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A New Measure of Equity Duration: The Duration-Based Explanation of the Value Premium Revisited

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Abstract
This paper proposes a new methodology to estimate a share's equity duration by using analysts' cash-flow forecasts. We find that short duration is associated with high expected and realized returns — which cannot be attributed to the shares' systematic risk exposure as implied by the market beta. Instead, we show that this measure of a company's average cash-flow maturity is a priced risk factor that has similar properties as the Fama-French factor B/M ratio. Our analysis suggests that the value premium might be a compensation for the value firms' higher exposure to cash-flow risk.

JEL Classification: G12, M41

Keywords: equity duration, value premium, analysts' forecasts, B/M ratio, cashflow risk, discount rate risk, implied cost of capital

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1. Introduction

The value premium, first detected by Graham and Dodd (1934), is one of the most prominent asset pricing puzzles: shares with a high book-to-market ratio of equity value (also called value stocks) provide on average higher returns than shares with a low book-to-market ratio (growth stocks). Most importantly, this additional return is not a compensation for the shares' higher systematic risk exposure as implied by the CAPM (Sharpe, 1964; Lintner, 1965), but seems to be a pricing anomaly with respect to this fundamental pricing model (Basu, 1983).

Recent advances in asset pricing theory suggest that cross-sectional differences in the companies' temporal cash-flow pattern might play an important role in explaining the value premium. Companies that pay out a large fraction of their cash flows in the near future not only tend to exhibit high B/M ratios, but they are also more exposed to aggregate cash-flow shocks (Campbell and Voulteenaho, 2004; Lettau and Wachter, 2007). Accordingly, the value premium is essentially a cash-flow risk premium.

This view, however, does not go unchallenged. Brennan and Xia (2006) show that a share's risk premium is not unambiguously decreasing with its cash-flow maturity. In fact, Da (2009) and Santos and Veronesi (2010) point out that not a firm's temporal cash flow pattern alone, but its cash-flow covariance with consumption is crucial to explain the observed cross-section of stock returns and the value effect.

This paper takes an empirical perspective on the question whether differences in the firms' temporal cash-flow pattern can explain the value premium. The standard measure of an asset's average cash-flow timing is its duration: the longer the duration, the later investors receive back the cash from their investment. Estimating a share's duration is however more difficult than estimating bond duration, since equity investments are a claim to a potentially infinite stream of risky cash flows. Hence, any duration estimate not only has to capture the investor's expected cash flows for a very long time horizon, but also determine an appropriate risk-adjusted rate of return at which these cash flows are discounted.[1]

The contribution of this paper is to propose a new methodology to estimate a firm's equity duration, and to show that cross-sectional differences in the shares' average cash-flow maturity – as measured by the equity duration – can explain the value premium. Our novel equity duration measure combines equity analysts' forecasts with assumptions implied by standard valuation formulas to obtain expected cash flow estimates for any time horizon. These cash flows are discounted with the firm's implied cost of capital (ICC). Defined as the internal rate of return that equates current share price to discounted future cash flows, the ICC is a share's equivalent of a bond's yield to maturity.[2]

During the period from 1992 to 2010, long-horizon equity has both lower average expected and realized returns than shares with a short cash-flow maturity. Since this difference cannot be attributed to the shares' systematic risk exposure as measured by the market beta, we confirm that a firm's cash-flow pattern is a priced risk factor.

If a firm's expected cash flows can be approximated by the simple Gordon (1962) growth model, its equity duration is inversely proportional to the traditional value/growth indicator, the B/M ratio. This relation can also be found in the data: the lower the B/M ratio, the longer a firm's average cash-flow maturity, and vice versa. Finally, equity duration has very similar empirical properties to the B/M ratio to explain the cross-section of stock returns and it even partly subsumes the explanatory power of this valuation multiple. Taken together, these findings suggest that the Fama-French factor B/M ratio might be a simple

1 - The concept of equity duration was proposed by Boquist *et al.* (1975) and Livingston (1978). In a series of papers, Leibowitz (Leibowitz, 1986; Leibowitz *et al.*, 1989; Leibowitz and Kogelman, 1993) presents first attempts to estimate an equity duration for individual firms. Other recent studies include Cohen (2002), Hamelink *et al.* (2002), Dechow *et al.* (2004), Lewin *et al.* (2007), and Shaffer (2007).

2 - Assuming efficient markets, the implied cost of capital (ICC) transforms expected cash flows and share prices into an expected return estimate. First proposed by Malkiel (1979) and Brigham *et al.* (1985), it has been used to estimate a forward looking equity risk premium by aggregating the ICC over entire markets. Similar studies are by Harris (1986), Cornell (1999a), Gebhardt *et al.* (2001) and Claus and Thomas (2001). Recent studies use the ICC to test asset pricing models (Lee *et al.*, 2009), or the risk-return trade-off of individual shares (Pástor *et al.*, 2008).

proxy for a more fundamental cash-flow risk factor captured by the equity duration.[3]

Our work is related to several recent studies that examine the relation of a firm's equity or cash-flow duration to the cross-section of stock returns and, more particular, the value premium. Dechow *et al.* (2004) and Da (2009) show that cross-sectional differences in the firms' duration can explain a substantial part of the cross-section of stock returns. Similar to us, Dechow *et al.* (2004) present evidence that equity duration and the B/M ratio are closely related to each other, suggesting that both measures capture similar risk factors. However, both studies use past cash-flow data to estimate the equity or cash-flow duration. In contrast, by using equity analysts' predictions as proxy for expected cash flows, our empirical methodology is entirely forward-looking, and not building on the premise that past information conveys information about the future. Besides this conceptual advantage, analyst-based duration estimates are more connected to stock returns than the duration estimates proposed by Dechow *et al.* (2004). To our knowledge, only Saarinen (2009) equally uses analysts' forecasts to estimate a firm's equity duration. However, he focuses on analyzing U.S. equity yield curve with the help of the aggregate market duration.

This paper also touches on the large empirical literature that establishes a link between a share's systematic risk exposure and the value premium by decomposing asset betas into cash-flow betas and discount rate betas, using the log-linear approximation of stock returns as proposed by Campbell and Shiller (1988) and Campbell (1991). Campbell and Mei (1993) decompose unexpected stock returns into returns following shocks about future cash flows and shocks about the discount rate, and then estimate the market betas of each return component. They find that the discount-rate betas constitute the largest fraction of a firm's total beta. Based on this observation, Cornell (1999b) suggests that high market betas of growth stocks are a consequence of the late timing of their cash flows, hence, their long duration. Campbell and Voulteenaho (2004) show that value stocks have larger cash-flow betas than growth stocks and that cash-flow betas carry higher risk premia as well. Campbell *et al.* (2009) finally find that the cross-sectional pattern of cash-flow betas and discount rate betas found by Campbell and Voulteenaho (2004) is primarily due to cross-sectional variations in the firm's cash flows. They show – similar to us – that the value premium is a consequence of differences in cash-flow fundamentals between value and growth stocks.

The paper develops as follows. The next section provides a theoretical derivation of equity duration and introduces the new estimation methodology. Section 3 contains a brief description of the U.S. data sample. Section 4 presents some preliminary analysis of the relation between equity duration and common firm risk. In section 5, we turn to the main objective of this paper and show that equity duration can explain the observed value premium in stock markets. Section 6 offers some concluding remarks and implications.

2. Equity Duration

Equity duration is the extension of bond duration to equity shares. This section offers first a theoretical characterization of equity duration. Then we present a novel methodology to estimate a firm's equity duration.

2.1 Equity duration: theoretical considerations

The definition of equity duration closely follows the definition of bond duration, as introduced by Macaulay (1938). Similar to bond duration, equity duration is the cash-flow weighted average time at which shareholders receive the cash flows from their investment in a company's share.

3 - The literature has suggested many alternative explanations of the value premium. Most papers propose macroeconomic foundations of the value premium, e.g., Liew and Vassalou (2000), Vassalou (2003), Brennan *et al.* (2004), Parker and Julliard (2005), Hahn and Lee (2006) and Petkova (2006). For a comprehensive literature review, see Cohen *et al.* (2003) and Lettau and Wachter (2007).

