Do Cash Flows of Growth Stocks Really Grow Faster?

Huafeng (Jason) Chen*

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Abstract

Contrary to conventional wisdom, growth stocks (low book-to-market stocks) do not have substantially higher future cash-flow growth rates or substantially longer cash-flow durations than value stocks, in both rebalanced and buy-and-hold portfolios. The efficiency growth, survivorship and look-back biases, and rebalancing effect help explain the results. This finding suggests that duration alone is unlikely to explain the value premium. Using rebalanced portfolios, I find that, consistent with asset pricing models that feature countercyclical risk premiums, there is a growth premium in the cross section of stock returns. That is, risky assets with higher expected cash-flow growth rates have higher expected returns, after controlling for cash-flow risks.

*Sauder School of Business, University of British Columbia, 2053 Main Mall, Vancouver, BC V6T 1Z2, Canada. Please address inquiries to jason.chen@sauder.ubc.ca. Previous drafts circulated under the titles "What does the value premium tell us about the term structure of equity returns?" and "The growth premium". I am especially indebted to John Campbell for many criticisms. I also thank Ravi Bansal (NBER discussant), Jonathan Berk, Jules van Binsbergen, Oliver Boguth, Tarun Chordia (ITAM discussant), John Cochrane, George Constantinides, Zhi Da, Peter DeMarzo, Eugene Fama, Adlai Fisher, Anisha Ghosh, John Heaton (Duke/UNC discussant), Ravi Jaganathan, Ralph Koijen, Martin Lettau, Stefan Nagel, Stavros Panageas, Ľuboš Pástor, Lawrence Schmidt (WFA discussant), Kenneth Singleton, Jessica Wachter, Toni Whited, Motohiro Yogo, Lu Zhang (UBC discussant), Pietro Veronesi, and seminar participants at UBC, UBC summer conference, Shanghai Advanced Institute of Finance, Cheung Kong GSB, City U of HK, HKU, Chinese U of HK, HKUST, University of Iowa, Iowa State University, Stanford University, Duke/UNC asset pricing conference, Northwestern University, the first ITAM conference, Western Finance Association meeting, and the NBER Summer Institute Asset Pricing workshop for comments. I thank Haibo Jiang, Pablo Moran, and Alberto Romero for excellent research assistance.

Growth stocks, defined as stocks with low book-to-market ratios, clearly have lower future returns. But do growth stocks really have substantially higher future cash-flow growth rates and substantially longer cash-flow durations? This question is interesting in its own right, and is also important for the following two reasons. First, a series of recent papers provides an influential *duration-based explanation* of the value premium (Lettau and Wachter (2007, 2011) and Croce, Lettau, and Ludvigson (2010)). Such an explanation has two key ingredients: the term structure of equity is downward sloping (long-duration assets earn lower expected returns); and growth and value stocks differ substantially in the timing of cash flows, in that cash flows of growth stocks grow faster. This explanation seems particularly promising, given that Binsbergen, Brandt, and Koijen (2010) find a downward sloping term structure of equity in the market portfolio. Is there enough difference between the timing of cash flows of growth and value stocks to explain the value premium? Second, a class of asset pricing models (such as Campbell and Cochrane (1999) and Bansal and Yaron (2004)) features countercyclical risk premiums, which tend to make the term structure of equity upward sloping (long-duration assets earn higher expected returns). When applied to a cross section of assets with constant but different cash-flow growth rates, this feature implies that there is a "growth premium". That is, assets with higher expected cash-flow growth rates (and therefore longer cash-flow durations) have higher expected returns, after controlling for cash-flow risks.[1] Is there any setting in which we observe this growth premium?

The existing empirical evidence paints a puzzling picture on whether cash flows of growth stocks grow faster. While several authors find that dividends of value stocks grow faster in rebalanced portfolios, conventional wisdom holds that in buy-and-hold portfolios (or at the firm level), growth stocks have substantially higher future cash-flow growth rates and substantially longer cash-flow durations than value stocks. This view is suggested by the name "growth stocks" and is apparently backed by empirical results.[2] This is puzzling because both buy-and-hold and

[1]Alternatively, this implication can be driven by procyclical expected growth rates, as in Johnson (2002) and Bansal and Yaron (2004). Johnson (2002) uses the growth premium driven by procyclical expected growth rates to explain the momentum effect. For ease of disposition, I only refer to countercyclical risk premiums in the text.

[2]A number of authors, including Chen (2004), have expressed views in line with the conventional wisdom. Dechow, Sloan, and Soliman (2004) and Da (2009) find that growth stocks have longer cash-flow durations. For a classic paper on the value premium, see Fama and French (1992). Evidence exists in the literature that rebalanced

rebalanced portfolios are valid ways of looking at the data. The two kinds of portfolios give rise to two streams of cash flows that have the same present values and the same first-year returns, analogous to two dividend streams in a Miller and Modigliani (1961) setting. On the one hand, rebalanced portfolios are the standard practice in empirical asset pricing (for example, Fama and French (1992)), and are likely to be more homogeneous over time. On the other hand, buy-and-hold portfolios correspond to firm-level behavior. Theoretical explanations of the value premium typically start by modeling firm-level behavior, and therefore have direct implications on buy-and-hold portfolios. I explore both approaches.

My first set of results is on cash-flow growth rates. Consistent with existing studies, I find that in rebalanced portfolios, cash flows of value stocks robustly grow faster than growth stocks. But, contrary to conventional wisdom, I find that in buy-and-hold portfolios, cash flows of growth stocks do not grow substantially faster (and in fact often grow more slowly) than value stocks. I provide four pieces of evidence on the buy-and-hold portfolios. First, in the modern sample period (after 1963), dividends in the growth quintile grow only a little faster than the value quintile. The difference in long-run growth rates is about 2% per year, substantially smaller than assumed in the duration-based explanations of the value premium, 19%. Second, in the early sample period (before 1963), dividends of value stocks grow faster than those of growth stocks, at least in the first ten years after portfolio formation. Third, in the modern sample period, earnings of value stocks grow faster than growth stocks, although the growth rates become more similar four years after portfolio formation. Finally, in regressions of future dividend growth rates on the book-to-market ratio, the coefficients are mostly positive after I account for survivorship bias. I also reconcile the different results between rebalanced and buy-and-hold portfolios, and show that rebalanced growth rates should be higher than buy-and-hold growth rates for value stocks, and that the opposite is true for growth stocks, under mild conditions.

My second set of results is on cash-flow durations. I first examine the conventional Macaulay duration of value and growth stocks, using the weighted average of cash-flow maturities. I find that growth stocks do have longer durations. However, the conventional duration is basically the

portfolios of value stocks have higher dividend growth rates (see Ang and Liu (2004), Bansal, Dittmar, and Lundblad (2005), Hansen, Heaton, and Li (2008), and Chen, Petkova, and Zhang (2008)).

price-dividend ratio, which is not a clean variable. It can be high either because the discount rate is low, or because the expected growth rate is high. If the expected growth rate is held constant across assets, higher cash-flow risk leads to a higher discount rate, which in turn leads to a lower price-dividend ratio and shorter duration. In this case, there is a negative relation between duration and the discount rate, but this relation is not anomalous. If cash-flow risk is held constant across assets, the difference in the expected growth rate leads to a positive relation between duration and the discount rate in leading asset pricing models. To isolate the effect of the cash-flow growth profiles, I propose to measure the pure *cash-flow* duration by discounting the asset-specific cash-flow growth profiles with a common discount rate for all assets. I find that even in the modern sample period, growth stocks have only slightly longer cash-flow durations than value stocks in buy-and-hold portfolios, and have shorter cash-flow durations than value stocks in rebalanced portfolios. In the early sample period, value stocks have no shorter cash-flow durations in value-weighted buy-and-hold portfolios, and longer cash-flow durations than growth stocks in equal-weighted buy-and-hold portfolios and in rebalanced portfolios.[3] Given that growth stocks do not have substantially higher growth rates and longer cash-flow durations, duration-based explanations alone are unlikely to account for the value premium.[4]

My final set of results is on the existence of the growth premium. The results so far show that rebalanced portfolios of value stocks have higher dividend growth rates and higher returns, suggesting that in rebalanced portfolios the value premium is consistent with the growth premium. I point out that rebalanced portfolios of small stocks and recent winners also have higher dividend growth rates. I provide empirical evidence that when using rebalanced portfolios, the growth premium is broadly consistent with the entire cross section of stock returns. Using portfolios

[3]Da (2009) and Santos and Veronesi (2010) also make a distinction between duration and cash-flow duration. Santos and Veronesi (2010) also distinguish between variation in the price-dividend ratio driven by cash-flow risk and the expected growth rate. I revisit Dechow, Sloan, and Soliman (2004) and Da (2009)'s cash-flow duration results. Dechow, Sloan, and Soliman (2004)'s measure is conceptually biased towards finding a longer cash-flow duration for growth stocks. Da (2009)'s measure is conceptually fine, but his empirical results are driven by unrealistic assumptions about the terminal *ROE*s.

[4]Santos and Veronesi (2010) calibrate a habit formation model to the value premium, and find that value stocks do not have enough cash-flow risk to explain their returns (the cash-flow risk puzzle). My results suggest that while there may very well be a cash-flow risk puzzle, habit formation per se (or any economic force that generates countercyclical risk premiums) does not deepen the puzzle of the value premium, because value stocks do not have substantially lower future cash-flow growth rates or shorter cash-flow duration in buy-and-hold portfolios.

sorted by size, book-to-market, and momentum, I find that portfolios with higher expected cash-flow growth rates do have higher future returns, after controlling for cash-flow risks.

There are at least four reasons why the conventional wisdom is widely held. First, Gordon's formula, $\frac{P}{D} = \frac{1}{r-g}$, suggests that all else being equal, stocks with higher prices should have higher cash-flow growth rates. Second, Fama and French (1995) show that growth stocks have persistently higher returns on equity than value stocks, even five years after they are sorted into portfolios. Third, in standard firm-level regressions of future dividend growth rates on the book-to-market ratios, the coefficients are highly negative, even for dividend growth rates ten years in the future. Finally, Dechow, Sloan, and Soliman (2004) and Da (2009) find that growth stocks have substantially longer cash-flow durations.

I address each of the above reasons. First, when we compare value stocks with growth stocks, all else is not equal. If we consider that value stocks have higher expected returns than growth stocks, valuation models actually imply that growth stocks have similar growth rates to value stocks in buy-and-hold portfolios, and have lower growth rates than value stocks in rebalanced portfolios.[5] Second, Fama and French (1995)'s results pertain to the behavior of the return on equity, which is relevant for studying the growth rates of book equity. However, those results do not imply that cash-flow growth rates for growth stocks are higher. In fact, some back-of-the-envelope calculations suggest that Fama and French (1995)'s results imply that growth stocks have lower earnings growth rates than value stocks initially. Changes in the return on equity (the efficiency growth) help explain the result. Third, the dividend growth rate regression is subject to survivorship bias. After I account for survivorship bias, high book-to-market equity no longer predicts a lower future dividend growth rate.[6] Finally, I point out that Dechow, Sloan, and Soliman (2004) and Da (2009) are biased towards finding longer cash-flow durations in growth stocks.

The growth premium in rebalanced portfolios is consistent with a class of models that feature

[5] Interestingly, in studying the time series of the aggregate stock market, most authors (see references in Cochrane (2011)) find that the dividend-price ratio does not predict the future dividend growth rate. My finding provides the cross-sectional counterpart.

[6] Chen (2004) focuses on the forecasted future dividend growth rates from firm-level regressions and is therefore subject to survivorship bias.

countercyclical risk premiums, analyzed in the Appendix. This feature implies that stocks are more risky because in bad times, prices go down further, as a result of an increase of the discount rate, than in an i.i.d. world. When applied to a cross section of assets with constant but different cash-flow growth rates, because the effects of changes in discount rates are larger in long-duration assets, this feature implies that there is a growth premium in the cross section. I also show that when expected growth rates are also time-varying, then the implication on the growth premium becomes ambiguous. Countercyclical risk premiums no longer guarantee a growth premium.

I thus focus on rebalanced portfolios in testing the growth premium for two reasons. First, there is no clear relation between cash-flow growth rates and the book-to-market ratio in buy-and-hold portfolios to begin with. Second, I find that cash-flow growth rates tend to mean revert in buy-and-hold portfolios. As Lettau and Wachter (2007) show, mean reversion in cash flows can lead to a negative association between expected cash-flow growth rates and expected returns. In the presence of countercyclical risk premiums and mean reversion in cash flows, the implication on the growth premium is unclear.

