Information ratio	0.61	0.10	0.54	0.23	-0.05	-0.18	-0.07
Adjusted-R^2	0.22	0.19	0.58	0.30	0.80	0.78	0.16
# of observations	306	306	306	306	306	306	306

Table 7
Predicting Returns with the Equity Yield Curve

This table reports the results of predictive regressions. We regress the future realized returns of different risk factors on the ex ante level and slope of the equity yield curve. The level is the equal weighted log book-to-market ratio of the four sub portfolios in the duration factor, and the slope is the average log book-to-market ratio of the long-leg of the two long-duration portfolios in the duration factor minus the average log book-to-market ratio of the two short-duration portfolios in the duration factor. In Panel A, we run monthly regressions of annualized returns. In Panel B, we run monthly regressions with varying holding horizon. We report *t*-statistics based on Newey West standard errors in parenthesis under parameter estimates and statistical significance at the five percent level is marked in bold.

Panel A: X-section

Long leg:	DUR Long duration	SMB Small cap	HML High B/M	RMW High profit	CMA Low invest	Low Risk Low beta	Low TV Low vol	Payout High payout
Level of yield curve	0.02	**0.11**	0.04	-0.05	0.02	-0.04	-0.11	0.01
	(0.49)	(2.35)	(0.73)	(-1.20)	(0.46)	(-0.49)	(-1.63)	(0.29)
Slope of yield curve	**0.12**	0.06	-0.13	**-0.15**	-0.10	-0.15	-0.20	-0.10
	(2.45)	(0.52)	(-1.38)	(-2.28)	(-1.64)	(-0.94)	(-1.36)	(-1.30)
Adjusted-R^2	0.07	0.08	0.03	0.09	0.03	0.02	0.08	0.03
# of observations	618	618	618	618	618	618	618	618

Panel B: Market

Horizon	MKT 1 year	MKT 2 years	MKT 3 years	MKT 4 years	MKT 5 years
Excess return	**0.16**	**0.31**	**0.44**	**0.66**	**1.01**
	(2.59)	(2.69)	(2.77)	(3.38)	(4.68)
CAPM beta	-0.13	**-0.44**	**-0.70**	**-0.94**	**-1.21**
	(-1.29)	(-2.20)	(-2.27)	(-2.33)	(-2.98)
Adjusted-R^2	0.09	0.19	0.25	0.31	0.41
# of observations	618	606	594	582	570

Table 8
What Does the Slope of the Yield Curve Predict?

This table report regressions results where the slope of the yield curve is the explanatory variable. The dependent variable in the leftmost regressions are the contemporaneous level of the yield curve and the CAY variable of Lettau and Ludvigson (2001). The level is the equal weighted log book-to-market ratio of the four sub portfolios in the duration factor, and the slope is the average log book-to-market ratio of the long-leg of the two long-duration portfolios in the duration factor minus the average log book-to-market ratio of the two short-duration portfolios in the duration factor. The dependent variable in the three rightmost columns are the one, three, and five year change in the level of the yield curve. We use monthly regressions in all specifications except for the CAY regression where we use quarterly regressions. We report *t*-statistics based on Newey West standard errors in parenthesis under parameter estimates and statistical significance at the five percent level is marked in bold.

	Level	CAY	Δlevel 1 year	Δlevel 3 years	Δlevel 5 years
Slope of yield curve	0.25	**-0.06**	-0.03	0.14	0.31
	(1.19)	(-3.99)	(-0.27)	(0.45)	(0.79)
Adjusted-R^2	0.02	0.30	0.00	0.01	0.02
# of observations	630	205	618	594	570

Figure 1
Average Return and Alpha for Duration Sorted Portfolios

This figure shows the average excess return and CAPM alpha for ten long-only portfolios sorted on duration and a long-short portfolio. We sort stocks intro ten groups based on our measure of ex ante duration. Portfolio weights are value-weighted and rebalanced monthly and the breakpoints are refreshed each June and based on NYSE firms. CAPM alpha is the intercept in a regression of the excess return to the portfolio on the excess return to the market portfolio.