In continuous time, Leibowitz *et al.* (1989) propose the following definition:
Definition 1 (Equity duration): *Let* P_0 *denote the share price at time 0,* $E_0[C_t]$ *the expected stream of cash flows, and k the company's cost of capital. Then the equity duration D is defined as:*

$$D = \frac{1}{P_0} \int_{t=0}^{\infty} t\, E_0[C_t] e^{-kt} dt \quad (1)$$

This definition demonstrates three differences to bond duration. First, equity investments do not have a predetermined maturity date, but are a claim to a potentially infinite stream of cash flows. Second, cash flows to shareholders are not fixed, but uncertain. Thus, equity duration can only be defined on *expected* future cash flows $E_0[C_t]$. In a theoretical model, this can be some stochastic cash flow process. Third, expected cash flows have to be discounted with a company-specific cost of capital k. The share's equivalent to the bond's yield to maturity is given by the so-called implied cost of capital (ICC). In analogy to bond yield, the ICC is defined as the internal rate of return that equates current price to discounted future cash flows.

Equity duration is a measure of a share's cash-flow maturity: stocks that pay a large fraction of cash flows in the distant future are long-duration stocks. Prominent examples of such stocks are those of rapidly growing technology companies, which might even not pay out any dividends in the first years after incorporation. In contrast, stocks of mature companies exhibiting high dividend-price ratios (such as utility companies) are short-duration stocks.

Leibowitz *et al.* (1989) also propose an alternative derivation of equity duration as a share's price sensitivity to changes in the discount rate or, equivalently, the company's cost of capital. Start from the general present value formula for a share

$$P_0 = \int_{t=0}^{\infty} E_0[C_t] e^{-kt} dt. \quad (2)$$

Then establish a relation between (1) and (2) by

$$\frac{\partial \ln P_0(k)}{\partial k} = \frac{1}{P_0} \frac{\partial P_0(k)}{\partial k} = -\frac{1}{P_0} \int_{t=0}^{T} t E_0[C_t] e^{-kt} dt = -D$$

to obtain the following representation.

Definition 2 (Representation of equity duration): *Let* $P_0(k)$ *be the pricing function of a share,* P_0 *its price at time 0, and k the company's cost of capital. Then the equity duration D can be represented as:*

$$D = -\frac{1}{P_0} \frac{\partial P_0(k)}{\partial k} \quad (3)$$

Similar to bonds, shares with a long duration are more sensitive to changes in the discount rate k than shares with a short duration. Hence, equity duration is also a measure of a firm's discount rate risk.[4]

Example. To get some intuition, we examine the equity duration using a simple pricing function. Following Boquist *et al.* (1975), suppose that future cash flows follow a non-stochastic geometric growth process with constant growth rate g, similar to the Gordon (1962) growth model:

$$\frac{dC_t}{C_t} = g\, dt$$

Then the pricing function (2) can be simplified to:

$$P_0 = \frac{C_0}{k - g} \quad (4)$$

4 - There is no universal definition of equity duration. Definition 2 captures a share's price sensitivity to changes in the equity discount rate, i.e., the sum of risk-free rate and a firm-specific risk premium, similar to Boquist *et al.* (1975). Cornell (2000) defines equity duration as share's price sensitivity to changes in the risk-free rate only. Although such an analysis is equally interesting, it does not correspond to the initial concept of duration that establishes a relation between the price of a security and its proper yield. Furthermore, a completely risk-free rate is a rather theoretical concept.

where C_0 denotes cash flows at $t = 0$. Given this pricing formula, Leibowitz *et al.* (1989) and Santa-Clara (2004) use (3) to obtain:

$$D = -\frac{1}{P_0}\frac{\partial P_0}{\partial k} = \frac{1}{k-g} \quad (5)$$

Ceteris paribus, companies with a high dividend growth rate g exhibit a long equity duration: a large fraction of cash flows occurs in the far future, such that their share price is very sensitive to changes in the discount rate k. In addition, companies with a low cost of capital exhibit a long duration: a change in the cost of capital k has a higher *relative* impact compared to companies with a high cost of capital.[5] The ICC of the Gordon (1962) model in continuous-time is obtained by solving (4) for k:

$$k = \frac{C_0}{P_0} + g$$

Insert this expression into the duration formula (5) to obtain:

$$D = \frac{P_0}{C_0} = \frac{P_0}{E_0}\frac{1}{p} = \frac{P_0}{B_0}\frac{1}{p \cdot roe} \quad (6)$$

where E_0 are earnings, p the payout ratio, B_0 the book value of equity, and *roe*: the return on equity. This expression demonstrates the close relation of equity duration to different price-to-fundamental ratios. When equating cash flows with dividend payments, equity duration is given by the inverse of the dividend-to-price ratio (Lintner, 1971; Bernstein, 1995; Cornell, 1999*b*): the lower the dividend yield, the longer it takes for an investor to recoup his initial investment costs. The last two equality signs can be obtained by expressing dividends as the fraction of earnings paid out to shareholders. Dechow *et al.* (2004) are the first to discuss the relation between equity duration and the P/E-ratio. Since earnings are not subject to different payout policies, the P/E ratio might be a reliable empirical proxy for equity duration. Finally, expression (6) shows the inverse relation between the Fama-French risk factor B/M ratio and equity duration. Stocks with a high B/M ratio (i.e., value stocks) are short-duration stocks and so-called growths stocks exhibit a long duration. To conclude, in the Gordon (1962) setting, the dividend-to-price, earnings-to-price and book-to-market ratio are alternative expressions for the inverse of a share's equity duration.

2.2 Equity duration: empirical methodology

Given the uncertainty about future cash flows until infinity, a firm's equity duration is more difficult to estimate than bond duration (Cornell, 2000). In this paper, we propose to use a discrete-time approximation of definition 2 to estimate the equity duration. In discrete time, the derivative of the present value formula (2) with respect to the cost of capital is given by:

$$\frac{\partial P_0}{\partial k} = -\frac{1}{1+k}\sum_{t=1}^{\infty} t\frac{E_0[C_t]}{(1+k)^t} = -\frac{P_0}{1+k}D.$$

such that the equity duration can be approximated by:

$$D \approx -\frac{\Delta P_0}{\Delta k}\frac{1+k}{P_0} \quad (7)$$

A firm's duration can hence be estimated as the slope of a share's pricing formula with respect to the implied cost of capital, standardized by the factor $-(1 + k)/P0$. Thus, our empirical methodology requires first the estimation of the share's ICC.[6]

In line with the literature on the ICC, future expected cash flows are obtained by combining analysts' forecasts for the short horizon with assumptions implied by standard valuation formulas for the long-run.[7] Given the well-known shortcomings of the Gordon (1962) formula, most

5 - Leibowitz *et al.* (1989) note that cost of capital and growth rate are not independent from each other, such that a simple comparative statics analysis can be misleading.

6 - Since this methodology makes use of information implied by equity prices, similar duration concepts are also known as implied equity duration (Dechow *et al.*, 2004).

7 - The use of analysts' forecasts hinges on the assumption that market prices reflect fundamental firm value are predicted by analysts', and that these projections are a good surrogate for the average investor's expectation. Although Elton *et al.* (1981) demonstrate the importance of analysts' forecasts and their usefulness of using them as proxy for market expectations, these forecasts tend to be biased upwards due to conflicts of interests (Chan *et al.*, 2007). However, any upward bias of forecasts also induces an upward bias in the ICC, such that the final duration estimate should be largely unaffected, see equation (1).

studies rely on more complex valuation models. We follow the literature and use a residual income model (RIM) to estimate the ICC.[8] This pricing model states that the value of a company should equal its invested equity capital, plus the expected discounted residual income from future activities.[9]

Definition 3 (Residual income, residual income model): *Let B_t denote the book value of equity per share at the end of year t, E_t the earnings per share in year t, roet the return on equity, and k the cost of equity capital. Then the residual income R_t per share is defined as:*

$$R_t = E_t - k(B_{t-1}) = (roe_t - k)B_{t-1} \quad (8)$$

If $E_0[R_t]$ denotes the expected residual income per share in year t, the price of a share P_0 is given by:

$$P_0 = B_0 + \sum_{t=1}^{\infty} \frac{E_0[R_t]}{(1+k)^t} = B_0 + \sum_{t=1}^{\infty} \frac{E_0[roe_t] - k}{(1+k)^t} B_{t-1} \quad (9)$$

Since earnings forecasts are not available until infinity, one has to make assumptions about expected cash-flows when implementing the model in practice. In this paper, we follow Pástor *et al.* (2008) and Lee *et al.* (2009), and resort to the three-stage formula by Gebhardt *et al.* (2001).[10]

Definition 4 (Three-stage residual income valuation): *Let $E_0[iroe_T]$ denote the expected industry return on equity, and T the forecast horizon. Then the price of a share is given by:*

$$P_0 = B_0 + \underbrace{\sum_{t=1}^{3} \frac{E_0[roe_t] - k}{(1+k)^t} B_{t-1}}_{\textit{Explicit forecasts}} + \underbrace{\sum_{t=4}^{T} \frac{E_0[roe_t] - k}{(1+k)^t} B_{t-1}}_{\textit{Transition period}} + \underbrace{\frac{E_0[iroe_T] - k}{k(1+k)^{T-1}} B_{T-1}}_{\textit{Terminal value}} \quad (10)$$

In the initial forecast period of three years, expected cash flows are taken from equity analysts. In the transition period of $T - 3$ years, this model assumes that the companies' return on equity converges to the long-term industry average. This assumption is based on the notion that over longer time periods, all competitive advantages are arbitraged away, so that no company within an industry achieves higher returns than its peers. In our implementation we set $T = 9$, implying a transition period of six years. For a detailed description of the implementation of the residual income model, see appendix A.