This paper builds on previous work that examines growth rates. In fact, Lakonishok, Shleifer, and Vishny (1994) already provide some results (in their Table V) that equal-weighted portfolios of extreme growth stocks have higher growth rates in some of the three accounting variables that they examine (earnings, accounting cash flow, and sales) in the very short-term but often have lower growth rates from year 2 to year 5 than extreme value stocks, an important result that has clearly been overlooked by the literature. Part of my contribution is to extend their results to depict a complete picture. I find that their results are not driven purely by small stocks, and hold up in value-weighted portfolios as well. I also point out that the growth rate in the very short term (look-back growth rate) is irrelevant for estimating cash-flow duration. Furthermore, I reconcile their results with Fama and French (1995) who show that growth stocks have substantially higher future book-equity growth. Finally, I also examine dividends, which behave differently from earnings, and extend the horizon of the analysis from five years into the infinite future. A contemporaneous working paper by Penman, Reggiani, Richardson, and Tuna (2011) also finds that value stocks have higher earnings growth rate than growth stocks in year 2.

However, their paper does not address survivorship bias in such calculations. Chen, Petkova, and Zhang (2008) find that rebalanced portfolios of value stocks have higher dividend growth rates but suggest that their finding is consistent with conventional wisdom, and that their results are driven by the fact that value stocks have higher capital gains. I show that cash-flow growth rates of buy-and-hold portfolios are often higher in value stocks. Relative to all these papers, I illustrate the effect of survivorship and look-back biases. I derive an explicit relation between growth rates of buy-and-hold and rebalanced portfolios, and show that rebalanced growth rates should be higher than look-back and buy-and-hold growth rates for value stocks, and that the opposite is true for growth stocks, under mild conditions (even in the absence of the value premium); thus enriching Chen, Petkova, and Zhang (2008)'s explanation. I provide new results and point out biases in existing studies on cash-flow durations. Most important, I examine the implications of these growth rates on asset pricing models, and show that duration alone cannot explain the value premium, and that there is a pervasive growth premium in rebalanced portfolios in the cross section, consistent with asset pricing models that feature countercyclical risk premiums.

The evidence in this paper lends support to the effort by the literature that employs models of time-varying expected returns to help understand the times series (e.g., Campbell and Cochrane (1999) and Bansal and Yaron (2005)) and the cross section (e.g., Zhang (2005)) of stock returns. My results are also broadly consistent with the view that growth stocks have longer durations (Cornell (1999), Campbell, Polk, and Vuolteenaho (2010)), but the discount rate risk is positively priced (Campbell and Vuolteenaho (2004)).

In studying the aggregate time series, most authors (e.g., Menzly, Santos, and Veronesi (2004), Lettau and Ludvigson (2005), and Binsbergen and Koijen (2010)) find that the expected return is positively related to the expected dividend growth rate. My results suggest that this positive association also exists in the cross section, when we examine rebalanced portfolios. Furthermore, Novy-Marx (2010) finds that more profitable firms (firms with "good growth") have higher returns; his results are difficult to reconcile with the duration-based explanation of the value premium (e.g., Lettau and Wachter (2007)), because more profitable firms have longer cash-flow duration. My results suggest that his are consistent with the growth premium.

In an influential paper, Binsbergen, Brandt, and Koijen (2010) use data from the derivative market between 1996 and 2009, and find a downward sloping term structure for the aggregate stock market.[7] I complement their analysis by showing a positive cross-sectional correlation between cash-flow durations and returns in rebalanced portfolios, suggesting that there are economic forces that tend to make an upward sloping term structure. The notions of the term structure are different (Binsbergen, Brandt, and Koijen (2010) focus on the term structure of a given asset, while I examine the cross-sectional relation between cash-flow duration and returns), and more work is needed to understand the relation of these results.

The rest of the paper is organized as follows. I present variable definitions and data sources in Section 1. Section 2 provides evidence that cash flows of growth stocks do not grow substantially faster than those of value stocks in the future. In doing so, I also point out survivorship and look-back biases in common empirical procedures. Section 3 shows that growth stocks do not have substantially longer cash-flow durations than value stocks in buy-and-hold portfolios, and have shorter cash-flow durations than value stocks in rebalanced portfolios. Section 4 presents evidence on the growth premium. Section 5 provides various robustness checks and additional tests. Section 6 concludes.

1 Data and variable definitions

The data I use come from CRSP and Compustat. I only include stocks with share codes 10 or 11 that are listed on NYSE, AMEX, or Nasdaq. Financials and utilities are excluded. Returns and market equity (abs(prc)*shrout) are from CRSP. Accounting variables are from Compustat fundamental file (North America). I define book equity (B) as stockholders' equity, plus balance sheet deferred taxes (txdb) and investment tax credit (itcb) (if available), minus the book value of preferred stock. Depending on availability, I use redemption (pstkrv), liquidation (pstkl), or par value (pstk), in that order, for the book value of preferred stock. I calculate stockholders' equity used in the above formula as follows. I prefer the stockholders' equity number reported

[7] Boguth, Carlson, Fisher, and Simutin (2011) argue that the results in Binsbergen, Brandt, and Koijen (2010) are partially driven by microstructure issues.

by Moody's (collected by Davis, Fama, and French (2000)) or Compustat (seq). If neither one is available, then I measure stockholders' equity as the book value of common equity (ceq), plus the book value of preferred stock. Note that the preferred stock is added at this stage because it is later subtracted in the book equity formula. If common equity is not available, I compute stockholders' equity as the book value of assets (at) minus total liabilities (lt), all from Compustat.

Earnings are defined as income before extraordinary items (ib) from Compustat. Firm-level dividends are computed from CRSP, by multiplying the lagged market equity by the difference between returns with and without dividends. I then sum up the dividends for each firm between July and June of the following year. I use dividends constructed from CRSP for two reasons. First, it is easier to address issues that arise from delisting from CRSP. Second, I know when dividends are paid out.

To compute per share variables, I divide most variables by the Compustat variable cshpri (common shares used to calculate earnings per share - basic). For book equity and assets, I use CRSP shares outstanding (shrout/1000). For earnings per share, I use Compustat epspx directly. CRSP adjustment factor (cfacpr) is used to ensure that per share variables are comparable over time.

When forming book-to-market portfolios in June of year t, I sort stocks according to their book-to-market ratios. The book-to-market equity uses the book equity for the fiscal year ending in the calendar year $t-1$. The market equity is from CRSP in December of year $t-1$. The breakpoints are computed using NYSE stocks only.

Portfolio dividends are constructed as follows. I first compute the value-weighted average of monthly returns and returns without dividends (*retx*). Missing delisting returns and *retx* are both set to be -30% if the delisting code is between 400 and 600. They are both set to be 0 otherwise. In the month of delisting, if there is no return in CRSP, I set the return (*ret*) and the return without dividends (*retx*) to the delisting return (*dlret*) and the delisting return without dividends (*dlretx*). When there is a return in the month of delisting, I compound the return and the delisting return. I also compound *retx* and *dlretx*. In most cases, the delisting *retx* reported by CRSP is the same as the delisting return, which implies that delisting proceeds are not taken out as dividends; therefore they are reinvested in the remainder of the portfolio.

All quantities are expressed in real terms using the Consumer Price Index (CPI), obtained from the U.S. Bureau of Labor Statistics.

2 Do cash flows of growth stocks grow faster than value stocks?

2.1 Portfolio dividends

I focus on quintile portfolios sorted by the book-to-market ratio. For each portfolio formation year t, I invest \$100 at the end of June. I then construct monthly dividends using $D_{t+s} = P_{t+s-1}(ret_{t+s} - retx_{t+s})$ and $P_{t+s} = P_{t+s-1}(1 + retx_{t+s})$. Annual dividends are the sum of monthly dividends from July to the following June. The dividends are then converted to real dollars using the CPI. Finally, I average across portfolio formation years to obtain average dividends. Delisting proceeds are reinvested in the remainder of each portfolio. To be consistent with existing studies (for example, Bansal, Dittmar, and Lundblad (2005) and Hansen, Heaton, and Li (2008)), I focus on cash dividends in the primary analysis and explore repurchases as a robustness check.

2.1.1 Buy-and-hold portfolios

Table 1 reports the resulting average dividends for buy-and-hold portfolios from year 1 to year 10 for three sample periods. Panel A reports results for the sample after 1963. To ensure that I compare the same set of portfolios, the last portfolio formation year I include is 2001. Dividends are expressed in year 0 real dollars.[8]

On average, growth stocks pay out \$2.03 in year 1. This figure increases to \$2.13 in year 2, and to \$2.89 in year 10. Value stocks tend to pay out more dividends in this sample period. In year 1, they on average pay out \$3.73. This figure increases to \$3.80 in year 2, and to \$4.13 in year 10. Thus value stocks pay more dividends in year 1, and they still pay substantially more dividends in year 10.

[8] To motivate this method, note that if dividends follow a geometric Brownian motion, $\frac{dD_t}{D_t} = gdt + \sigma dW_t$, then $D_{t+s} = D_t e^{(g - \frac{\sigma^2}{2})s + \sigma(W_{t+s} - W_t)}$. It can be shown that $E[D_{t+s}] = D_t e^{gs}$. Therefore, $\frac{E[D_{t+2}]}{E[D_{t+1}]} = E[\frac{D_{t+2}}{D_{t+1}}] = e^g$. The sample counterpart of $E[.]$ is taking average across portfolio formation years.

The right half of Panel A reports the growth rates of the average dividends. From year 1 to year 2, the average dividends in growth stocks increase by 5.26% (from \$2.03 to \$2.13). This is higher than the growth rate in value stocks, 1.91% (from \$3.73 to \$3.80). The difference (value-growth) is -3.34%. This difference declines a little in magnitude, although not monotonically, to -2.76% in year 10. The series of growth rates (in year 2 through year 10) have almost identical arithmetic averages (for example, 1.15% for the value stocks) and geometric averages (1.14%). From year 1 to year 10, the average dividends of growth stocks grow at a geometric average rate of 4.01%, while value stocks grow at 1.14%. The difference (value-growth) is -2.87%.

To put these number in perspective, I also examine what is commonly assumed in the duration-based explanations of the value premium. Lettau and Wachter (2007, 2011) and Croce, Lettau, and Ludvigson (2010) assume that dividend shares of extreme individual growth stocks grow at 20% for the first 25 years, while dividend shares of extreme individual value stocks shrink at 20% per year for the first 25 years. The cycle is reversed in the next 25 years and then repeats itself thereafter. This assumption implies that, the portfolio of growth stocks also grows substantially faster than the portfolio of value stocks. Motivated by Da (2009), I compute $\bar{g_i} = \sum_{s=2}^{+\infty} \rho^s g_{is} / \sum_{s=2}^{+\infty} \rho^s$, in which $\rho = 0.95$ and g_{is} is the growth rate of expected dividends in year s for portfolio i.[9] This share process implies that the quintile portfolio of growth stocks grows at $\bar{g_i}$ of 14.06% per year, while the quintile portfolio of value stocks grows at -4.89%. The difference (value-growth) is -18.94% per year. For more details of the calculation, see Fig. A1 and Appendix 7.1. I conclude that, dividends of growth stocks do grow a little faster than dividends of value stocks in the modern sample period, but the difference is substantially smaller than commonly assumed.

Panel B shows that even the small growth differential between growth and value stocks is not robust if we examine the early sample period (1926-1962). In the early sample period, value stocks initially pay a little less dividends in year 1 than growth stocks (\$4.01 vs. \$4.70). 10 years later, value stocks pay more dividends (\$7.51 vs. \$5.83). In each year between year 2 and year 10, growth rates of average dividends in value stocks exceed those in growth stocks. In year 2,

[9] Da (2009) uses $\sum_{s=1}^{+\infty} \rho^s g_{is}$ as his measure of cash-flow duration. I scale this metric by $\sum_{s=0}^{+\infty} \rho^s$ so it can be interpreted as a long-run growth rate. I skip the look-back growth rate in year 1 for reasons explained later.

dividends of value stocks grow by 12.98%, dwarfing 3.07% in growth stocks. The difference is 9.91%. This difference substantially declines over time and is about 2% in year 10. From year 1 to year 10, the geometric average growth rate is 7.22% for the value quintile, and 2.43% for the growth quintile. The difference (value-growth) is 4.78%.

Panel C shows that over the long sample (1926-2001), growth stocks grow at a geometric average of 2.95% per year (from \$3.33 to \$4.32) in the first 10 years. The average growth rate for value stocks is 4.56% (from \$3.87 to \$5.78). As in Panel B, dividends of value stocks grow faster and the difference tends to decline as the year from portfolio formation increases, consistent with the idea that growth stocks and value stocks tend to become more alike after initial sorting.