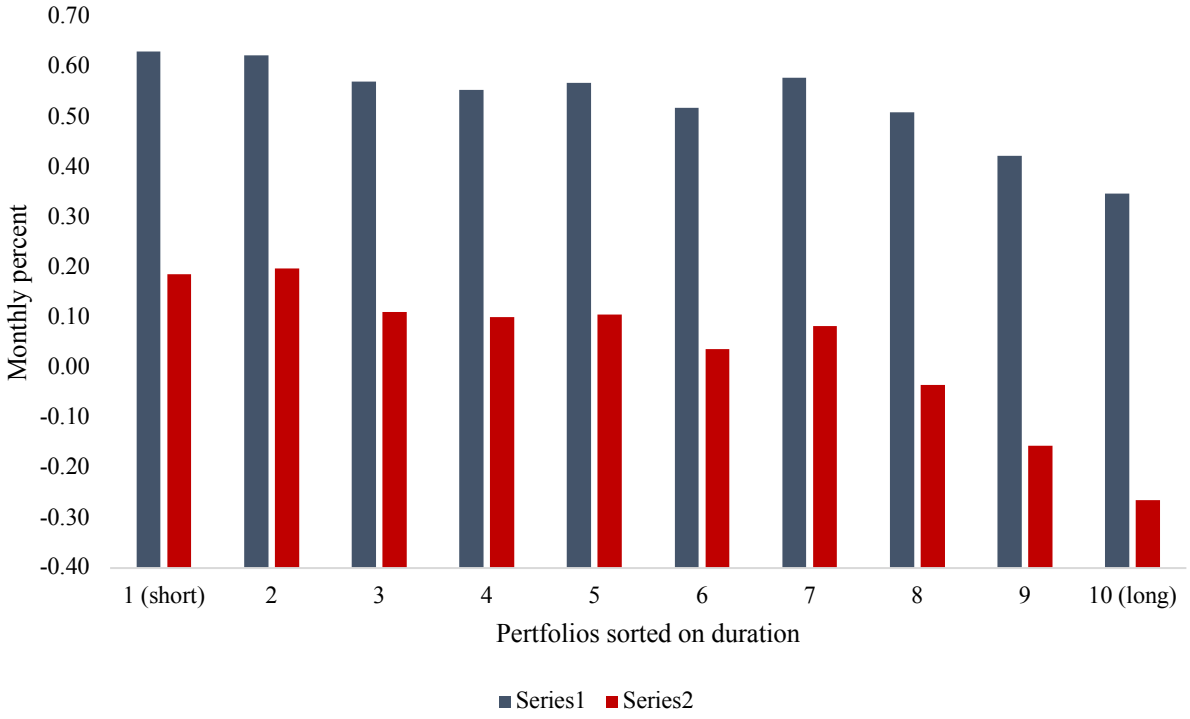


Figure 2
Realized Dividend Growth Rates for Long- and Short-Duration Firms

This figure shows the realized dividend growth rates for long and short duration firms. We sort stocks intro ten groups based on our measure of ex ante duration. Portfolio weights are value-weighted and rebalanced monthly and the breakpoints are refreshed each June and based on NYSE firms. Starting each June, calculate the dividend growth rates of the portfolios over the subsequent fifteen years and average across different years to get average growth rates by year after formation period. The figure shows the average cumulative growth rate of the five high-duration portfolios per year after formation period and the average cumulative growth rate of the five low-duration portfolios. All growth rates are measured in excess of the cross-sectional average and are adjusted for inflation.