The ICC is estimated by solving the residual income model (10) for the internal rate of return, given the share price and expected cash flows. The solution is straightforward, since the RIM is monotone in the cost of capital k, and can be solved iteratively. Following expression (7), we then estimate the slope coefficient of the valuation formula at the ICC estimate. The equity duration is obtained by multiplying the slope with $-(1 + k)/P_0$.

3. Data and Descriptive Statistics

3.1 Data

We analyze the usefulness of the shares' duration to explain the cross-section of stock returns in the U.S. equity market from January 1992 to October 2010. Equity analysts' earnings and growth forecasts are obtained from IBES. These forecasts are published on the third Thursday of each calendar month. To ensure that the duration estimates are based on publicly available information only, we employ the last available information of the additional data items (prices,

8 - In principle, many valuation formulas can be used to estimate the ICC. The first studies on the ICC relied on the dividend discount model (DDM), see Malkiel (1979) and Brigham *et al.* (1985). However, following empirical evidence that shows the superiority of the RIM over the DDM to estimate firm value (Francis *et al.*, 2000; Hand, 2001; Jiang and Lee, 2005), recent papers use the RIM to estimate the ICC. In a robustness check we used a DDM following Cornell (1999a) to estimate the equity duration. The results are similar, although less significant.

9 - The residual income model (RIM) was brought forward by Preinreich (1938) and Edwards and Bell (1961).A more theoretical treatment can be found in Ohlson (1990, 1995) and Feltham and Ohlson (1995).

10 - There are alternative implementations of the RIM by Claus and Thomas (2001), Gode and Mohanram (2003) or Easton (2004). A good summary of the different formulae and assumptions can be found in Botosan and Plumee (2005) and Easton (2006). In unreported tests, we checked the robustness of our results by using different implementations of the RIM. The results are qualitatively similar.

dividends per share and market capitalization) as of the same day, equally provided by IBES. All market capitalization data is free float adjusted. Book value data is obtained from Worldscope since it is more reliable for accounting data compared to IBES; data on past returns on equity is from Worldscope as well. Monthly data on total stock returns and stock indices to derive market betas and deflate firm size data are taken from Datastream. Similarly, time series data of national accounts to calculate the expected nominal GDP growth rate is obtained from Datastream.

We use the four Carhart (1997) firm characteristics to account for firm risk, i.e., market beta, firm size, B/M ratio, and price momentum. Market beta is the company's five year regressed return sensitivity on the market portfolio. We use the S&P 500 index as proxy for the market.[11] Price momentum is calculated as the change in stock prices over six months prior to each observation.

We include all non-financial firms[12] for which there is sufficient data to estimate the equity duration using the methodology described above, and for which we have the full set of the four Carhart risk proxies. Furthermore, we drop all observations with a duration estimate higher than 100, and all observations with a negative book value of equity. Finally, we remove the lowest and highest centile of the duration estimates and the Carhart risk variables to reduce the impact of outliers.

3.2 Summary statistics

3.2.1 Large data sample

Panel A of table 1 reports the summary statistics for the full data set, after the exclusions describe above. The average equity duration is 27.4 years. In other words, equity investors expected to wait on average about 27 years to get back the money from their investment. These duration estimates are significantly higher compared to earlier works that analyze a share's price sensitivity to changes in the risk-free rate only, which usually yields estimates from two to six years (Leibowitz and Kogelman, 1993). Thus, the inclusion of firm specific risk premia seems to be essential. A comparison with the duration proxies derived from the Gordon (1962) model (see section 2.1) shows that the estimates are reasonable, indeed. For example, using the price-to-dividend approximation of equation (6), a dividend yield of 4% implies an average equity duration of 25 years.

The average implied cost of capital estimate of around 6% is well in line with previous work (Claus and Thomas, 2001; Gebhardt *et al.*, 2001; Lee *et al.*, 2009). When assuming a nominal risk-free rate of 3%, this implies an equally-weighted market risk premium of 3%, which seems a reasonable approximation. The average beta estimate matches its theoretical value of 1. Beta estimates are however very noisy, exhibiting a high standard deviation. The average firm size of the sample is at around USD 2,504 million. The B/M ratio is just below 0.5; past 6-month price momentum is at round 7.5%.

Figure 1 displays the median, mean, and market-cap weighted average equity duration from 1992 to 2010. The equity duration increased during the examined time horizon from around 20 to more than 30. Only with the beginning of the financial crisis in 2007, the average duration drops back to lower levels. A possible interpretation of this pattern is that the equity duration is a valuation indicator, suggesting an equity overvaluation during 2004-2008.[13] On the other hand, the equity duration is rather unaffected by the stock market bubble around the year 2000. The figure shows that the mean estimate is always above the median estimate, exhibiting a much higher volatility as well. In contrast, the median duration remained over the whole time in a smaller range between 20 and 26 years. Mean and market-cap weighted averages follow each other closely, suggesting that there is no strong relation between firm size and equity duration.

11 - If the share price is not available 60 months before any observation, the beta estimation period is reduced down to 24 months. If the available time period is even shorter, the observation is dropped from the sample.
12 - A sample that includes financial firms yields qualitatively similar results.
13 - A positive correlation between equity duration and prices implies that equities exhibit convexity, i.e., the discount rate risk increases as equity prices rise.

Panel A of table 2 shows the correlation statistics. To remove the impact of outliers and to be in line with the regression analysis in sections 4 and 5, the correlation matrices are calculated using the natural logarithms of equity duration, B/M ratio, and firm size (which is deflated by the stock market level). With the exception of the B/M ratio, the correlation of equity duration with the Carhart risk characteristics is rather low. The pronounced negative correlation of -0.40 between equity duration and B/M matches with the approximation of (6) and the interpretation that the B/M ratio is a simple proxy for equity duration. In this correlation matrix, there is only little relation between equity duration and market beta – opposed to Cornell (1999*b*) and Brennan and Xia (2006). However, market beta is very weakly correlated to any of the Carhart (1997) risk characteristics. The correlation structure of the various risk indicators with each other exhibits the standard characteristics as documented in many empirical asset pricing studies.

3.2.2 Small data sample

To draw comparisons across different equity duration estimates, this paper also examines a smaller subset of observations where duration estimates following the approach by Dechow *et al.* (2004) are also available. To allow for the best possible comparison with the approach by Dechow *et al.* (2004), we replicate their methodology as closely as possible. In one variant, we use their forecasting parameters. Since they cover a different time period (1963-1998), we additionally re-estimate their model with updated parameter values.[14] In addition, we compare these duration estimates with simple valuation multiples (P/E ratio, P/D ratio) for this smaller sample.

Because of additional deletions, the small data set contains only a quarter of observations compared to the large sample, including 68,020 monthly observations. In this sub-sample, the average equity duration derived from the RIM is slightly shorter, attaining 24 years (see panel B of table 1). This difference can be explained by the divergent composition of this subset, as the included companies are on average larger, trade at higher B/M ratios, and have a lower sensitivity to the market. The duration estimates obtained from the Dechow *et al.* (2004) methodology are much lower, with an average duration of 16.91 using their original forecasting parameters. When using updated forecasting parameters, the average duration increases to more than 21, closer to our duration estimates.[15] Due to the rather simplistic treatment of the terminal value, the distribution of the Dechow *et al.* (2004) estimates is however highly asymmetric, with a skewness of -2.06. In addition, the duration estimates exhibit very little cross-sectional variation: 80% of the estimates lie in a narrow range of 2.5 years only. There are no significant differences in the correlation structure compared to the large data sample, see panel B of table 2. The correlation with B/M ratio and firm size is slightly more pronounced. All equity duration measures and valuation multiples are positively correlated. The P/E ratio exhibits the highest connection to our standard estimates of equity duration. In contrast, the equity duration measure as proposed by Dechow *et al.* (2004) is most closely connected to the B/M ratio.