The left panels of Fig. 1 provide a plot of the average dividends in buy-and-hold portfolios in the three sample periods.

To ensure that each portfolio consists of a reasonably large number of stocks, I examine the average and minimum number of stocks in each year. The results are reported in Table 2. Table 2 shows that at any given point in time, there are at least 55 stocks in each portfolio. There are more firms in the modern sample period than in the early sample period.

One noteworthy feature is that firms tend to exit over time, and this is particularly pervasive in the modern sample period (see also Chen (2011)). For example, in the modern sample period, there are on average 613 firms in the first year in the value quintile. This number declines to 553 firms in year 2, and by year 10 there are only 271 firms left. Thus it is important to take account of the delisting proceeds.

2.1.2 Annually rebalanced portfolios

Forming rebalanced portfolios has become second nature for empirical asset pricing researchers. To examine the value premium, the standard practice since Fama and French (1992) is to form a portfolio as of June of year t, and then hold the portfolio between July of year t and June of year $t+1$, at which time the portfolio is rebalanced. I thus repeat the exercise in 2.1.1, but now using rebalanced portfolios.

Results are reported in Table 3. Because rebalancing only occurs once a year, the average dividends in year 1 are the same in rebalanced and buy-and-hold portfolios. In Panel A (the modern sample period), the average dividends of growth stocks grow from $2.03 to $2.25 in year 10, corresponding to a 1.18% annual growth rate. For value stocks, dividends grow from $3.73 to $5.39, corresponding to a 4.16% growth rate per year. The difference in the growth rates is 2.99%. In the early sample period (Panel B) and the full sample period (Panel C), the difference is 8.68% and 6.17%, respectively.

The results suggest three points. First, cash-flow growth rates in buy-and-hold portfolios and rebalanced portfolios can be qualitatively different. For example, in the modern sample period, dividends of growth stocks grow faster than those of value stocks in buy-and-hold portfolios, but the opposite is true for rebalanced portfolios. Second, the finding, that in rebalanced portfolios dividends of value stocks grow faster than those of growth stocks, is robust to sample periods. Third, although the growth differential is smaller in the modern sample period than in the early sample period, the growth rates in rebalanced portfolios are substantially more persistent than those in buy-and-hold portfolios. The pattern is clearest in the full sample period. In buy-and-hold portfolios, the growth rate differential (value-growth) declines from 3.75% in year 2 to 0.30% in year 10. In rebalanced portfolios, the growth rate differential (value-growth) declines only modestly from 6.45% in year 2 to 6.20% in year 10.

The right panels of Fig. 1 provide a plot of the average dividends in rebalanced portfolios in the three sample periods.

The evidence so far shows that in rebalanced portfolios dividends of value stocks clearly grow faster than those of growth stocks. Contrary to conventional wisdom, in buy-and-hold portfolios, dividends of growth stocks do not grow much faster than value stocks. Why is the conventional wisdom so widely held? I think it is because there are many good reasons to believe the conventional wisdom. In each of Sections 2.2 through 2.4, I start with a reason that seems to support the conventional wisdom and then explain why it does not contradict my findings. Unless otherwise stated, I focus on value-weighted buy-and-hold portfolios.

2.2 Earnings

2.2.1 Evidence that suggests growth stocks grow faster

One piece of evidence comes from Fama and French (1995), who show that growth stocks have persistently higher returns on equity than value stocks. I update their results in Panel A of Fig. 2. In each year t between 1963 and 2001, I sort stocks into value-weighted quintile portfolios according to their book-to-market ratios. Once I have formed the portfolios, I then look at the return on equity for each portfolio five years before and ten years after portfolio formation. The return on equity in year $t+s$ for a portfolio formed in year t is computed as: $ROE_{t+s} = \frac{E_{t+s}}{B_{t+s-1}}$. The return on equity is then converted to real terms using the CPI.

Portfolio earnings (E) and book equity (B) are the sum of firm earnings and book equity in that portfolio. I treat earnings and book equity with fiscal year ends between July of year $t+s-1$ and June of year $t+s$ as earnings and book equity in year $t+s$.[10] I follow Fama and French (1995) and require a stock to have data for both E_{t+s} and B_{t+s-1} to be included in the computation of the portfolio return on equity, although I show later that this requirement gives rise to survivorship bias. I average the portfolio return on equity across the 39 portfolio formation years 1963-2001. That is, $ROE_s = E[ROE_{t+s}]$, in which taking expectation means averaging over portfolio formation years t. Because I track the portfolio five years before and ten years after its formation year, accounting information between 1957 and 2011 is used.

Panel A of Fig. 2 plots the ROE_s for s between -5 and 10. The figure shows that growth stocks have persistently higher returns on equity than value stocks, even ten years after portfolio formation. This finding led Fama and French to term the stocks with low book-to-market ratios as "growth stocks". The difference in the return on equity reaches the highest value in year 1. This pattern is the same as in Fama and French (1995).

[10]When looking at return on equity, Fama and French (1995) treat earnings and book equity with fiscal year ends in calendar year $t+s$ as earnings and book equity in year $t+s$. Because most firms have December fiscal year ends, their year 0 roughly corresponds to my year 1.

2.2.2 The back-of-the-envelope calculation

I argue that Fama and French (1995)'s results on return on equity are related to the growth rates of book equity, but not necessarily of cash flows.[11] In fact, I argue that Fama and French (1995)'s results on return on equity imply that the earnings growth rates are initially higher for value stocks.[12] Consider a back-of-the-envelope calculation for the earnings growth rates. Earnings growth rate in year s is,

$$\frac{E_s}{E_{s-1}} - 1 = \frac{\frac{E_s}{B_{s-1}}}{\frac{E_{s-1}}{B_{s-2}}} \frac{B_{s-1}}{B_{s-2}} - 1. \tag{1}$$

Assuming the clean surplus relation in year $s-1$ and a constant dividend payout ratio, $po = D_{s-1}/E_{s-1}$, I show that,

$$\frac{E_s}{E_{s-1}} - 1 = (1-po)ROE_s + \left(\frac{ROE_s}{ROE_{s-1}} - 1\right). \tag{2}$$

The first term on the right-hand side of the previous equation, $(1-po)ROE_s$, is commonly referred to as the sustainable growth rate. The second term, $\frac{ROE_s}{ROE_{s-1}} - 1$, is often referred to as the efficiency growth. A standard result is that when the ROE is constant, the earnings growth rate is simply equal to the sustainable growth rate. But in this case, ROE exhibits clear time-varying patterns, and the efficiency growth cannot be ignored.

For value stocks, the sustainable growth rate, $(1-po)ROE_s$, is lower than growth stocks, but the efficiency growth, $\frac{ROE_s}{ROE_{s-1}} - 1$, is higher than growth stocks. It turns out that the efficiency growth dominates, at least initially. For example, assume that the payout ratio is 0.5. In year 2, for value stocks, ROE_s is 0.051, ROE_{s-1} is 0.037, and the earnings growth rate is $0.051/0.037 + 0.5 * 0.051 - 1 = 39.4\%$. For growth stocks, ROE_s is 0.183, ROE_{s-1} is 0.203, and the earnings growth rate is $0.183/0.203 + 0.5 * 0.183 - 1 = -0.4\%$.

The results of the back-of-the-envelope calculations are plotted in Panel B of Fig. 2. Prior to and in the first year after portfolio formation, growth stocks have higher earnings growth rates

[11] The clean surplus relation holds that $B_t = B_{t-1} + E_t - D_t$. When dividends are proportional to earnings, the return on equity is proportional to book-equity growth rates.

[12] To be clear, Fama and French (1995) do not claim that growth stocks have higher future cash-flow growth rates than value stocks.

than value stocks. However, in year 2, the earnings growth rate of value stocks (39.4%) greatly exceeds that of growth stocks (-0.4%). In year 3, the earnings growth rate of value stocks (23.8%) still exceeds that of growth stocks (3.7%). Starting in year 4, the earnings growth rates of the three portfolios become more similar.[13]

In a previous draft of the paper, I find that growth stocks do have higher future book-equity growth than value stocks. Growth stocks also have higher growth rates in many other accounting variables, such as assets, sales, and costs, than value stocks, although the differences in growth rates in these variables are smaller than those in the book equity. The results suggest that cash-flow growth can be qualitatively different from firm growth, in the presence of the efficiency growth (mean reversion in the return on equity). I speculate that competition is one driver for the observed efficiency growth.

2.2.3 Earnings growth rates adjusted for survivorship bias

In the procedure above, I require a firm to be alive in both years $t+s-1$ and $t+s$ to be included in the calculation of growth rates. However, when investors invest in year $t+s-1$, they do not know whether the firm will be alive in year $t+s$. Therefore, requiring the firm to have a valid data entry in year $t+s$ gives rise to survivorship bias. Suppose that growth stocks (such as internet firms) tend to either become extremely successful (e.g., Google), or they die. If we only look at the firms that survive, we may see a picture that is different from investors' actual experiences. As shown in Table 2, delisting and exits have become a pervasive phenomenon in the modern sample period.

To account for survivorship bias, it is important that when computing the growth rate in year $t+s$, I do not look at just the firms that are alive in year $t+s$. Instead, I examine all firms that are alive in year $t+s-1$, and reinvest delisting proceeds in the remainder of the portfolios when firms exit in year $t+s$. In Appendix 7.2, I develop a five-step procedure to construct earnings per share growth rate that accounts for survivorship bias. The key idea is to first construct the price

[13] Lettau and Wachter (2007) argue that because the firms in their model have no debt, the dividends in their model may be better analogues to earnings and accounting cash flows in the data, rather than dividends themselves. However, my results suggest that earnings of value stocks grow faster than those of growth stocks after portfolio formation.

series using *ret* and *retx*. Because CRSP keeps track of delisting, this price series is survivorship bias free. Then I use the earnings per share to price ratio and the price series to construct the survivorship bias adjusted earnings per share series. This procedure can be applied to any other accounting variable.

Panel A of Fig. 3 reports the average real earnings between year -5 and year 10 corresponding to a $100 investment at the end of year 0, in value-weighted buy-and-hold portfolios. The average earnings of value stocks show a particularly interesting pattern. They largely decline from year -5 to year 1, and then rebound after that. In year 0, the earnings for value stocks are $5.54. This figure declines to $4.10 in year 1 and strongly rebounds to $5.98 in year 2.

Panel B of Fig. 3 plots the growth rate of average earnings for value, neutral, and growth stocks. In general, the pattern is very similar to what we see in the back-of-the-envelope calculation in Panel B of Fig. 2. Prior to and in the first year after portfolio formation, growth stocks have higher earnings growth rates than value stocks. But in year 2, the earnings growth rate of value stocks (45.8%) greatly exceeds that of growth stocks (1.1%). In year 3, the earnings growth rate of value stocks (19.7%) still exceeds that of growth stocks (2.5%). Starting in year 4, the earnings growth rates of the three portfolios become more similar.

Some sources (e.g., Investopedia) define growth stocks as shares in a company whose earnings are expected to grow at an above-average rate relative to the market. Throughout this paper, I define growth stocks as those with low book-to-market ratios. My results show that these two definitions may contradict each other.

In a previous draft, I examine the effect of survivorship bias in many accounting variables (book equity, assets, sales, costs, earnings, accounting cash flows, and dividends). I find that in value-weighted portfolios, survivorship bias makes a quantitative but not qualitative difference (results available upon request).

2.2.4 The growth rate in year 1 and look-back bias

The above analysis shows that earnings of value stocks significantly outgrow those of growth stocks in year 2 and year 3. But from year 0 to year 1, earnings of value stocks shrink from $5.54

to \$4.10, corresponding to a growth rate of -25.9%. At the same time, earnings of growth stocks grow from \$4.63 to \$4.88, corresponding to a growth rate of 5.4%. Thus in year 1, the earnings growth rate of growth stocks is substantially higher than that of value stocks.