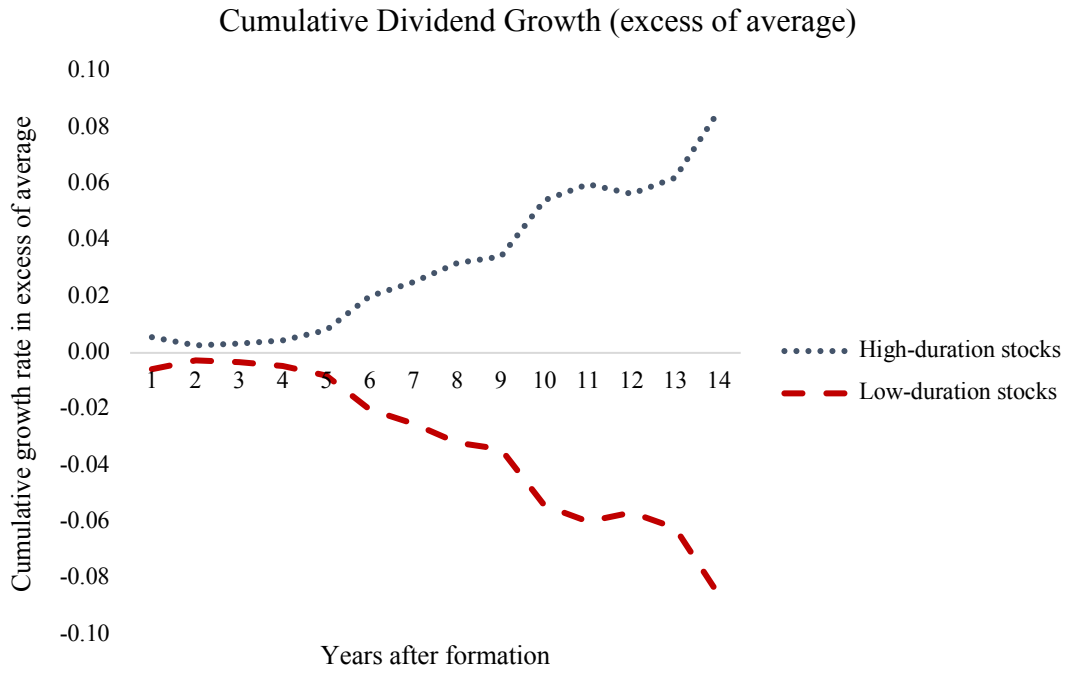


Figure 3
Realized Duration and Sharpe Ratios

This figure shows the ex post realized duration and Sharpe ratios of duration-sorted portfolios. We sort stocks intro ten groups based on our measure of ex ante duration. Portfolio weights are value-weighted and rebalanced monthly and the breakpoints are refreshed each June and based on NYSE firms. We calculate realized fifteen-year dividend growth rates for each portfolio as explained in the text. We then calculate the realized duration based on the assumption that the growth rates continue forever and that all portfolio have a discount rate of 6%.

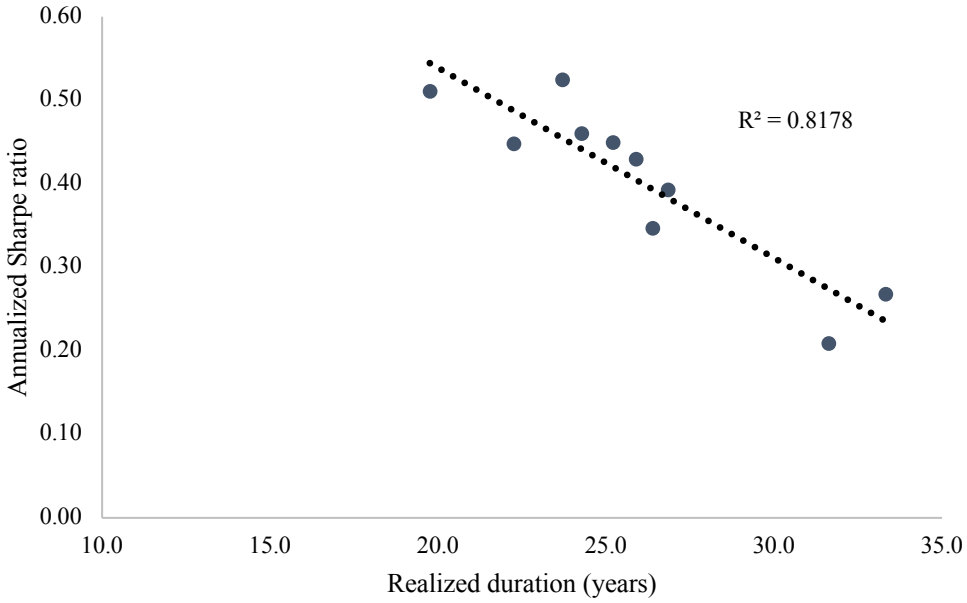


Figure 4
Cumulative return and CAPM alpha to the Duration Factor

This figure shows the cumulative excess return and CAPM alpha to the duration factor. The duration factor is constructed as follows. We sort stocks into six portfolios based on ex ante size and duration. The breakpoints are the median market capitalization and the 30th and 70th percentile of duration. Portfolio weights are value-weighted and rebalanced monthly and the breakpoints are refreshed each June and based on NYSE firms. The duration factor is long 50 cent in the two high-duration portfolios and short 50 cent in each of the two short duration portfolios. The alpha is the return to the duration factor minus the product of duration factor's market beta and the excess return on the market portfolio.