4. Equity Duration and Firm Characteristics

This section sheds more light on the relation between equity duration and common firm risk. A simple segmentation of all observations into short and long-duration stocks allows for a first assessment. Section 4.2 then analyzes this relationship in more detail by performing regression tests of the duration estimates.

4.1 Long and short duration stocks

As a first assessment, all observations of the large data set are divided into two equal partitions according to their equity duration estimate, i.e., into a set of long-duration and short-duration stocks. Table 3 shows the average firm characteristics of these two sub-samples.

14 - Please refer to Dechow *et al.* (2004) for a detailed description of their empirical methodology. Dechow *et al.* (2004) use an autocorrelation coefficient of *roe*, $\rho(roe) = 0.57$, a long-term cost of equity capital $k = 0.12$, an autocorrelation coefficient for sales growth $\rho(g) = 0.24$, and a long-run growth rate $g = 0.06$. In our updated version, we use $\rho(roe) = 0.39$, $k = 0.085$, $\rho(g) = 0.20$, and $g = 0.055$. Sales data is obtained from Worldscope.

15 - Dechow *et al.* (2004) report an average equity duration of 15.13 years. Much of the difference compared to our replication can probably be attributed to the different time period, with our sample covering much higher average valuation levels, including the stock market bubble around the year 2000.

The table allows for several important conclusions. First, long-duration equity carries smaller risk premia than short-duration stocks. The average cost of capital for long-term equity, as measured by the implied cost of capital, is more than 4.5% lower than for short-duration stocks. Second, this difference cannot be explained by the systematic risk exposure as measured by the market beta. Short-duration stocks have even a lower average beta estimate compared to longduration stocks, in line with empirical evidence (Cornell, 1999b; Dechow *et al.*, 2004) and the model of Brennan and Xia (2006). This result is thus consistent with the view that not total systematic risk is decisive for pricing a share, but the proportion of cash-flow risk to discount rate risk. Under the premise that short-duration stocks exhibit more cash-flow risk, they are priced at a discount (Campbell and Voulteenaho, 2004; Campbell *et al.*, 2009). The table also confirms the negative relation between B/M ratio and equity duration. Long-duration stocks are growth stocks, i.e., companies with a low B/M ratio. Again, this fits with the simple approximation of equity duration presented in section 2.1. Table 3 also reveals a rather strong relation of firm size with duration, although we do not have a risk-based explanation for this effect. Finally, high-duration stocks tend to be past winners: they exhibit a considerable average price momentum of 14% over six months prior to each observation, which sharply contrasts with the prices of short-duration stocks, that did not change on average. This is intuitive: *ceteris paribus*, a rise in the share price implies that an investor has to wait longer for the amortization of the stock investment.

4.2 Regression tests of equity duration

The preceding analysis shows that equity duration is closely related to the B/M ratio. However, other well-known risk factors are also related to equity duration, especially firm size and price momentum.

This observation might question the direct link between equity duration and book yield. After all, equity duration could just capture other known equity risk factors that happen to be correlated with the B/M ratio – which would challenge the duration's ability of explaining the value premium. Hence, the question is whether the relation of B/M ratio to duration is independent of other firm-risk effects. Since the correlation structure (table 2) does not provide a joint assessment of the relation between equity duration and all risk proxies, we next perform regression tests of the equity duration.

We adopt the panel regression approach, including two fixed effects. First, we allow for an individual firm effect to capture other determinants of firm risk that might not be reflected by the Carhart (1997) risk proxies. Second, we include a time effect, that captures broad market valuation cycles that are not attributable to individual firms (see again figure 1). The regression equation is given as follows:

$$D_{i,t} = \alpha_i + \lambda_t + \gamma' X_{i,t} + u_{i,t} \quad (11)$$

where α_i captures the firm effect and λ_t the time effect for each month. The equity duration is denoted $D_{i,t}$, all firm risk variables are contained in $X_{i,t}$, and $u_{i,t}$ is the disturbance term. To reduce the impact of outliers, we employ the natural logs of the valuation ratios and firm size in the regression tests.[16]

Table 4 presents the results. Both in univariate regressions (upper panel) and multivariate regressions (lower panel), all Carhart (1997) risk proxies are significantly related to equity duration. Most of all, the higher the price-to-book ratio, the more firms tend to be longhorizon equity. Besides, in terms of t-values, price momentum is an important determinant of equity duration. The intuition is similar to the discussion in the previous section: *ceteris paribus*, a rise in share prices implies a longer payback time. Similar to before, market beta is slightly positively related to equity duration. To conclude, although equity duration reflects different types on common firm risk, the Fama-French risk factor B/M ratio is most related to equity duration.

16 - We ascertain the validity of the two-way fixed effects model by testing the joint significance of each fixed effect using an F-test. For more details about the panel regression approach, see the discussion in section 5.1 and appendix B.

5. Cross-sectional Regressions

According to Brennan and Xia (2006) and Lettau and Wachter (2007), the timing of a share's cash flows is an important source of equity risk. This section empirically investigates the relation between stock returns and a share's average cash-flow maturity, as measured by the equity duration. Furthermore, we examine to which extent equity duration captures the explanatory power of the traditional Fama-French risk-factor B/M ratio.

After outlining the empirical methodology, we examine the equity duration's explanatory power for stock returns. Section 5.3 presents some robustness checks and extensions, including alternative measures of equity duration.

5.1 Panel regressions: Methodology

The literature proposes different methodologies to assess the cross-section of stock returns. Traditionally most researchers rely on a two-pass regression approach, either by first estimating the cross-sectional dimension at each point of time and then averaging the coefficients over the entire time horizon (Fama and MacBeth, 1973), or by first using individual time-series regressions to obtain factor loadings, and then estimating the respective risk premia over the cross-section (see, e.g., chapter 12.2 of Cochrane (2005)). More recently, several studies analyze finance data in a one-pass panel regression, see e.g. Subrahmanyam (2005). Panel regressions make better use of the information contained in the data (Baltagi, 2005) and circumvent some of the fundamental problems of the two-pass estimation (Petersen, 2009; Lewellen *et al.*, 2010). Accordingly, this analysis focusses on panel regressions. Section 5.3.2 also discusses the results obtained from the two-pass regressions following Cochrane (2005). For a detailed discussion of alternative regression techniques, please refer to Petersen (2009) and appendix B.

Panel regressions extend the Fama and MacBeth (1973) cross-sectional regressions to multiple time periods. Instead of first regressing each monthly cross-section and then taking the mean of the monthly coefficients, we combine all monthly cross-sections to estimate the model. In analogy to Fama and French (1992), we regress the firms' monthly stock returns $r_{i,t}$ on their duration estimate $D_{i,t}$, the market beta $\beta_{i,t}$, and the Carhart (1997) risk characteristics $X_{i,t}$.[17] Similar to the equity duration regressions in section 4, we also include fixed firm and time effects:

$$r_{i,t} = \alpha_i + \lambda_t + \delta D_{i,t} + \varphi d_t \beta_{i,t} + \gamma' X_{i,t} + u_{i,t} \qquad (12)$$

where the subscript i denotes the company (cross-sectional dimension) and t denotes the time of the observation (time-series dimension). α_i captures the individual firm effect and λ_t the time effect. The variable d_t is a dummy for the observed market risk premium (the difference between the market return and the risk-free rate), equal to 1 when if market risk premium is positive, and -1 if negative. This dummy accounts for the fact that during periods when the market return is below the risk-free rate, the relationship between stock returns and beta is reversed. More precisely, high-beta stocks should have lower returns when the risk premium is negative (Pettengill *et al.*, 1995). The fixed firm effect allows the returns of some company to be on average higher than its risk exposure would predict, whereas other companies provide lower returns. This effect can capture returns compensating additional firm risk that is not included in the Carhart (1997) risk characteristics or the equity duration. It can also catch unobservable firm-specific characteristics (e.g. managerial skills, corporate culture), and reduces the impact of outliers, making the coefficient estimates more reliable. The time effect captures broad market valuation cycles that are not attributable to firm risk, such as the record stock market highs in many countries around the year 2000, or the financial crisis of 2007/09. Furthermore, underlying determinants of stock returns, such as the expected equity risk premium, might change over time. The inclusion of a fixed time effect also helps to control