I believe that the growth rate in year 1 itself is not relevant for thinking about cash-flow duration. The reason is as follows. For the above exercise, the investment of \$100 occurs at the end of year 0. Therefore, the denominator of the growth rate in year 1 is earnings that accrued between year -1 and year 0, and is strictly in the past. Cash-flow duration is about whether future cash flows are more concentrated in the near future or in the distant future. But growth rate in year 1 is about how cash flows in the near future compare with the *past*. Although the growth rate in year 1 can be used to forecast future growth rates, it is itself not relevant in estimating cash-flow duration. For this reason, I refer to the growth rate in year 1 as the look-back growth rate, and the bias that arises from including that growth rate in the cash-flow duration as the look-back bias.[14]

Here is another way to illustrate the point. Consider at the end of year 0. Suppose that a stock has paid out D_0 as dividends in the last year. Next year it will pay D_1, and after that, the dividends will be D_2, D_3, D_4, ... Note that D_1, D_2, D_3, D_4,... all can be stochastic. I denote that this stock is characterized by $\{D_0, D_1, D_2, D_3, D_4, ...\}$. Now imagine another stock that is characterized by $\{2D_0, D_1, D_2, D_3, D_4, ...\}$. It follows immediately that going forward, these two stocks are exactly the same, and their future growth and return paths are exactly the same (state by state). Any reasonable measures of cash-flow durations should be the same for these two stocks, although these two stocks clearly have very different growth rates in year 1. I advocate not including the look-back growth rates in estimating the cash-flow duration.

2.2.5 Negative earnings in year 1

Value stocks experience a substantial decline of earnings in year 1 and subsequently a large increase in earnings. This suggests that a number of value stocks may experience negative earnings in year 1. To examine this issue further, I examine firms with positive and negative earnings in year 1

[14] For example, Da (2009)'s cash-flow duration measure is $\sum_{s=1}^{+\infty} \rho^s g_{is}$, $\rho = 0.95$.

separately. To do so, I look at firms that survive in year 1 and year 2. For each portfolio formation year, real earnings are scaled to correspond to a \$100 investment at the end of year 0. I then decompose total earnings in year 1 into earnings from firms that report positive earnings (E_1, if $E_1 > 0$), and earnings from firms that report negative earnings (E_1, if $E_1 <= 0$). Total earnings in year 2 are equal to the sum of earnings in year 2 from firms that report positive earnings in year 1 (E_2, if $E_1 > 0$), and earnings in year 2 from firms that report negative earnings in year 1 (E_2, if $E_1 <= 0$). I then average across portfolio formation years.

The results are plotted in Fig. 4. Panel A plots for the growth quintile while Panel B plots for the value quintile. While negative earnings are not important for growth stocks, they are an important phenomenon for value stocks. Panel B of Fig. 4 shows that the value stocks that have negative earnings in year 1, typically experience an improvement in year 2 (less losses in earnings).

Table 4 reports the numbers derived from Fig. 4. Panel A considers the sample from 1963-2001. For this set of firms, for a \$100 investment, growth stocks earn \$5.11 in earnings, and value stocks earn \$6.10 in earnings in year 1.[15] They grow to \$5.18 and \$7.47 in year 2, respectively. The growth rates are 1.43% for growth stocks and 22.45% for value stocks. Again earnings of value stocks grow faster.

The value stocks' total earnings in year 1, \$6.10, consist of positive earnings of \$9.77 and negative earnings of -\$3.67. For value firms that earn positive earnings in year 1, earnings shrink from \$9.77 to \$8.69, corresponding to a growth rate of -11.07%; this contrasts with a 0.94% increase for growth stocks. However, for value firms that have negative earnings in year 1, the earnings improve greatly from -\$3.67 in year 1 to -\$1.22 in year 2. This improvement in earnings more than offsets the decline in earnings in positive earnings firms. Negative earnings firms are not important for the growth quintile as they are -\$0.17 in year 1 and -\$0.15 in year 2.

Panel B reports the same set of results for formation years from 1963 to 2009 and finds qualitatively the same result.

In Section 2.2.2, I show that as long as ROE is time-varying, the efficiency growth can drive a wedge between book equity growth and earnings growth. The analysis in this section depicts an

[15]These number are larger than the survivorship-bias adjusted earnings in Fig. 3, which are \$4.88 and \$4.10, respectively. It is not surprising that earnings are higher conditional on survival.

extreme case in which this wedge occurs. When firms have negative earnings, a decline in firm size (as measured by the book equity) can be good news for earnings if it means that losses in earnings shrink.

2.3 Firm-level dividend and survivorship bias

In Table 5, I provide another piece of evidence that suggests cash flows of growth stocks grow faster. I estimate firm-level regressions of log dividend growth rates on lagged book-to-market ratios. In particular, I estimate the following regression in each year:

$$log(D_{i,t}/D_{i,t-1}) = b_0 + b_1 log(B/M)_{i,t-k} + \epsilon_{i,t}. \tag{3}$$

I estimate the regression using the Fama-MacBeth procedure between 1965 and 2011, for k between 1 and 10. $D_{i,t}$ is the dividend from July of year $t-1$ to June of year t computed from CRSP. Variables are winsorized at 1% and 99% in each year. Table 5 reports the results. Years negative refer to the number of years in which the coefficient b_1 is negative. I report Newey-West t-statistics with an automatically selected number of lags.

Table 5 shows that the book-to-market equity appears to strongly forecast negative dividend growth. When $k=1$, the coefficient b_1 is negative in 47 out of 47 years. The average coefficient is -0.069 and is highly statistically significant. In year 2, the coefficient b_1 is again negative, with an average coefficient of -0.042. It is negative in 41 out of 47 years. The coefficient is significantly negative even after ten years.

I argue that the regression of the dividend growth rate on the book-to-market ratio in Table 5 is inherently subject to survivorship bias, because a firm has to be alive to be included in the regression. As Table 2 shows, delisting has become a pervasive phenomenon in the modern sample period. To account for survivorship bias in this regression, I include the delisting proceeds (delisting amount, abs(dlamt), multiplied by shares outstanding) as a form of liquidating dividends. I then re-estimate the regressions and report the new results in Table 6.

Table 6 shows a different picture from Table 5. Although the coefficient on the book-to-market equity is still negative in the first two years, it becomes positive starting in year 3. The coefficient generally increases over time, although the increase is not monotonic. Starting in year 3, each coefficient is statistically significant at the 10% level.

The reason that adjusting for survivorship bias makes a bigger difference in the regression than in portfolio growth rates is because regressions are equal weighted in nature. Accounting for survivorship bias is more important in small firms, since large firms are less likely to exit.

2.4 Evidence from valuation models

Gordon's formula, $\frac{D_1}{P_0} = r - g$, suggests that all else being equal, stocks with higher prices should have higher cash-flow growth rates. I argue that this does not necessarily imply that growth stocks should have higher expected dividend growth rates for two reasons. First, sorting on the book-to-market ratio results in a much smaller (and sometimes negative) spread in dividend-price ratio. Second, all else is not equal when we compare value stocks with growth stocks, because they differ in expected returns.

To see the first point, I note that the dividend-to-price ratio is related to the book-to-market ratio as follows: $\frac{D_1}{P_0} = \frac{B_1}{P_0}\frac{D_1}{B_1}$. Value stocks have higher book-to-market ratios, but Fama and French (1995) show that value stocks also have substantially lower earnings-to-book ratios (basically the return on equity, also replicated in Panel A of Fig. 2). If value stocks also have substantially lower dividend-to-book ratios, then sorting on the book-to-market ratio may result in a much smaller spread in the dividend-to-price ratio.

Table 7 reports the analysis on this issue. I compute the average book equity (B_1) and dividends (D_1) in year 1 in buy-and-hold portfolios for a \$100 (P_0) investment at the end of year 0. The accounting variables are adjusted for survivorship bias. D_1/B_1 refers to the average real dividends in year 1 divided by average real book equity in year 1. In Panel A1, I focus on the modern sample period (1963-2001). Sorting on book-to-market clearly results in a large spread in $\frac{B_1}{P_0}$, going from 0.28 (growth) to 1.49 (value). However, $\frac{D_1}{B_1}$ is substantially higher for low book-to-market stocks, 7.28% in growth stocks vs. only 2.50% in value stocks. Sorting on the book-to-market ratio results in a spread in the dividend-price ratio of only 1.71% (3.73% in the value quintile vs. 2.03% in the growth quintile). This spread is similar if I look at the 1963-1991 or the 1963-1976 sample periods.

If we look at the early sample period (in Panel B), as we go from growth to value, $\frac{B_1}{P_0}$ increases from 0.42 to 4.92. However, $\frac{D_1}{B_1}$ declines from 11.22% to 0.82%. This results in a dividend-price ratio that is hump shaped. In fact, the value quintile has a lower dividend-price ratio (4.01%) than the growth quintile (4.70%).

Next, I examine the spread in returns (the value premium). I report the T-year average returns for the buy-and-hold portfolio, $\sum_{s=1}^{T} \rho^s r_{is} / \sum_{s=1}^{T} \rho^s$, where $\rho = 0.95$ and r_{is} is the average annual return in year s after portfolio formation, for portfolio i. When $T = 1$, this produces the average return in the rebalanced portfolio. The value premium in rebalanced portfolios has been 5.73%, 5.29%, 7.45%, and 10.94%, for the 1963-2001, 1963-1991, and 1963-1976, and the early sample periods, respectively. I note that the value premium exceeds the spread in the dividend-price ratios in rebalanced portfolios. Thus valuation models imply that dividends of value stocks should grow faster than those of growth stocks in rebalanced portfolios.

In buy-and-hold portfolios, the value premium is also significant relative to the spread in the dividend-price ratio. In the modern sample period, the value premium has been 3.90%, 1.95% and 3.12%, when $T = 10$, $T = 20$, $T = 35$, respectively. At the same time, the spread in the dividend-price ratio is 1.71%, 2.21%, 2.01%, respectively. In the early sample period, the value premium has been 5.10%, 3.86% and 3.31%, when $T = 10$, $T = 20$, $T = 35$, respectively. At the same time, the spread in the dividend-price ratio is -0.69%. Thus, Gordon's formula suggests that in buy-and-hold portfolios, growth stocks should not grow substantially faster than value stocks.

My analysis above uses realized returns as a proxy for expected returns. But my point does not hinge on this proxy. The spread in dividend-price ratios between value and growth stocks is only about 2% in the modern sample period and slightly negative in the early sample period. As long as one believes that the value premium exists (as one must, if one is to explain the value premium), then there is little reason to expect growth stocks to grow much faster in dividends than value stocks.

2.5 The relation between growth rates of rebalanced and buy-and-hold portfolios

The results so far show that in rebalanced portfolios, the dividend growth rate is clearly positively related to the book-to-market ratio. But in buy-and-hold portfolios, the dividends of growth stocks grow a little faster than value stocks in the modern sample period. I now examine the relation between growth rates in rebalanced and buy-and-hold portfolios. I show that value stocks should have higher growth rates in rebalanced than in buy-and-hold portfolios, and the opposite is true for growth stocks. The intuition is as follows. Consider investment in value stocks. For the same amount of initial investment, rebalanced and buy-and-hold portfolios generate the same amount of dividends in the first year and the same amount of capital available for reinvestment. Subsequently, rebalanced portfolios use the capital to invest in the new value stocks, while buy-and-hold portfolios invest in the old value stocks. Because the new value stocks are likely to have higher dividend-price ratios than the old value stocks, they tend to generate more dividends subsequently, thereby producing a higher growth rate in rebalanced portfolios. The following analysis shows this more formally.

2.5.1 Notations

I now introduce notations. Suppose there are N stocks, whose prices and dividends per share are $P_{n,t}$ and $D_{n,t}$, for $n = 1, 2, ..., N$. Prices are measured at the end of the year. Dividends are paid shortly before the end of the year. The trading strategy uses information up to year t and calls for buying those stocks with a certain characteristic at the end of year t, and holding the stocks until the end of year $t + 1$. At the end of year $t + 1$, we take out and consume the dividend. We also rebalance the portfolio and use the proceeds from stock sales to buy stocks that fit the portfolio selection criteria at the end of year $t + 1$, and then hold those stocks in year $t + 2$. For ease of disposition, assume that there are only five stocks, $N = 5$, and our strategy calls for holding one stock at any given point in time. Assume that the stocks selected by the strategy at the end of years t, $t + 1$, and $t + 2$, are stocks i, j, and k, respectively. Note that in year t, the identities of j and k are not known and may or may not be i. Our initial investment is $P_{i,t}$, so we can buy one share of stock i. Therefore, the portfolio generates a dividend of $D_{i,t+1}$ in year $t+1$. The investor is left with $P_{i,t+1}$, and then can buy $\frac{P_{i,t+1}}{P_{j,t+1}}$ shares of stock j. Therefore, in year $t+2$, the investor earns a dividend of $D_{j,t+2}\frac{P_{i,t+1}}{P_{j,t+1}}$. The dividend growth rate of the rebalanced portfolio in year $t+2$ is

$$g_{t+2} = \frac{D_{j,t+2}\frac{P_{i,t+1}}{P_{j,t+1}}}{D_{i,t+1}} - 1. \tag{4}$$

The dividend growth rate in year $t+s$ for the buy-and-hold portfolio formed in year t is:

$$g_{t,t+s}^{BH} = \frac{D_{i,t+s}}{D_{i,t+s-1}} - 1, for s \geq 2. \tag{5}$$

Note that when $s \leq 1$, we have not yet bought the portfolio. Nevertheless, we can compute the growth rate of such a portfolio. When $s = 1$, it is the look-back growth rate.

$$g_{t,t+1}^{LB} = \frac{D_{i,t+1}}{D_{i,t}} - 1. \tag{6}$$

In the above example, I note that $g_{t,t+2}^{BH} = \frac{D_{i,t+2}}{D_{i,t+1}} - 1$ and $g_{t+1,t+2}^{LB} = \frac{D_{j,t+2}}{D_{j,t+1}} - 1$.