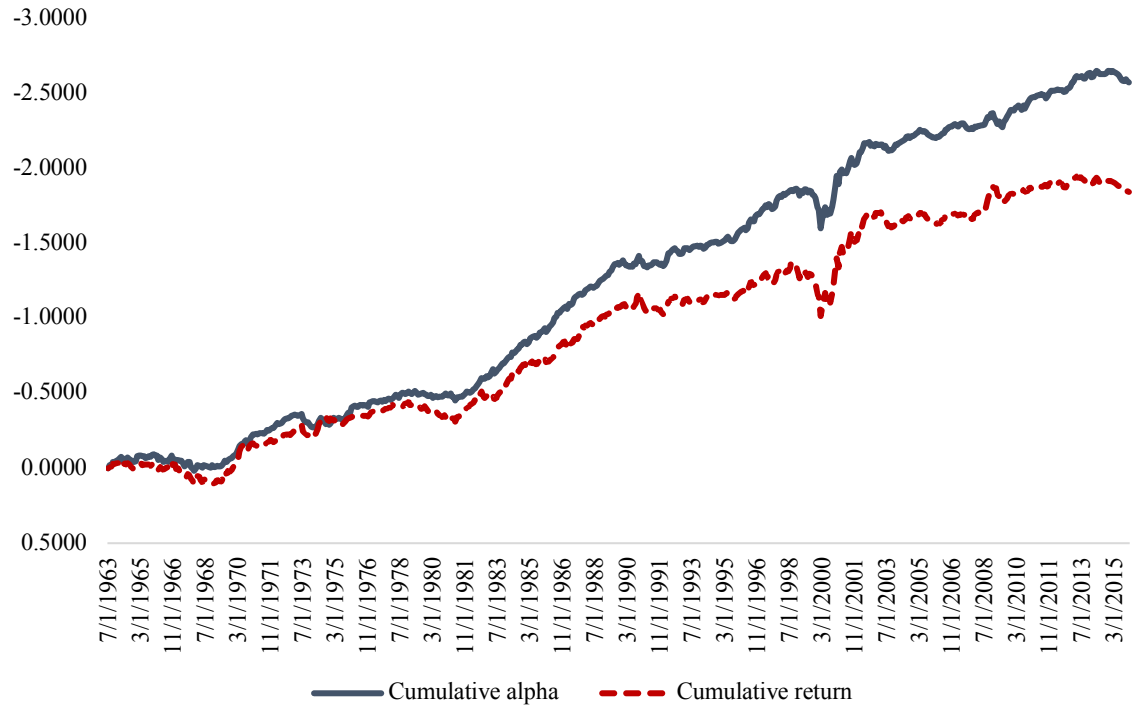


Figure 5
Returns to the Duration Factor around the World

This figure shows the cumulative excess return and CAPM alpha to the duration factor. The duration factor is constructed as follows. We sort stocks into six portfolios based on ex ante size and duration. The breakpoints are the median market capitalization and the 30th and 70th percentile of duration. Portfolio weights are value-weighted and rebalanced monthly and the breakpoints are refreshed each June and based on NYSE firms. The duration factor is long 50 cent in the two high-duration portfolios and short 50 cent in each of the two short duration portfolios. The alpha is the return to the duration factor minus the product of duration factor's market beta and the excess return on the market portfolio.