17 - We use the natural logs of the valuation multiples and firm size (deflated by the stock market level). Instead of the sensitivities on the SMB and HML factors (Fama and French, 1993), we use directly the firms' characteristics. This procedure is motivated by the work of Daniel and Titman (1997) who argue that it is rather the characteristics than the covariance structure that explains the variation in stock returns. Moreover, factor loading estimates are less reliable when using individual stocks instead of portfolios.

for movements in stock returns that stem from the calendar time only, such as the well-known January effect (Bhardwaj and Brooks, 1992).[18]

5.2 Panel regressions: empirical results

Table 5 presents the results of the two-way fixed firm and time effects panel regressions of monthly stock returns following specification (12). To have a benchmark, the upper panel reports the univariate regression of stock returns on the B/M ratio and the multiple Carhart (1997) stock return regressions, without the duration estimate as explanatory variable. The results are fairly in line with prior studies. In the univariate specification, the B/M ratio is positive y related to stock returns, similar to Fama and French (1992, 1993). In the full Carhart (1997) regression, the B/M ratio loses its statistical significance, however.[19] Firm size exhibits the standard negative relation to stock returns – small companies are riskier. Market beta is not related to stock returns, probably a consequence of the time effect that takes up much of the market return, and thus the time-varying component of the individual betas (times the risk premium dummy). Finally, price momentum is positively related to stock returns, as shown by Jegadeesh and Titman (1993). In general, the estimated coefficients are rather small, almost not economically significant. Given that stock returns almost follow a random walk over the short horizon, a low predictive power in monthly return regressions might be expected. Section 5.3.3 thus discusses the results when extending the forecast horizon.

The next row presents the univariate regression of stock returns on the equity duration. Equity duration is strongly negatively related to stock returns, i.e., short-duration stocks provide on average higher returns to their shareholders. In efficient markets persistently higher returns do not come for free, but are usually a compensation for a share's risk exposure. Consequently, this result underscores the role of equity duration as a measure of firm risk. In economic terms, this finding implies that the timing of a share's cash flows is a priced risk factor – in line with the models of Brennan and Xia (2006) and Lettau and Wachter (2007). Moreover, the fact that long-horizon equity is *less* risky confirms the predictions of the latter. Although long-horizon equity exhibits more discount rate risk, this risk does not to seem priced by market participants (Campbell and Voulteenaho, 2004; Lettau and Wachter, 2007).

This interpretation hinges on the assumption that equity duration is largely independent from other firm risk that has been found to determine a share's returns, such as market beta, B/M ratio and firm size. Although the correlation analysis in section 3.2 supports this view, this independence has to hold in stock return regressions as well. Multiple regressions of stock returns on the equity duration and the Carhart (1997) firm risk characteristics allow to disentangle the explanatory power of equity duration from these risk effects. The results are shown in the fourth row. As expected, including the Carhart (1997) risk proxies reduces the duration coefficient, as well as its significance. Still, the relation between stock returns and equity duration is pronounced, indicating that higher returns of short-duration stocks are indeed a consequence of a company's average cash-flow maturity. The results also show that in the presence of equity duration, the coefficient of the B/M ratio decreases, turning even negative. This is yet another sign of the close relation between these two risk proxies: As the univariate regressions show, equity duration is significantly more related to stock returns than the traditional Fama-French factor B/M ratio. In joint regressions, equity duration then takes up most of the explanatory power of the B/M ratio, such that the negative B/M ratio coefficient is a consequence of this close connection, only capturing the remaining (negative) effects. Put differently, equity duration partly subsumes the B/M effect. This empirical result matches the connection between B/M ratio and equity duration as presented in section 2.1. Hence, the B/M ratio might be re-interpreted as a simple proxy for a more fundamental cash-flow risk factor.

18 - We use an F-test to examine whether the fixed effects are jointly significantly different from zero. Since the H_0 (no significance of the fixed effects) for both fixed firm and fixed time effects can be rejected, we adopt the two-way fixed effects model for our panel regressions. We also considered a random effects model. Using a Hausman (1978) specification test, we conclude that a fixed-effect model is preferred to the random effects estimation.

19 - The low explanatory power is a result of using logs in a two-way fixed effects model. First, taking logarithms reduces the cross-sectional variation of the B/M ratio. Second, the fixed time effect and firm size take up a large part of the remaining explanatory power of the B/M ratio.

To summarize, equity duration is not only closely related to the traditional Fama-French factor B/M ratio, but it has also a higher explanatory power for stock returns. This suggests that equity duration might be an alternative to the B/M ratio to capture the value premium. To test this hypothesis, we re-estimate the Carhart (1997) specification, but replace the B/M ratio by the equity duration. The results, displayed in the last row of the table, confirm this view: compared to the standard Carhart (1997) specification, all risk proxies exhibit a stronger relation to stock returns, with the exception of market beta. This is also true for the two alternative measures of the "value factor". Whereas equity duration is highly significant, the B/M ratio is not related to stock returns.

Our findings confirm the notion of Lettau and Wachter (2007) that a company's average cash flow maturity, as captured by the equity duration, is important for assessing a firm's cost of capital or expected return. Although long-term equity has more exposure to discount rate risk, this type of risk seems to carry lower risk premia (Campbell and Voulteenaho, 2004; Lettau and Wachter, 2007). In addition, we find that equity duration performs better in explaining the cross-section of stock returns than the B/M ratio. Hence, it may prove itself to be a well-founded alternative to the traditional Fama-French risk factor.

5.3 Robustness tests

This section examines the robustness of the previous results by extending the analysis in several directions. We first compare the results with those obtained from alternative equity duration measures, including the Dechow *et al.* (2004) approach and simple price-to-fundamental ratios. Section 5.3.2 replicates the analysis using the two-pass regression approach as described in Cochrane (2005). Additional robustness checks are summarized in section 5.3.3.

5.3.1 Alternative equity duration measures

The equity duration proposed in this paper is only one of many possibilities to estimate a share's average cash-flow maturity. First, we compare our estimates with the equity duration measure as proposed by Dechow *et al.* (2004). Second, we test how a simple approximation by valuation multiples (see equation (6)) compares to the more complex approach advocated in this paper. Since the estimation of these alternative duration measures requires more data, we can perform this comparison using the small data set only.

The results are summarized in table 6. In the small data sample, the B/M ratio is significantly positively related to stock returns, similar to Fama and French (1992, 1993). In contrast, price momentum is negatively related to stock returns, although not highly significant. Hence, this smaller set is qualitatively slightly different from the large set. Since the focus of this section is to compare alternative duration estimates, we believe that this difference is not vital for the analysis.

A comparison of the various duration estimates and proxies shows that the equity duration based on the RIM performs best in explaining the cross-section of stock returns, both in terms of explained variance and significance of the duration coefficient. Most important, this result holds true when controlling stock returns for their risk exposure implied by the Carhart (1997) characteristics. Besides, the Fama-French factor B/M-ratio also exhibits a good explanatory power for stock returns. All other duration measures are considerably less connected to stock returns, including the autoregressive approach proposed by Dechow *et al.* (2004). This observation suggests that the use of analysts' forecasts is an important ingredient of our duration estimates. Apparently, these forecasts contain valuable information for expected future cash flows, going beyond the information contained in current and past accounting data.

5.3.2 Two-stage cross-sectional regressions

The panel regressions (section 5.2) suggest that equity duration might be an alternative to the HML factor of the Fama and French (1993) asset pricing model. To test this hypothesis, we compare the average pricing errors of the Fama and French (1993) model with those of an alternative specification where the value factor is replaced by a duration factor.[20] We construct an equity duration factor (DUR) for the period from January 1992 to October 2010.[21] The data of the other factors is obtained from the web-site of Kenneth French. The descriptive statistics, see panel A of table 7, show – as expected – a strong correlation between HML and DUR, reaching more than 70%.