2.5.2 The portfolio rebalancing effect

I now show that relative to the rebalanced growth rate, the look-back growth rate is necessarily lower for the value portfolio and necessarily higher for the growth portfolio. Suppose the value strategy calls for buying the stock with the highest dividend-price ratio at the end of year t and then holding that stock during year $t+1$. Again, assume that the stocks selected by the strategy at the end of year t, $t+1$, and $t+2$, are stocks i, j, and k, respectively.

For the value portfolio, $g_{t+2} \geq g_{t+1,t+2}^{LB}$, because

$$1 + g_{t+2} = \frac{D_{j,t+2}\frac{P_{i,t+1}}{P_{j,t+1}}}{D_{i,t+1}} = \frac{D_{j,t+2}}{P_{j,t+1}}\frac{P_{i,t+1}}{D_{i,t+1}} \geq \frac{D_{j,t+2}}{P_{j,t+1}}\frac{P_{j,t+1}}{D_{j,t+1}} = \frac{D_{j,t+2}}{D_{j,t+1}} = 1 + g_{t+1,t+2}^{LB}. \tag{7}$$

The inequality holds because we sort on dividend-price ratios and stock j has the highest dividend-price ratio in year $t+1$. Similar arguments show that the look-back growth rate necessarily overstates the growth rates of the growth portfolio, that is, $g_{t+2} \leq g^{LB}_{t+1,t+2}$ for the growth portfolio.

This analysis uses dividends, but the logic works for any fundamental variable. If we sort on the book-to-market ratio, then as long as the sorting preserves the ranking of the fundamental-to-price ratio in the portfolio formation year, the look-back growth rate in that fundamental value understates value investors' experiences. That is, the look-back growth rate is lower than the rebalanced portfolio growth rate if sorting on the book-to-market ratio preserves the ranking of $\frac{F_0}{P_0}$.

In the equations below, I show the relation between the buy-and-hold growth rates and the rebalanced portfolio growth rates. For the value portfolio, $g_{t+2} \geq g^{BH}_{t+1,t+2}$, if

$$\frac{D_{j,t+2}}{P_{j,t+1}} \geq \frac{D_{i,t+2}}{P_{i,t+1}}. \tag{8}$$

This is because,

$$1 + g_{t+2} = \frac{D_{j,t+2}\frac{P_{i,t+1}}{P_{j,t+1}}}{D_{i,t+1}} = \frac{D_{j,t+2}}{P_{j,t+1}}\frac{P_{i,t+1}}{D_{i,t+1}} \geq \frac{D_{i,t+2}}{P_{i,t+1}}\frac{P_{i,t+1}}{D_{i,t+1}} = \frac{D_{i,t+2}}{D_{i,t+1}} = 1 + g^{BH}_{t,t+2}. \tag{9}$$

Thus, if we sort on the book-to-market ratio, then as long as the sorting preserves the ranking of the forward-fundamental-to-price ratio, the buy-and-hold growth rate in that fundamental value understates rebalancing value investors' experiences. That is, the buy-and-hold growth rate is lower than the rebalanced portfolio growth rate if sorting on the book-to-market ratio preserves the ranking of $\frac{F_1}{P_0}$.

In unreported results, I examine $\frac{F_0}{P_0}$ and $\frac{F_1}{P_0}$ in the modern sample period. The results show that sorting on the book-to-market ratio results in a hump shape in the earnings/price ratio. But sorting on the book-to-market ratio preserves the rankings in the accounting cash flow/price ratio, the dividend/price ratio, and of course, the book-to-market ratio. In terms of the forward fundamental to price ratio, $\frac{F_1}{P_0}$, the ranking is almost preserved for accounting cash flow and dividends. The ranking is entirely preserved for book equity. Hence, I conclude that for the latter three variables, looking at the static growth rates (both the look-back growth rate and the buy-and-hold growth rate), understates a rebalancing value investor's experiences. Further, this understatement mechanically arises when we sort on fundamental-to-price ratios.

3 Do growth stocks have longer cash-flow durations?

So far, I have examined cash-flow growth rates and find that growth stocks have similar and lower growth rates, relative to value stocks, in buy-and-hold portfolios and rebalanced portfolios, respectively. I now directly examine the duration of portfolios. The most common notion of the duration is the Macaulay duration, which is the weighted average of cash-flow maturities. To distinguish from the cash-flow duration (discussed later), I call this the canonical duration.

$$Dur_i^{canonical} = \sum_{t=1}^{\infty} \frac{\frac{D_{it}}{(1+r_i)^t}}{\sum_{t=1}^{\infty} \frac{D_{it}}{(1+r_i)^t}} \times t \tag{10}$$

To implement this, I use the historical average of dividends in the first T years, and assume that beyond year T, the cash flows are a growing perpetuity, growing at $g_{i\infty}$ per year. I report the results for $T = 20$, although the results are qualitatively the same if I use $T = 10$ or $T = 35$.

I calibrate $g_{i\infty}$ as follows. In buy-and-hold portfolios, dividend-price ratios converge substantially over time. I first report results for the modern sample period. By the end of year 20, there is little difference in the dividend-price ratio between growth stocks and value stocks (2.2% vs 2.5% in value-weighted quintiles). I explore three sets of assumptions for $g_{i\infty}$. First, I assume that the terminal dividend-price ratios only forecast terminal growth rates and all assets have the same terminal returns ($r_{i\infty} = 4.5\%$ for value-weighted portfolios and $r_{i\infty} = 7\%$ for equal-weighted portfolios). Therefore, $g_{i\infty} = \frac{r_{i\infty} - DP_{iT}}{1+DP_{iT}}$. Second, I assume that the terminal dividend-price ratios only forecast terminal returns and all assets have the same terminal growth rates ($g_{i\infty} = 2\%$ for value-weighted portfolios and $g_{i\infty} = 5.5\%$ for equal-weighted portfolios). Third, I assume that $g_{i\infty}$ is the average of the terminal growth rates under the previous two assumptions. Because the dispersion in the terminal dividend-price ratios is small, the three sets of assumptions produce similar results. I report results based on the third assumption.

In rebalanced portfolios, I compute the terminal growth rates as follows. I first use the dividend-to-price and book-to-market ratios to forecast the direct terminal growth rates (the forecasting coefficients are determined by the same regression in the first 20 years). I then use the dividend-to-price and book-to-market ratios to forecast terminal returns and obtain the indirect terminal growth rates by subtracting the terminal returns from the terminal dividend-to-price ratios. I then take an average of the direct and indirect terminal growth rates.

I then compute r_i, the portfolio discount rate that equates the present value of future cash flows with the current market price,

$$P_i = \sum_{t=1}^{T} \frac{D_{it}}{(1+r_i)^t} + \frac{D_{iT}(1+g_{i\infty})}{r_i - g_{i\infty}}. \tag{11}$$

To facilitate the calculation, I note that the growing perpetuity beyond year T has a canonical duration of $T + \frac{(1+r_i)}{r_i - g_{i\infty}}$.

The results for the modern sample period are reported in Panel A of Table 8. I consider both buy-and-hold and rebalanced portfolios. I also consider both value-weighted and equal-weighted portfolios. The results show that growth stocks clearly have longer canonical durations than value stocks, in all four kinds of portfolios. In Panel B, I report the steady-state long-term growth rates, $g_{i\infty}$. $g_{i\infty}$ has little relation with the book-to-market ratio in buy-and-hold portfolios, and it increases with the book-to-market ratio in rebalanced portfolios.

The result can be understood as follows. Durations are related to price-dividend ratios. In Gordon's model, the canonical duration can be shown to be

$$Dur^{canonical} = \frac{1+r}{r-g} = \frac{P_0}{D_0}\frac{1+r}{1+g} \tag{12}$$

Because value stocks have lower price-dividend ratios, it is not surprising that they have shorter durations.[16]

Note however, that the price-dividend ratio is not a clean variable. It can be high either because the discount rate is low, or because the expected growth rate is high. Consider two assets

[16]Another notion of duration relates to the sensitivity of prices to long-term discount rates. This duration is similar to the Macaulay duration and price/dividend ratios: $Dur^{sensitivity} = -\frac{\partial P/P}{\partial r} = \frac{P_0}{D_0(1+g)}$, in Gordon's model.

that have the same growth profiles, but differ in cash-flow risk. Higher cash-flow risk leads to a higher discount rate, which in turn leads to a lower price-dividend ratio and shorter duration. In this case, there is a negative relation between duration and the discount rate even when risk premiums are countercyclical, but few would find this anomalous. However, if two assets have the same cash-flow risk, and differ in growth profiles, leading asset pricing models imply a positive relation between duration and discount rates.

Thus, it is important to separate the discount rate effect and the growth-profile effect. To do so, I propose to measure the *cash-flow* duration by using a common discount rate for all assets, i.e., to replace the asset-specific discount rate r_i with a common discount rate $\bar{r}$.

$$Dur_i^{cashflow} = \sum_{t=1}^{\infty} \frac{\frac{D_{it}}{(1+\bar{r})^t}}{\sum_{t=1}^{\infty} \frac{D_{it}}{(1+\bar{r})^t}} \times t \tag{13}$$

In implementing the above equation, I use the same cash-flow profiles, including D_{i1} through D_{i20}, and $g_{i\infty}$ imputed previously. To ensure that prices are not infinite, I use the discount rates of the value portfolio as $\bar{r}$.[17] This assumption implies that the value portfolio has the same canonical and cash-flow durations but the other portfolios do not.

The results are presented in Panel C. In buy-and-hold portfolios, the cash-flow duration exhibits a mildly negative relation with the book-to-market equity. Growth stocks have a cash-flow duration of 30.84 years and value stocks have 26.42 years in value-weighted portfolios. In equal-weighted portfolios, the difference is even smaller (42.71 years for growth stocks and 41.62 years for value stocks). In rebalanced portfolios, the cash-flow duration exhibits a clearly increasing pattern with the book-to-market equity, increasing from 14.86 to 39.46 in value-weighted portfolios, and from 6.57 to 91.79 in equal-weighted portfolios.[18]

[17] Results are qualitatively the same if I use the average discount rates as $\bar{r}$. However, this leads to infinite prices in rebalanced equal-weighted portfolios.

[18] In an original paper, Dechow, Sloan, and Soliman (2004) for the first time compute equity duration systematically. Their duration is not a pure cash-flow duration, despite their claim. The reason is that they use a common cost of equity of 12% for all assets, but they also use the actual market price to decide the relative weight of the terminal perpetuity. Their duration is biased towards finding a longer cash-flow duration for growth stocks with lower discount rates. To see this, recall that their duration measure is $Dur^{DSS} = \frac{\sum_{t=1}^{T} t \times CF_t/(1+\bar{r})^t}{\sum_{t=1}^{T} CF_t/(1+\bar{r})^t} \times \frac{\sum_{t=1}^{T} CF_t/(1+\bar{r})^t}{P} + (T + \frac{1+\bar{r}}{\bar{r}}) \times (1 - \frac{\sum_{t=1}^{T} CF_t/(1+\bar{r})^t}{P})$. Now consider a value stock and a growth stock that have the same cash-flow profiles $\{CF_t\}$, but differ in discount rates. Because the growth stock has a lower discount rate, it has a higher price, P, than the value stock. For the growth stock, Dur^{DSS} would put more

As a further robustness check, I also report $\bar{g_i} = \sum_{s=2}^{\infty} \rho^s g_{is} / \sum_{s=2}^{\infty} \rho^s$, $\rho = 0.95$. This is based on the cash-flow duration measure in Da (2009) and also uses information in cash flows only and disregards discount rates. As before, I use the actual dividend growth rates in the first 20 years, and growth rates beyond year 20 are assumed to be $g_{i\infty}$. The results in Panel D suggest that in buy-and-hold portfolios, growth stocks grow a little faster than value stocks, but in rebalanced portfolios, value stocks clearly have longer cash-flow durations.[19]

The results here suggest that a common assumption that growth stocks have substantially higher growth rates and substantially longer cash-flow durations than value stocks has little empirical basis. For example, the assumptions in Lettau and Wachter (2007) imply that $\bar{g_i}$ differ substantially between growth and value stocks, with the difference being around 19% per year, as reported in Panel E. This number is substantially larger than my estimate of 1.98% in the modern sample period.