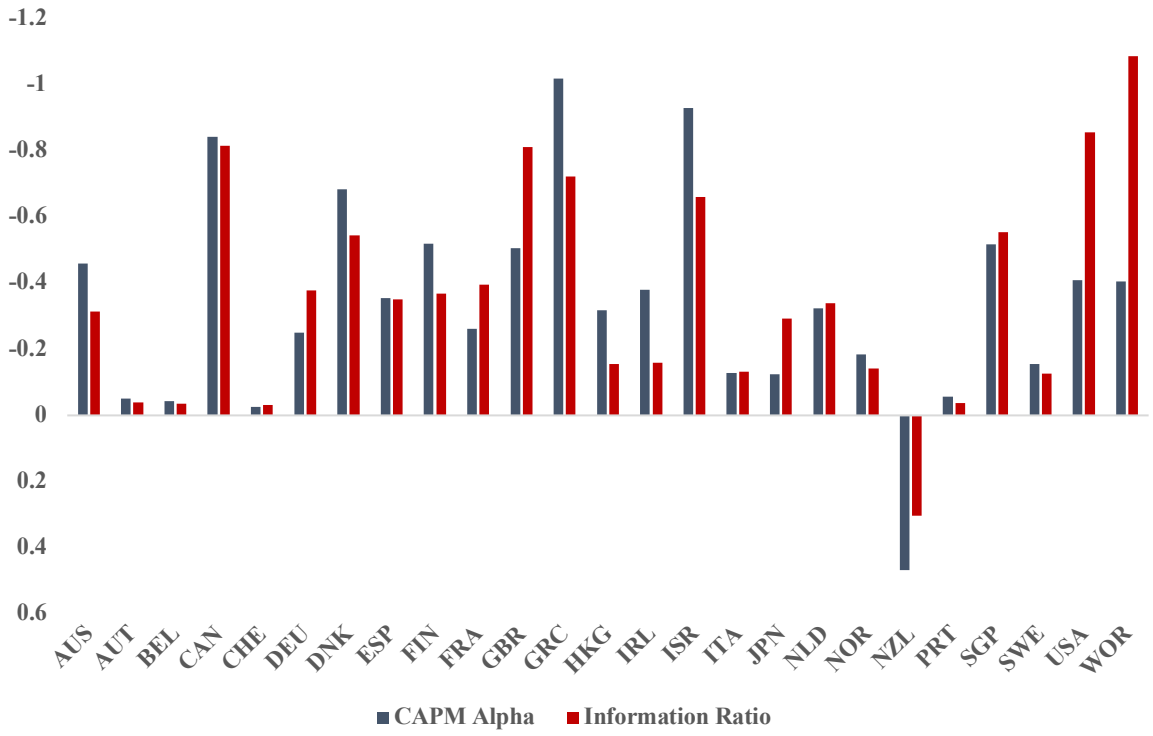


Figure 6
The Equity Yield Curve

This figure shows the time series of the level and slope of the equity yield curve. We regress the future realized returns of different risk factors on the ex ante level and slope of the equity yield curve. The level is the equal weighted log book-to-market ratio of the four sub portfolios in the duration factor, and the slope is the average log book-to-market ratio of the long-leg of the two long-duration portfolios in the duration factor minus the average log book-to-market ratio of the two short-duration portfolios in the duration factor.

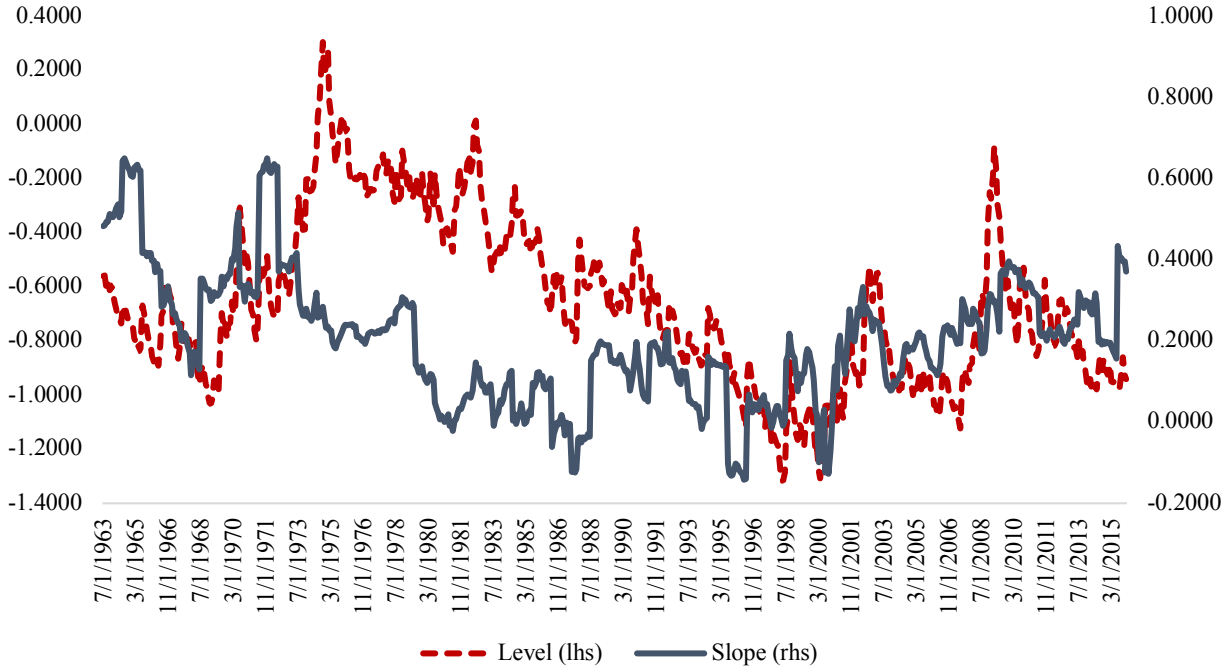


Figure 7
Analyst's Growth Rate Expectations and CAPM Alpha of Duration Sorted Portfolios

This figure shows analysts growth rate expectations and the CAPM alpha of duration sorted portfolios from 1980 – 2016. Analyst expectations are the long term growth rates from the I/B/E/S database.