We adopt the two-stage cross-sectional regressions following Cochrane (2005). In the first step, we regress the monthly excess returns of the 25 Fama-French size and book-to-market sorted portfolios, equally obtained from Kenneth French, on the market excess return, the size factor, and the duration factor:

$$r_i - r_f = \alpha_i + \beta_{i,M}(r_m - r_f) + \beta_{i,SMB}SMB + \beta_{i,DUR}DUR + u_i \quad i = 1, ..., 25$$

This yields the betas (or factor loadings) of the 25 portfolios. In the second stage, the sample averages of the monthly portfolio excess returns are regressed on the betas without intercept to obtain the risk premia for each factor λ:

$$\overline{r_i - r_f} = \hat{\beta}_{i,M}\lambda_M + \hat{\beta}_{i,SMB}\lambda_{SMB} + \hat{\beta}_{i,DUR}\lambda_{DUR} + v_i$$

The model mispricing for each portfolio is given by:

$$\hat{\alpha}_i = \overline{r_i - r_f} - \hat{\beta}_{i,M}\hat{\lambda}_M + \hat{\beta}_{i,SMB}\hat{\lambda}_{SMB} + \hat{\beta}_{i,DUR}\hat{\lambda}_{DUR}$$

The results (see panels B and C) show that this two-step estimation has a rather low power, probably since this analysis is limited to 15 years only.[22] The χ^2-test statistic rejects the hypothesis of insignificant pricing errors for both factor pricing models ($p < 1\%$). The market and the SMB factor are not significantly priced. However, the two alternative value factors, DUR and HML are significantly positive. More important, in a direct comparison of the two models, we find that the duration model seems to have an edge, exhibiting a lower average pricing error. In addition, the equity duration coefficient is almost twice as large, resulting in a higher statistical significance.

5.3.3 Additional robustness checks

A firm's industry membership is an important determinant for its expected and realized return (Fama and French, 1997). Hence, we examine whether the duration effect is equally strong across industries, or if it is confined to some specific sector that drives the overall results. We replicate the panel regressions (as in section 5.2), but multiply the equity duration with an industry dummy for each of the 10 GICS industry sectors to obtain separate duration coefficients for each industry. In univariate regressions of stock returns on equity duration, we find that all industry coefficients are significant, with the exception of the utility sector (GICS code 10). After controlling for the firm's risk exposure as implied by the Carhart (1997) risk characteristics, the inverse relation between equity duration and stock returns breaks down for the industrials and consumer staples sector (GICS codes 20 and 30). Hence, although the predictive power of equity duration is not equally pronounced across all industries, it is not restricted to some specific industry segment.

All previous regressions have analyzed the cross-section of monthly stock returns. Since monthly returns almost follow a random walk, the estimated coefficients are very small, see table 5. Hence, in a final robustness check, we extend the time horizon of the stock return regressions up to 24 months.[23] In univariate regressions, the absolute value of the duration coefficient increases from 0.023 for monthly returns to 0.631 in the 24-month specification, being highly significant over all time horizons. When controlling equity duration for Carhart (1997) risk, the results do not

20 - We also compared the four-factor model of Carhart (1997) with an alternative where the duration factor replaces the value factor. The results are qualitatively similar to those using the Fama and French (1993) model.

21 - We estimate the duration factor by exactly replicating the methodology of the momentum factor as described on the web-site of Kenneth French. First, we create six value-weighted portfolios which are the intersections of 2 portfolios on market size and 3 portfolios on equity duration (based on the RIM). The monthly size breakpoint is the median size of the large data set. The equity duration breakpoints are the 30 and 70 percentiles. The duration factor DUR is the monthly return of an equally weighted portfolio that is long in the two short-duration portfolios and short in the two long-duration portfolios.

22 - Comparable studies, e.g., Brennan *et al.* (2004), obtain similarly weak results when looking at short time sub-samples.

23 - Long-horizon regressions may be carried out using either overlapping or non-overlapping observations. Since Campbell (2001) shows that the use of overlapping observations increases the power of the regression, it is standard to run the regression over the whole overlapping data set (Fama and French, 1988; Chan *et al.*, 1996).

change qualitatively compared to the monthly return regressions. Equity duration remains highly significant – far more connected to stock returns than the B/M ratio. Hence, the results are robust to an extension of the forecasting horizon.

6. Concluding Remarks

This paper examines the relation between the temporal cash-flow pattern of firms and the cross-section of stock returns. We measure the firm's cash-flow timing by their equity duration. In analogy to bond duration, equity duration is estimated as the share's price sensitivity to changes in the discount rate. The main contribution of our empirical methodology is the use of analysts' forecasts as proxy for the firms' expected cash flows. Since market prices essentially reflect expectations, this approach is conceptually more consistent than earlier attempts to estimate an equity duration.

We find that short-duration stocks have, on average, both higher expected and realized returns than long-duration stocks. This difference cannot be explained by a share's systematic risk exposure as measured by the market beta. Instead, we show – empirically and theoretically – that equity duration is very closely related to a firm's B/M ratio. In direct comparison, the incorporation of analysts' forecasts improves the quality of the duration estimates significantly. However, our approach is limited to companies covered by equity analysts.

This paper supports Lettau and Wachter (2007) who suggest that a firm's average cash flow maturity is a priced risk factor. Since short-duration stocks have, by definition, less exposure to discount rate risk, this additional return must be a compensation for their higher exposure to cash-flow risk. In addition, our results suggest that the traditional Fama-French factor B/M ratio can be conceived as a simple proxy for a more fundamental cash-flow risk factor captured by the equity duration. Short-term equity carries higher risk premia to compensate investors for their exposure to cash-flow risk: the value premium is essentially a cash-flow risk premium. On the contrary, this study conflicts with Santos and Veronesi (2010) who show that differences in a share's cash flow timing alone cannot explain the value premium in standard consumption based asset pricing models with external habit. In line with conventional asset pricing theory, they suggest that only the covariance of a firm's cash-flows with consumption can resolve this pricing puzzle. Equity duration is however a purely idiosyncratic risk measure. Clearly, the duration-based explanation of the value premium leaves some questions open.

We believe that the equity duration concept put forward in this paper is valuable for both academics and practitioners. It is not confined to the specific valuation model chosen, but can be applied to many different pricing functions or valuation formulas. Thus, it might be easily extended to other asset classes, such as real estate. As such, equity duration can be very useful for investment managers of pension funds that seek to assess their portfolio's sensitivity to changes in discount rates. Equity duration can help trustees to ensure a better match between their investments across asset classes and pension liabilities without sacrificing too much of potential returns.

A. Implementation of the residual income model

This appendix describes the implementation of the residual income model following Gebhardt *et al.* (2001).

In the first three years, the expected return on equity is calculated using explicit earnings forecasts of equity analysts as provided by IBES. Instead of individual forecasts, this study uses the median of expected earnings of all contributing sell-side equity analysts. If no median earnings estimate for year 3 is available, an earnings estimate for year 3 is generated by applying the long-term consensus earnings growth rate to expected earnings in year 2. In case that the last available explicit forecast is negative (either in year 2 or year 3), the observation is excluded. The long-term industry *roe* is the median *roe* of all companies belonging to a firm's industry sector over the preceding 60 months. This procedure aims to average out business cycle effects of the industry profitability. This study uses the 10 industry sector codes of the GICS classification. To reduce the impact of outliers, the lowest and highest centile of all realized *roe* are removed prior to the industry *roe* estimation. In case that the so-obtained industry *roe* is negative, it is replaced by 0.5%. In addition, industry *roes* higher than 50% are removed for being unreasonably high. We also calculated the industry *roe* using more detailed industry classifications, such as the GICS industry group or GICS industry classification. However, the results are very similar, with a correlation of the duration estimates of more than 0.87.[24]

Future expected book values of equity are calculated using the clean surplus relation, $B_t = B_{t-1} + E_t(1 - p_t)$. To that end, one has to make assumptions regarding future long-term payout ratios. While the use of industry averages for the long-term return on equity has some appeal due to the findings of empirical analysis (Nissim and Penman, 2001; Soliman, 2008), the commonly used assumption of a constant payout ratio to construct future book values (Gebhardt *et al.*, 2001) seem arbitrary to us. As a consequence, we consider a slightly modified version of the three-stage RIM that avoids relying on assumptions on future payout ratios. Following the literature on sustainable growth rates, we use the following identity between payout ratio *p*, return on equity *roe* and the long-term growth rate of the company g_l:

$$p = 1 - \frac{g_l}{roe} \quad \text{(A.1)}$$

In order to estimate the future development of a company, one has to make assumptions for two out of the three parameters. Instead of assuming the long-run payout ratio *p*, we opt to fix the long-term growth rate of the company g_l. By setting g_l equal to the expected GDP growth rate of the economy, we ensure that no company will persistently grow faster than the whole economy and eventually exceed it.[25] Hence, we employ the RIM following Gebhardt *et al.* (2001) as presented in equation (10), but using different long-run payout ratios for each industry. For each sector, we calculate the long-term industry payout ratio using the relation (A.1), given the expected GDP growth of the economy and the industry *roe*. In the transition period, we fade both payout ratio and *roe* linearly towards their long-term industry levels. In our implementation we set $T = 9$, implying a transition period of six years. In practice, our residual income specification does not diverge substantially from the model as proposed by Gebhardt *et al.* (2001). In our small data set, the correlation of the equity duration estimates obtained from both models is at around 0.99.