Panel A of Table 9 reports the cash-flow duration and $\bar{g_i}$ for the early sample period (formation years 1926-1962). In value-weighted buy-and-hold portfolios, value stocks have almost identical cash-flow durations as growth stocks (18.10 vs. 18.07 years). To reconcile the findings in Table 1 that dividends of value stocks grow faster initially, I note that growth stocks are forecasted to grow a little faster than value stocks beyond year 20 (the difference is about 0.5% per year). In equal-weighted buy-and-hold portfolios, value stocks have somewhat longer cash-flow durations than growth stocks (19.68 vs. 14.18 years). In rebalanced portfolios, as in the modern sample, value stocks have clearly longer cash-flow durations than growth stocks in both value-weighted (26.32 vs. 10.46 years) and equal-weighted (26.93 vs. 6.98 years) portfolios. The results on $\bar{g_i}$ are largely consistent with those on cash-flow durations. One minor difference is that in buy-and-hold

weight on the longer-duration terminal perpetuity, relative to the value stock. Thus, Dur^{DSS} would be higher for the growth stock, even with exactly the same cash-flow profiles.

[19] In a seminal paper, Da (2009) proposes to measure a pure cash-flow based duration as this infinite sum of dividend growth rates. To compute it, he first uses a log linearization to transform this cash-flow duration into the difference between an infinite sum of ROEs and the log dividend-to-book ratio. His finding that growth stocks have longer cash-flow durations is primarily driven by his assumption on the terminal ROEs. He assumes that beyond year 7, ROE is equal to the average ROE during the first 7 years. Given that Panel A of Fig. 2 shows clear convergence of ROE over time, this assumption is biased towards finding longer cash-flow durations for growth stocks. There are three other minor differences between our measures: 1) Da (2009) computes $\sum_{s=1}^{\infty} \rho^s g_{is}$, while I exclude the first year look-back growth rates. 2) I use simple growth rates of dividends, while Da (2009) uses average log dividend growth rates. 3) Mine is adjusted for survivorship bias while his is not.

value-weighted portfolios, value stocks have slightly higher $\bar{g}_i$ than growth stocks (the difference being 1.73% per year). Panel B reports the cash-flow duration and $\bar{g}_i$ for the full sample period (formation years 1926-1991). The results for the full sample period are qualitatively the same as those in the early sample period.

Can duration alone explain the value premium? The results suggest that it is unlikely. First, in the modern sample period, buy-and-hold portfolios of growth stocks grow a little faster than value stocks and have a little longer cash-flow duration, but the difference is far smaller than assumed in the duration-based explanations. Second, in the modern sample period, this difference is smaller in equal-weighted portfolios than in value-weighted portfolios, yet it is well known that the value premium is substantially larger in equal-weighted portfolios. Third, in the early sample period, value stocks have higher $\bar{g}_i$ than growth stocks in both value-weighted portfolios (the difference is relatively small: 1.73% per year) and equal-weighted portfolios (the difference is 6.17% per year), and yet in the early sample period, the value premium is even larger than that in the modern sample period.[20]

4 The growth premium

4.1 Theoretical implications of asset pricing models regarding the growth premium

In the Appendix, I analyze four affine asset pricing models. The first three are one-factor affine models with time-varying expected returns that match most of the stylized facts in the time series. The first model has time-varying market price of risk, which captures the habit formation; the second has time-varying amount of risk, which captures the conditional heteroskedasticity in the long run risk model; and the third has both time-varying market price of risk and time-varying amount of risk. When applied to assets with a constant expected growth rate, all three models imply that the expected return is an increasing function of the expected growth rate, after

[20] I stress that I do not rule out duration as a partial explanation of the value premium when we look at dividend growth rates in the modern sample period. Mean reversion in cash flow growth, as featured in Lettau and Wachter (2007), likely helps explain why there is no clear growth premium in buy-and-hold portfolios.

controlling for cash-flow risks, if these models are to help explain the equity premium puzzle.

The economic intuition for this result is that time-varying expected returns only increase risk if expected returns are countercyclical. If expected returns are countercyclical, then in bad times, prices will go down, not only because cash flows decrease but also because expected returns increase. Thus, time-varying expected returns make stocks more risky. This mechanism also implies that longer-duration assets are more risky because the effects of changes in discount rates are larger in longer-duration assets. The opposite is true if expected returns are procyclical. In that case, in bad times, prices tend to decrease because of negative cash flow shocks, but prices also tend to go up because expected returns decrease. Thus, stocks are less risky than they would be otherwise. Longer-duration assets are less risky than short-duration assets because procyclical expected returns essentially provide a hedge.

Fig. A2 depicts these two cases in Model 1 (time-varying price of risk). In Panel A of Fig. A2, I plot the expected excess return, the expected capital gain, and the dividend yield when the price of risk is countercyclical. The expected excess return is equal to the expected capital gain plus the dividend yield minus the interest rate (assumed to be 10%). In this case, as the expected growth rate increases, the expected capital gain increases, the dividend yield decreases, and the expected excess return increases. The expected capital gain increases in the expected dividend growth, because in the long run dividend-price ratios are stationary. Dividend-price ratios decrease because all else being equal, a higher growth rate leads to a higher price-dividend ratio and a lower dividend-price ratio. In this case, the capital gain effect dominates, and the expected return increases as the expected dividend growth rate increases.

In Panel B of Fig. A2, I plot the three quantities when the price of risk is procyclical. Again, the expected excess return is equal to the expected capital gain plus the dividend yield minus the interest rate (10%). In this case, as the expected growth rate increases, the expected capital gain again increases, and the dividend yield again decreases. But in this case, the dividend yield effect dominates, and the expected return decreases as the expected dividend growth rate increases.

In the fourth model, I consider both time-varying market price of risk and time-varying expected growth rate. The implication on the growth premium is less clear now. As discussed in the introduction, two conditions are important in generating the growth premium. The first is whether the market price of risk is countercyclical. The second is whether the expected growth rate is procyclical. When both conditions are met, the model clearly implies a growth premium. When both conditions are violated, then the model implies a negative growth premium. However, if only one condition is satisfied (e.g., if both the market price of risk and the expected growth rate are countercyclical), then the overall relation between the expected growth rate and the expected return depends on the relative strength of these two counteracting forces. Also, in this case, the relation between the expected growth rate and the expected return may not be monotonic. As a result, requiring the equity premium to be high no longer ensures a monotonic growth premium. Whether there is a growth premium is ultimately an empirical question.

4.2 Evidence of the growth premium in rebalanced portfolios

I now test whether there is a growth premium in the cross section of stock returns. In principle, both buy-and-hold and rebalanced portfolios should be priced correctly and can be used as test portfolios. I choose to focus on rebalanced portfolios in this section because in buy-and-hold portfolios there is no clear relation between growth rates and the book-to-market ratio. As shown earlier, portfolio dividends appear to grow faster in growth stocks in the modern sample period, but there are many settings in which the opposite happens (for example, in the early sample period, or earnings, or firm-level regressions). Second, I find that cash-flow growth rates tend to mean revert in buy-and-hold portfolios. As Lettau and Wachter (2007) show, mean reversion in cash flows can lead to a negative association between expected cash-flow growth and expected returns. As I show in the Appendix, the implication of the growth premium is unambiguous when the expected growth rate is constant, and rebalanced portfolios provide a closer setting to this abstraction. Focusing on rebalanced portfolios has two additional practical benefits. First, risk clearly changes over time for buy-and-hold portfolios, while it may stay relatively constant for rebalanced portfolios; therefore, it is likely easier to measure risk for rebalanced portfolios. Second, the vast majority of asset pricing literature uses rebalanced portfolios to implement the value strategy, probably because it generates higher return dispersions.

My previous results suggest that the value premium is consistent with the growth premium, because in rebalanced portfolios value stocks clearly have high cash-flow growth rates. I now examine whether there is a growth premium in the broad cross section of stock returns. To do so, I use 3 sets of 20 portfolios, each sorted by size, book-to-market equity, and momentum (previous 11-month return, skipping one month), between 1963 Q3 and 2011 Q2. I then estimate the Fama-MacBeth regressions of returns on historical average dividend growth rates (as a proxy of the expected growth rate), while controlling for cash-flow risks.

Table 10 reports summary statistics for quarterly real returns, historical average dividend growth rates, and cash-flow risks. The historical average dividend growth rate, $\bar{g}_{i,t-1}$, is the average annual real dividend growth rate of the rebalanced portfolio i, using information up to year $t-1$. $\bar{g}_{i,t-1}$ is winsorized at 1% and 99%. I consider two cash-flow risk measures. The first one is the contemporaneous consumption beta of dividend growth rates, β_i^{dc}. It is estimated in the following equation: $log(1+g_{i,t}) = b_i^0 + \beta_i^{dc}(log(1+g_{c,t})) + \epsilon_{i,t}$, using all information between 1963 Q3 and 2011 Q2. Here $g_{i,t}$ is the annual (July to June) real dividend growth rate, and $g_{c,t-k}$ is the annual real consumption (also from July to June) growth rate. The second measure, γ_i, is the Bansal-Dittmar-Lundblad cash-flow risk, estimated from the regression $log(1+g_{i,t}) = \gamma_i \left(\frac{1}{K}\sum_{k=1}^{K} log\,(1+g_{c,t-k})\right) + \epsilon_{i,t}$. Here $g_{i,t}$ is the quarterly real dividend growth rate, and $g_{c,t-k}$ is the quarterly real consumption growth rate. Dividends and consumptions are seasonally adjusted. When computing γ_i, both $log\,(1+g_{i,t})$ and $log((1+g_{c,t-k})$ are demeaned. As in Bansal, Dittmar, and Lundblad (2005), I primarily focus on the case $K=8$, although $K=12$ yields similar results. While β_i^{dc} captures contemporaneous covariance between the realized dividend growth rate and the consumption growth rate (short-run risk), γ_i captures the covariance between the expected dividend growth rate and the history of consumption growth rates (long-run risk).

Fig. 5 plots the historical average dividend growth rates in value-weighted rebalanced portfolios. This figure plots $\bar{g}_{i,t-1}$ in the last year, that is, the average annual real dividend growth rate of the rebalanced portfolio i, using information between 1958 and 2010. The average dividend growth rates nicely line up with returns. Small stocks, high book-to-market stocks, and recent winner stocks, all have had higher dividend growth rates in rebalanced portfolios. This association between dividend growth rates and returns appears to be pervasive and I now test whether this relation survives after controlling for cash-flow risks.

Table 11 reports the results of the Fama-MacBeth regression of returns on historical average growth rates and cash-flow risks. Panel A examines value-weighted portfolios. The left-hand-side variable is the quarterly real return multiplied by four. In the first three rows of Panel A in Table 11, I estimate univariate regressions using all 60 portfolios. I find that $\bar{g}_{i,t-1}$ is positively associated with returns, with the coefficient being 0.49 and highly statistically significant. The coefficient on cash-flow risks β_i^{dc} and γ_i are both positive (0.0025 and 0.0048, respectively) and statistically significant.

In Row 4, I find that after controlling for cash-flow risk β_i^{dc}, the coefficient on $\bar{g}_{i,t-1}$ stays at 0.48, with a t-statistic of 3.54. The coefficient on β_i^{dc} remains positive but becomes statistically nonsignificant. In Row 5, after controlling for cash-flow risk γ_i, the coefficient on $\bar{g}_{i,t-1}$ reduces to 0.29, with a t-statistic of 2.40. The coefficient on γ_i reduces to 0.0033 (t=3.72). In Row 6, after controlling for both β_i^{dc} and γ_i, the coefficient on $\bar{g}_{i,t-1}$ is 0.28 (t=3.02).

As a robustness check, I now use 20 portfolios sorted by one characteristic at a time. In Rows 7 through 9, I use 20 portfolios sorted by size as test assets. After controlling for β_i^{dc} and γ_i, the coefficient on $\bar{g}_{i,t-1}$ is 0.32. In Rows 10 through 12, I use 20 portfolios sorted by book-to-market equity as test assets. The coefficient on $\bar{g}_{i,t-1}$ is 0.51, after controlling for β_i^{dc} and γ_i. When I use the momentum portfolios in Rows 13 through 15, the coefficient on $\bar{g}_{i,t-1}$ is 0.37, after controlling for both β_i^{dc} and γ_i. The coefficients on $\bar{g}_{i,t-1}$ are generally similar in magnitude.

The results on equal-weighted portfolios are even stronger in Panel B of Table 11. In univariate regressions, I find that $\bar{g}_{i,t-1}$ is positively associated with returns, with the coefficient of 0.67, and a t-statistic of 6.96. Again, the coefficients on cash-flow risks β_i^{dc} and γ_i are positive (0.0049 and 0.0073, respectively) and statistically significant.

In Rows 4 through 6 of Panel B, I control for β_i^{dc} alone, γ_i alone, and both β_i^{dc} and γ_i, respectively. The coefficient on $\bar{g}_{i,t-1}$ hovers around 0.63, with a t-statistic of at least 4.70. The coefficients on both cash-flow risks are statistically not significant.

In Rows 7 through 9, I use 20 portfolios sorted by size as test assets. After controlling for both cash-flow risks, the coefficient on $\bar{g}_{i,t-1}$ is 0.68. In Rows 10 through 12, I use 20 portfolios sorted by book-to-market equity as test assets. The coefficient on $\bar{g}_{i,t-1}$ is 0.76, after controlling for both cash-flow risks. When I use the momentum portfolios in Rows 13 through 15, the coefficient on $\bar{g}_{i,t-1}$ is 0.44, after controlling for β_i^{dc} and γ_i. In sum, in equal-weighted portfolios, the coefficient on $\bar{g}_{i,t-1}$ is always statistically significant at the 5% level, with the minimum t-statistic being 2.58. Cash-flow risks exhibit similar patterns as those in value-weighted portfolios. They mostly lose their statistical significance after controlling for $\bar{g}_{i,t-1}$.

The coefficient on the expected growth rate implies an economically important effect. In Row 6 of Panel A (value-weighted), the coefficient on the expected growth rate is 0.28. In Row 6 of Panel B (equal-weighted), the coefficient on the expected growth rate is 0.63. This means a one-standard-deviation increase in the expected growth rate is associated with a 1.1% or 2.8% increase in annual expected returns in value-weighted or equal-weighted portfolios, respectively. In comparison, a one-standard-deviation increase in γ_i is associated with a 1.7% or 0.6% increase in annual expected returns.

I now examine whether the coefficient on the expected growth rate is reasonable. In Panel A of Fig. A2, as the expected growth rate increases from 0 to 0.1, the expected excess return increases approximately from 0.04 to 0.09. These numbers suggest a slope coefficient of about 0.5. The coefficient on growth rates is 0.28 and 0.63, after controlling for both cash-flow risk measures, in value- and equal-weighted portfolios, respectively. Notwithstanding the fact that Panel A of Fig. A2 uses a set of parameter values that are not empirically estimated, I conclude that the magnitude of my empirical findings does not seem unreasonable.

4.3 Discussions

I find that stocks with higher expected dividend growth rates have higher future returns. One concern is that this result is mechanical. The reason is that in the long run, if the dividend-price ratio is to stay stationary, the expected dividend growth rate should align with the expected price growth rate (capital gains). Thus, I am simply finding a positive association between returns and capital gains.

I believe that this finding is not mechanical, because theory suggests that the opposite could happen.[21] Recall that in Panel B of Fig. A2, I plot the expected excess return, the expected capital gain, and the dividend yield, when the price of risk is procyclical and there is a negative growth premium. When the expected growth rate increases, the expected capital gain indeed increases. But in this case, the dividend yield strongly decreases with the expected growth rate. As a result, the expected return is again negatively associated with the expected growth rate. In this case, there is a negative association between returns and capital gains. I do not observe this implication in the data.

Chen (2004) examines the forecasted future dividend growth rates from firm-level regressions and concludes that there is no growth premium in the cross section. The results in this paper suggest that there are two conceptual issues in Chen (2004). First, in firm-level regressions, survivorship bias is severe. Second, Chen (2004) analyzes models in which the expected growth rates are constant, but then tests the implication of the growth premium on buy-and-hold portfolios. The results in the current paper suggest that in buy-and-hold portfolios there is strong mean reversion in cash-flow growth rates, and rebalanced portfolios are a closer approximation to constant expected growth rates.

The growth premium is consistent with a class of models that feature countercyclical risk premiums. In exploratory analysis, I find that if I identify the shocks in the pricing kernel with the shocks to aggregate consumption, the models can be rejected, especially when we use equal-weighted portfolios. But I believe countercyclical risk premiums should be an important ingredient in richer models that can quantitatively explain the time series and the cross section of asset returns jointly.[22]

[21] I have also been careful to use the historical growth rates as the proxy for the expected growth rate.

[22] The growth premium is also consistent with the mispricing hypothesis or the luck hypothesis (i.e., value stocks have simply been lucky and their high realized returns are not expected returns). Given that the value premium exists in out-of-sample tests (the early sample period, international data, and other assets classes), I believe luck is an unlikely cause. Existing studies ((Bansal, Dittmar, and Lundblad (2005), Cohen, Polk, and Vuolteenaho (2009), and Koijen, Lustig, and Van Nieuwerburgh (2012)) find that value stocks have clearly higher cash-flow risks, suggesting mispricing is not the whole explanation.

5 Additional Tests

In this section, I provide a number of robustness checks. The main results are robust to different definitions of growth rates, dividend shares, different scaling variable for earnings, alternative horizons when computing cash-flow durations, and including repurchases as a form of dividends. Unless stated otherwise, the results are for value-weighted buy-and-hold portfolios.

5.1 Average of growth rates

In the main test, I focus on the growth rates of average dividends, $\frac{E[D_s]}{E[D_{s-1}]} - 1$. I now examine the average of dividend growth rates directly, $E\left[\frac{D_s}{D_{s-1}}\right] - 1$. In both notations, $E[.]$ refers to taking the sample average across portfolio formation years. These two quantities are different due to Jensen's inequality.

Panel A examines the modern sample period (formation years 1963-2001). The average growth rate from year 1 to year 2 is 5.29% for the growth quintile, and 1.72% for the value quintile. The difference of value minus growth is -3.57%. The average of the growth rates in year 2 through year 10 is 4.23% for the growth quintile, and 2.86% for the value quintile. The difference is only -1.37%.

Panel B examines the early sample period (formation years 1926-1962). The average growth rate from year 1 to year 2 is 3.34% for the growth quintile, and 37.61% for the value quintile. The difference (value - growth) is very large, at 34.27%. The average of the growth rates in year 2 through year 10 is 3.37% for the growth quintile, and 38.77% for the value quintile. The difference is 35.40%.

Panel C shows that the results in the full sample period (formation years 1926-2001) are very similar to that of Panel B. The average growth rate from year 1 to year 2 is 4.34% for the growth quintile, and 19.19% for the value quintile. The average of the average growth rates in year 2 through year 10 is 3.81% for the growth quintile, and 20.34% for the value quintile.

In sum, results in this table are similar to those in Table 1. Dividends of growth stocks grow a little faster than dividends of value stocks in the modern sample period, but value stocks grow faster in the early or the full sample period. The magnitudes are substantially large if I look at the average of growth rates in the early and full sample periods. The average of growth rates is susceptible to outliers. For example, if the value portfolio pays a close to zero dividend in one year, and subsequently pays a normal dividend, then the growth rate can be very large. Because of this reason, I report the growth rates of average dividends in Table 1 as the baseline result, and only include Table 12 as a robustness check.

5.2 Dividend shares

In Table 1, I scale dividends to correspond to a $100 investment in each portfolio formation year and then average across portfolio formation years. In Table 13, I now scale dividends by the total dividends (the sum of dividends in five portfolios). Initial investment is proportional to the market capitalization of each portfolio at the end of year 0. I first compute the percentage of dividends in each portfolio as a fraction of total dividends, which add up to 100% in each year. I then average the shares across portfolio formation years. The right panel reports the growth rates of the average shares.

In the modern sample period (Panel A), from year 1 to year 10, the average dividend share of growth stocks increases from 30.20% to 35.00%, corresponding to an annual growth rate of 1.65%. For value stocks, the share decreases from 9.75% to 8.77%, corresponding to a -1.17% decline per year. The difference (value-growth) is -2.82%, almost the same as that reported in Table 1, -2.87%.

The opposite is true in the early sample period (Panel B). From year 1 to year 10, the average dividend share of growth stocks barely changes from 42.50% to 42.61%, corresponding to an annual growth rate of 0.03%. For value stocks, the share increases from 4.60% to 5.68%, corresponding to a 2.37% growth rate per year. The difference (value-growth) is 2.34%, somewhat smaller than that reported in Table 1, 4.78%.

The results over the long sample (1926-2001) in Panel C are a little different from Table 1. While Table 1 shows that in the full sample period, dividends grow faster in value stocks, Table 12 shows that growth stocks grow a little faster if we look at dividend shares instead. From year 1 to year 10, the average dividend share of growth stocks grows slightly from 36.19% to 38.70%, corresponding to an annual growth rate of 0.75%. For value stocks, shares are almost constant, going from 7.24% to 7.26%, corresponding to a 0.04% growth rate per year. The difference (value-growth) is -0.71%, rather than 1.61% as reported in Table 1.

Fig. A1 plots the dividend shares of quintile buy-and-hold portfolios implied by the assumptions in Lettau and Wachter (2007). The dividend share of the growth quintile increases from 1.37% in the 4th quarter of year 1 to 6.93% in the 4th quarter of year 10, and to 62.52% in the 4th quarter of year 25. The dividend share of the value quintile decreases from 56.66% in the 4th quarter of year 1 to 11.30% in the 4th quarter of year 10, and to 1.40% in the 4th quarter of year 25. The cycle then reverses and repeats itself. Although these numbers cannot be directly compared to the data (because after year 25 the cycle reverses), they do seem extreme relative to the data.

Despite the difference in the full sample period, the results in Table 13 still confirm that dividends of growth stocks do not substantially outgrow those of value stocks.

5.3 Earnings scaled by GDP

In Table 14, I scale earnings by GDP and then average the earnings-to-GDP ratio across portfolio formation years. Initial investment is proportional to the market capitalization of each portfolio at the end of year 0. Earnings are adjusted for survivorship bias. The right panel reports the growth rate of the average shares.

The results are qualitatively the same as Fig. 3. From year 0 to year 1, value stocks' average earnings-to-GDP ratio declines by 21.77%. From year 1 to year 2, it increases substantially by 24.28%. During the same period, growth stocks' average earnings-to-GDP ratio declines by 4.08%. The results suggest that earnings of value stocks grow substantially faster than growth stocks in year 2 and year 3 and they become more similar afterwards.

5.4 Alternative horizons

In the baseline calculation of cash-flow duration, I use historical data on the first $T = 20$ years and try to forecast the terminal growth rates beyond year T. In Table 15, I provide robustness checks for alternative T. I consider $T = 10$ and $T = 35$ and then recompute the cash-flow duration and $\bar{g}_i$ for each book-to-market quintile.

The results are similar to those in Table 8. First consider buy-and-hold value-weighted portfolios. In Table 8, growth stocks have a cash-flow duration that is 4.42 years longer than value stocks when $T = 20$. That number is 2.74 years when $T = 10$ and 2.73 years when $T = 35$. In Table 8, growth stocks have a $\bar{g}_i$ that is 1.98% higher than value stocks when $T = 20$. That number is 1.21% when $T = 10$ and 1.10% when $T = 35$.

The results for rebalanced portfolios are also qualitatively the same. In Table 8, value stocks have a cash-flow duration that is 24.61 years longer than growth stocks when $T = 20$. That number is 19.54 years when $T = 10$ and 35.22 years when $T = 35$. In Table 8, value stocks have a $\bar{g}_i$ that is 3.05% higher than growth stocks when $T = 20$. That number is 3.67% when $T = 10$ and 4.64% when $T = 35$.

5.5 Repurchases

Grullon and Michaely (2002) find that firms have gradually substituted repurchases for dividends. In Table 16, I include repurchases as a form of dividends. This amounts to redefine $retx_t^* = (1 + retx)min(n_t/n_{t-1}, 1) - 1$, following Bansal, Dittmar, and Lundblad (2005). n_t is the number of shares after adjusting for splits, etc., using the CRSP share adjustment factor.

I only show test results using dividends plus repurchases in the modern sample period (after 1963), because in the early sample period repurchases are not a pervasive phenomenon. Panels A and B of Table 16 correspond to Panel A of Table 1. When I include repurchases, firms pay out more cash flows. But the cross-sectional relation of the cash-flow growth rate with the book-to-market ratio is almost the same as before. From year 1 to year 2, the average cash flows (dividends plus repurchases) grow 2.44% faster in growth stocks than in value stocks. From year 1 to year 10, the difference is 2.94% per year. These numbers are similar to 3.34% and 2.87%, reported in Table 1.