Note that we do not carry out any time adjustment procedures similar to other studies on the ICC (Gebhardt *et al.*, 2001; Easton *et al.*, 2002). Since we use a monthly data set, such adjustments would require the exact dividend payout dates and book value adjustments for all companies since 1992. Such data is not easy to get hold of, nor is it reliable.

24 - Instead of using the GICS classification, Gebhardt *et al.* (2001) rely on the 48 Fama and French (1997) industry classifications.

25 - In this study we use a simple moving average forecast model and calculate the expected GDP growth rate as the average geometric nominal GDP growth rate over the past 5 years. Annual data for real GDP and inflation is obtained from Datastream.

B. Two-stage regressions versus panel regressions

The traditional approach of two-step regressions comes in several flavors. Fama and MacBeth (1973) first estimate the cross-section at each moment in time, and then averages the coefficients over time. Cochrane (2005) and others first perform time-series regressions to obtain the asset's factor loadings, and then estimate the risk premia over the cross-section.

Recent studies, however, point out some possible weaknesses of this empirical methodology. Most of all, two-pass regressions are usually carried out using portfolios constructed according to some exogenously specified sorting variable. This raises the issue which sorting variable to select. Brennan *et al.* (1998) argue that selecting some out of many possible explanatory variables creates a "data-snooping bias that is inherent in all portfolio based approaches", since the selection of the sorting variable as well as the sorting order can influence the results significantly. Especially the common practice to construct portfolios according to B/M ratio and size (as performed in section 5.3.2) is likely to overestimate the regression results (Lewellen *et al.*, 2010). An alternative approach would be to use many different firm characteristics or risk factors to construct the portfolios. But as Bauer *et al.* (2007) emphasize, the number of portfolios needed increases exponentially with the number of firm characteristics examined - such that many portfolios would contain none or few stocks. Instead of relying on portfolios, some researchers carry out the two-step regressions on individual firm data, such as e.g. Chan *et al.* (1996), Lee *et al.* (1999), or Subrahmanyam (2005). In general, however, these regressions have very low power and insignificant coefficient estimates because of a rather short time-dimension of the examined data sets, i.e. the average slope coefficients are small compared to their standard errors. Similarly, when applying the (Fama and MacBeth, 1973) methodology to our data set, we equally obtain little meaningful results.

One-pass panel regressions, in contrast, can overcome this problem. The main advantage of the panel regression methodology is its ability to use the whole information conveyed in the data in one regression step. Thus, panel analysis usually provides more significant coefficient estimates (Baltagi, 2005) without imposing a data-snooping bias through the construction of portfolios. For a detailed comparison of the various empirical methods to analyze finance panel data sets, see Petersen (2009) and Jagannathan *et al.* (2009).

Tables

Table 1: Descriptive statistics

Panel A: Large data set. Observations: 268,190				
	Mean	Standard deviation	10% centile	90% centile
Equity duration	27.41	13.19	15.24	45.40
Implied cost of capital	5.94%	3.37%	2.51%	10.08%
Market beta	1.00	3.13	-2.30	4.39
B/M ratio	0.44	0.92	0.03	0.89
Size (in mn USD)	2,504	5,170	104	6,154
Price momentum	7.83%	49.96%	-37.99%	49.11%
Panel B: Small data set. Observations: 68,020				
	Mean	Standard deviation	10% centile	90% centile
Equity duration	23.97	8.64	15.26	34.35
Implied cost of capital	5.66%	2.42%	3.10%	8.86%
Market beta	0.77	3.45	-3.17	4.80
B/M ratio	0.26	0.29	0.03	0.60
Size (in mn USD)	4,164	6,666	235	11,265
Price momentum	6.79%	42.86%	-27.01%	33.44%
Equity duration (Dechow)	16.91	1.84	14.95	18.34
Equity duration (Dechow, new parameters)	21.08	1.34	19.57	22.09
P/E ratio	20.10	15.50	10.17	30.11
P/D ratio	60.99	52.32	17.29	122.42
P/B ratio	14.85	25.61	1.68	35.77

This table presents the summary statistics of the estimated equity duration, the implied cost of capital estimates (ICC), the Carhart (1997) risk characteristics, and average valuation multiples. Panel A summarize the large data set, panel B summarizes the small data set. The equity duration and ICC in the upper rows of each panel are based on the three-stage RIM valuation model, using 10 different long-term industry sector return on equity estimates. Market beta is the company's five year regressed sensitivity on the market portfolio. Price momentum is calculated over the 6 months prior to the duration estimation. The lower panel additionally provides equity duration estimates using the approach advocated in Dechow *et al.* (2004) and some valuation multiples. The sample period is from January 1992 to October 2010.

Table 2: Correlations of equity duration and firm risk

Panel A: Large data set. Observations: 268,190					
	Duration ln(dur)	Market beta	B/M ratio ln(B/M)	Size ln(mcap/idx)	Price momentum
Duration – ln(dur)	1.000				
Market beta	0.042	1.000			
B/M ratio – ln (B/M)	-0.403	0.009	1.000		
Size – ln(mcap/idx)	0.167	-0.001	-0.490	1.000	
Price momentum	0.144	0.003	-0.115	0.086	1.000
Panel B: Small data set. Observations: 68,020					
	Duration ln(dur)	Market beta	B/M ratio ln(B/M)	Size ln(mcap/idx)	Price momentum
Duration – ln(dur)	1.000				
Market beta	-0.001	1.000			
B/M ratio – ln (B/M)	-0.525	-0.003	1.000		
Size – ln(mcap/idx)	0.191	0.005	-0.342	1.000	
Price momentum	0.137	0.005	-0.083	0.090	1.000
Duration (Dechow)	0.409	-0.005	-0.423	0.172	0.139
Duration (Dechow, new parameters)	0.514	-0.009	-0.574	0.212	0.130
P/E ratio - ln (P/E)	0.530	0.033	-0.288	0.090	0.170
P/D ratio - ln (P/D)	0.312	0.051	-0.375	0.029	0.086
P/B ratio - ln (P/B)	0.525	0.003	-1.000	0.342	0.083

This table reports the correlations of the equity duration with the Carhart (1997) risk characteristics and valuation multiples. To reduce the impact of outliers, we use the log of equity duration, B/M ratio, firm size (which is standardized by the level of the market index), and the valuation multiples. Panel A summarize the large data set, panel B summarizes the small data set. The equity duration in the upper row of each panel are based on the three-stage RIM valuation model, using 10 different long-term industry sector return on equity estimates. Market beta is the company's five year regressed sensitivity on the market portfolio. Price momentum is calculated over the 6 months prior to the duration estimation. The lower panel additionally provides the correlations with alternative equity duration estimates following the two variants of the approach advocated in Dechow *et al.* (2004) and the valuation multiples. The sample period is from January 1992 to October 2010.

Table 3: Relation of equity duration to firm risk - large data set

	Long-Duration Stocks	Short-Duration Stocks
Equity Duration	36.53	18.28
Implied cost of capital	3.59%	8.28%
Market beta	1.10	0.90
B/M ratio	0.21	0.67
Size (in mn USD)	3,159	1,849
Price momentum	13.96%	0.17%
Observations	134,095	134,095

This table reports the average risk characteristics of long and short duration stocks. The left column displays the average implied cost of capital, market beta, B/M ratio, firm size, and price momentum of the long-duration stocks; the right column presents the same information of the short-duration stocks. The sample period is from January 1992 to October 2010.

Table 4: Panel regressions tests of equity duration - large data set

Dependent Variable: Equity Duration (RIM3), ln(DUR)				
Market beta	B/M ratio ln(B/M)	Size ln(mcap/idx)	Price momentum	R^2
0.002				19.21
(2.26)				
	-0.177			30.58
	(-31.93)			
		0.138		26.67
		(27.18)		
			0.099	22.11
			(42.92)	
0.002	-0.130	0.071	0.056	33.06
(2.22)	(-20.06)	(11.54)	(27.49)	

This table reports the results of the 2-way fixed panel regression tests of the equity duration on the Carhart firm risk characteristics. The upper panel contains univariate regression results, the lower panel the joint regression tests. To correct for outliers, we use the natural logarithm of equity duration, B/M ratio and firm size (which is standardized by the level of the market index). Equity duration is based on the three-stage RIM valuation model, using 10 different long-term industry sector return on equity estimates. Market beta is the company's five year regressed sensitivity on the market portfolio. Price momentum is calculated over the 6 months prior to the estimation. Standard errors are adjusted for the impact of heteroscedasticity and serial correlation following Rogers (1993). The sample period is from January 1992 to October 2010. Observations: 268,190.

Table 5: Two-way fixed firm and time panel regressions of monthly stock returns - large data set

Dependent Variable: monthly stock returns					
Equity duration ln(dur)	B/M ratio ln(B/M)	Market beta	Size ln(mcap/index)	Price momentum	R^2
	0.010				16.44
	(16.56)				
	0.000	-0.000	-0.021	0.002	17.01
	(0.36)	(-0.95)	(-30.74)	(3.38)	
-0.023					16.46
(-20.17)					
-0.011	-0.001	-0.000	-0.020	0.003	17.06
(-9.46)	(-1.83)	(-0.93)	(-29.71)	(4.43)	
-0.011		-0.000	-0.019	0.003	17.05
(-9.24)		(-0.92)	(-31.19)	(4.67)	

This table reports the results of the two-way fixed firm and time panel regressions of monthly stock returns on the equity duration and the Carhart (1997) firm risk characteristics following specification (12). To correct for outliers, we use the natural logarithm of equity duration, B/M ratio and firm size (which is standardized by the level of the market index). Equity duration is based on the three-stage RIM valuation model, using 10 different long-term industry sector return on equity estimates. Market beta is the company's five year regressed sensitivity on the market portfolio. Price momentum is calculated over the 6 months prior to the estimation. Standard errors are adjusted for the impact of heteroscedasticity and serial correlation following Rogers (1993). The sample period is from January 1992 to October 2010. Observations: 268,190.

Table 6: Alternative equity duration measures – small data set

Dependent Variable: monthly stock returns						
	Equity duration ln(dur)	Market beta	B/M ratio ln(B/M)	Size ln(mcap/index)	Price momentum	R^2
		-0.000	0.007	-0.017	-0.002	20.71
		(-0.91)	(5.06)	(-14.51)	(-2.05)	
Equity duration - ln(dur)	-0.030					20.31
	(-12.79)					
	-0.017	-0.000	0.005	-0.016	-0.001	20.79
	(-7.19)	(-0.89)	(3.33)	(-13.96)	(-1.28)	
Equity duration - ln(dur) (Dechow et al., 2004)	-0.019					20.05
	(-4.91)					
	-0.007	-0.000	0.007	-0.017	-0.002	20.72
	(-1.83)	(-0.89)	(4.80)	(-14.53)	(-1.84)	
Equity duration - ln(dur) (Dechow et al., 2004), with new parameters	-0.074					20.13
	(-7.56)					
	-0.029	-0.000	0.006	-0.017	-0.002	20.73
	(-3.02)	(-0.90)	(4.26)	(-14.51)	(-1.78)	
P/E ratio - ln(P/E)	-0.007					20.08
	(-6.02)					
	-0.002	-0.000	0.007	-0.017	-0.002	20.72
	(-1.48)	(-0.89)	(4.76)	(-14.53)	(-1.83)	
P/D ratio - ln(P/D)	-0.015					20.26
	(-8.68)					
	-0.002	-0.000	0.007	-0.016	-0.002	20.72
	(-1.37)	(-0.89)	(4.53)	(-13.18)	(-1.89)	
P/B ratio - ln(P/B)	-0.017					20.33
	(-10.51)					
	-0.007	-0.000		-0.017	-0.002	20.71
	(-5.06)	(-0.91)		(-14.51)	(-2.05)	

This table reports the results of the two-way firm fixed effects panel regressions of stock returns on different equity duration measures, valuation multiples and the Carhart (1997) firm risk characteristics following specification (12). To correct for outliers, we use the natural logarithm of equity duration, valuation multiples and firm size (which is standardized by the level of the market index). Market beta is the company's five year regressed sensitivity on the market portfolio. Price momentum is calculated over the 6 months prior to the estimation. Standard errors are adjusted for the impact of heteroscedasticity and serial correlation following Rogers (1993). The sample period is from January 1992 to October 2010. Observations: 68,020.

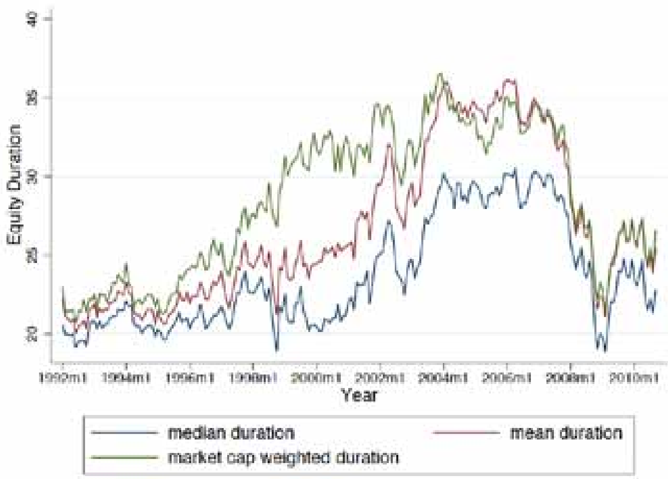
Table 7: Cross-sectional regressions tests of Fama and French (1993) three factor model and equity duration model for the 25 size and B/M sorted portfolios, following Cochrane (2005)

Panel A: Summary statistics of the risk factors				
	$R_m - R^f$	SMB	HML	DUR
Mean	0.478%	0.217%	0.393%	0.070%
Standard deviation	4.51%	3.57%	3.45%	3.21%
Correlation	$R_m - R^f$	SMB	HML	DUR
$R_m - R^f$	1.000			
SMB	0.236	1.000		
HML	-0.248	-0.376	1.000	
DUR	-0.174	-0.262	0.706	1.000
Panel B: Fama and French (1993) three factor model				
	λ_M	λ_{SMB}	λ_{HML}	
Coefficients	0.415	0.317	0.498	
t-statistics (Shanken)	(1.31)	(1.13)	(1.99)	
average $\hat{\alpha}$		0.014%		
$\alpha'\Sigma^{-1}\alpha$		124.4		
p-value		< 1%		
Panel C: alternative duration model				
	λ_M	λ_{SMB}		λ_{DUR}
Coefficients	0.330	0.248		0.863
t-statistics (Shanken)	(1.03)	(0.87)		(2.56)
average $\hat{\alpha}$		0.012%		
$\alpha'\Sigma^{-1}\alpha$		120.1		
p-value		< 1%		

This table reports the two-stage cross-sectional regression tests of the Fama and French (1993) three factor model and equity duration model for the 25 size and B/M sorted portfolios, following chapter 12.2 of Cochrane (2005). Panel A presents the mean, standard deviation and correlation statistics of the market factor ($R_m - R^f$), the Fama-French factors (HML and SML), and the duration factor (DUR). Panel B shows the results for the Fama and French (1993) specification, panel C the alternative specification where the *HML* factor has been replaced with the duration factor *DUR*. The λ's indicate the risk premia for each of the factors, $\hat{\alpha}$ is the average mispricing of each factor pricing model, and Σ the variance-covariance matrix of the pricing errors. The t-statistics and the variance-covariance matrix Σ is calculated following Shanken (1992). The sample period is from January 1992 to October 2010.

Figures

Figure 1: Equity duration in the United States



This graph plots the monthly average mean, median, and market-cap weighted equity duration estimate in the United States from 1992 to 2010.

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