Panels C and D of Table 16 correspond to Table 8. When I include repurchases in dividends, the cash-flow duration generally becomes shorter. In buy-and-hold portfolios, growth stocks have cash-flow durations that are a little longer than value stocks: 22.99 vs. 18.61 years in value-weighted portfolios, and 25.99 vs. 24.12 years in equal-weighted portfolios. Growth stocks have $\bar{g}_i$ that is a little higher than value stocks: 3.67% vs. 1.30% years in value-weighted portfolios, and 7.67% vs. 6.43% in equal-weighted portfolios. In rebalanced portfolios, growth stocks have cash-flow durations that are shorter than value stocks: 13.70 vs. 23.58 years in value-weighted portfolios, and 7.23 vs. 43.73 years in equal-weighted portfolios. Growth stocks have $\bar{g}_i$ that is lower than value stocks: 3.01% vs. 5.61% years in value-weighted portfolios, and 0.40% vs. 12.11% in equal-weighted portfolios. Overall, I conclude that my results are robust to consideration of repurchases.

6 Conclusions

Conventional wisdom holds that growth stocks, defined as low book-to-market stocks, have substantially higher future cash-flow growth rates and longer cash-flow durations than value stocks. Yet, I find that in buy-and-hold portfolios, growth stocks do not have substantially higher cash-flow growth rates and longer cash-flow durations. Furthermore, in many settings (if we look at the early sample period, or earnings growth rate, or firm-level regressions), value stocks appear to grow faster. In rebalanced portfolios, growth stocks have clearly lower cash-flow growth rates and shorter cash-flow durations than value stocks. Using rebalanced portfolios, I find that there is a growth premium in the broad cross section of stock returns.

The growth premium is consistent with a class of asset pricing models that feature countercyclical risk premiums. My results suggest that countercyclical risk premiums may be important in understanding the cross section of stock returns.

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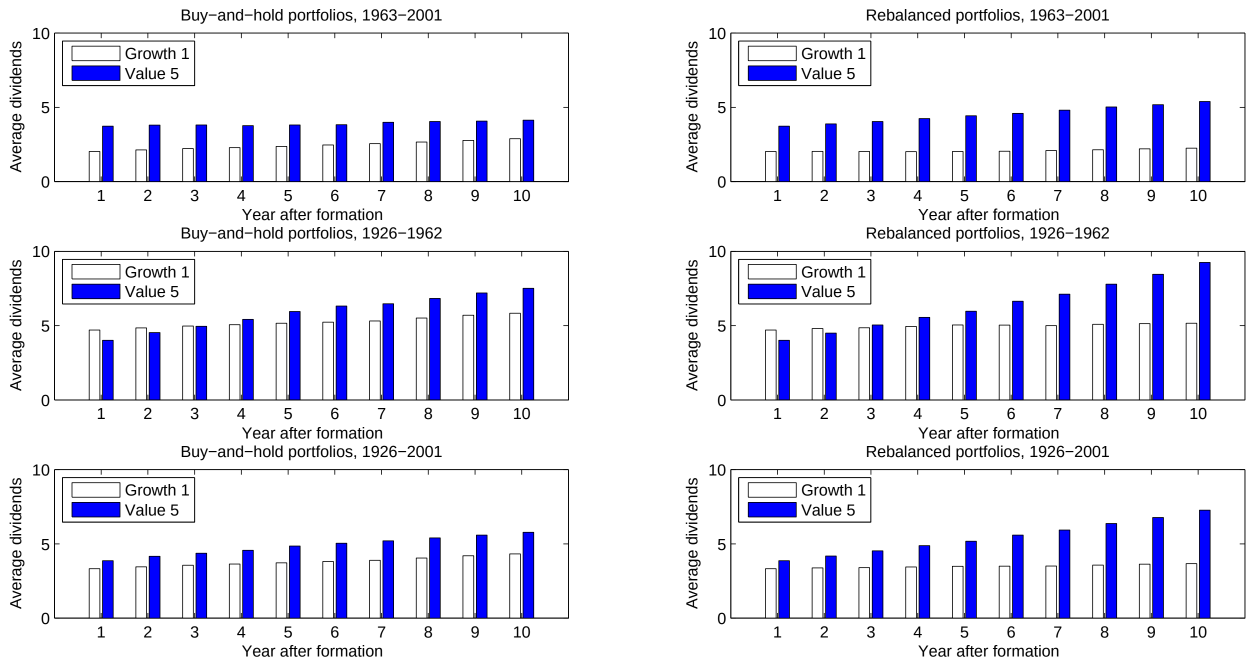

Fig. 1: **Average dividends for a \$100 investment at the end of year 0.** In each year t between 1926 and 2001, I sort stocks into value-weighted quintile portfolios according to their book-to-market ratios. The growth and value portfolios consist of stocks with book-to-market equity that are in the lowest and highest quintiles. The breakpoints are computed using NYSE stocks only. Dividends in year $t+s$ are sums of monthly dividends between July of year $t+s-1$ and June of year $t+s$. Dividends are converted to year 0 real dollars using the CPI. I then average the portfolio dividends across portfolio formation years. The left panel plots average dividends for buy-and-hold portfolios and the right panel is for rebalanced portfolios. The top, middle, and bottom panels plot the modern (formation years 1963-2001), the early (formation years 1926-1962), and the full (formation years 1926-2001) sample periods, respectively.

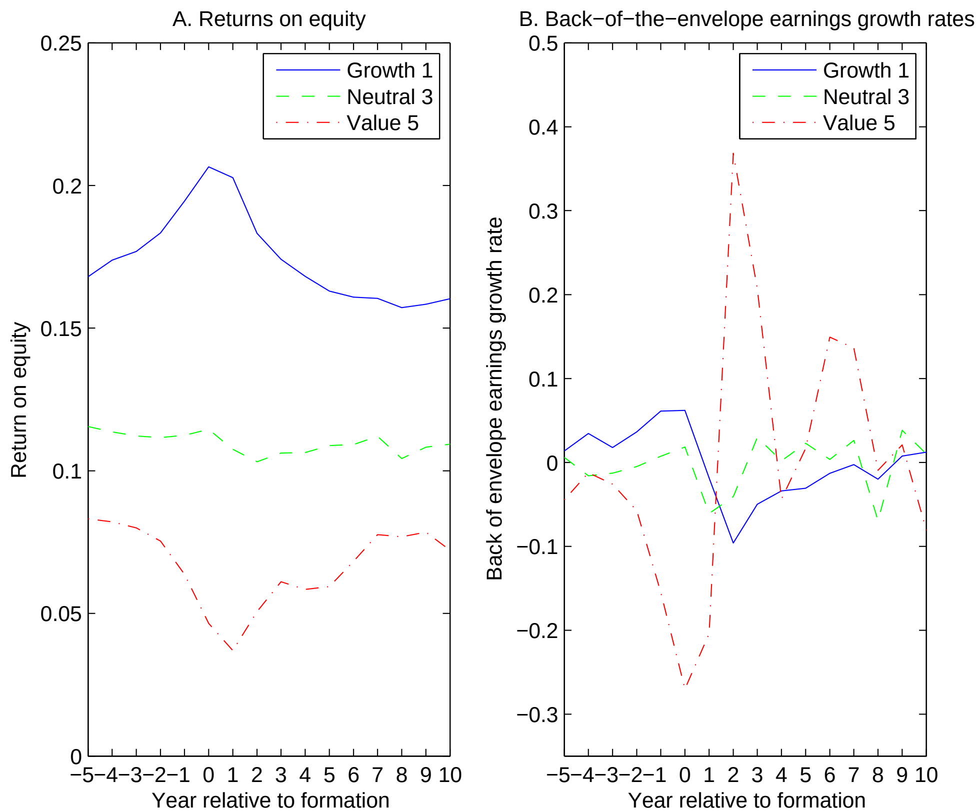

Fig. 2: **Returns on equity and back-of-the-envelope earnings growth rates for buy-and-hold portfolios sorted by book-to-market ratios.** In each year t between 1963 and 2001, I sort stocks into value-weighted quintile portfolios according to their book-to-market ratios. The growth, neutral, and value portfolios consist of stocks with book-to-market ratios that are in the lowest, middle, and highest quintiles. The breakpoints are computed using NYSE stocks only. The portfolio return on equity in year $t + s$ is the sum of earnings (ib) in year $t + s$ over the sum of book equity in $t + s - 1$. The return on equity is then converted to real terms using the CPI. Panel A plots the average return on equity across portfolio formation years. In computing the return on equity, I treat earnings and book equity with fiscal year ends between July of year $t + s - 1$ and June of year $t + s$ as earnings and book equity in year $t + s$. I require a stock to have data for both E_{t+s} and B_{t+s-1} to be included in the computation of the portfolio return on equity. Panel B plots the back-of-the-envelope earnings growth rates, which are computed based on information in Panel A and the following formula: $\frac{E_s}{E_{s-1}} - 1 = (1 - po)ROE_s + \left(\frac{ROE_s}{ROE_{s-1}} - 1\right)$. E_s, ROE_s, and po refer to earnings, return on equity, and dividend payout ratio, respectively. po is assumed to be 0.5 in the back-of-the-envelope calculations.

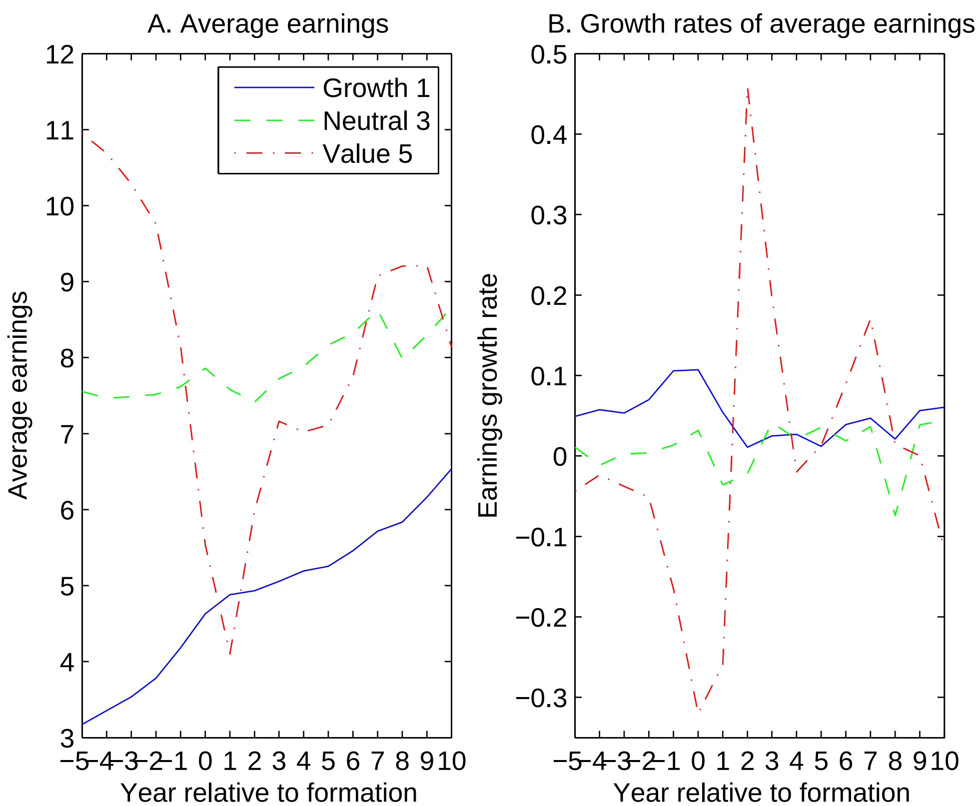

Fig. 3: **Average earnings for a $100 investment at the end of year 0 and growth rates of the earnings, adjusted for survivorship bias.** In each year t between 1963 and 2001, I sort stocks according to their book-to-market ratios. The growth, neutral, and value portfolios consist of stocks with book-to-market ratios that are in the lowest, middle, and highest quintiles. The breakpoints are computed using NYSE stocks only. I treat earnings with fiscal year ends between July of year $t+s-1$ and June of year $t+s$ as earnings in year $t+s$. For each portfolio formation year, earnings (in year 0 real dollars) are scaled to correspond to a $100 investment at the end of year 0. Panel A plots the average portfolio earnings across the 39 portfolio formation years 1963-2001. Panel B plots the growth rates for the average earnings.

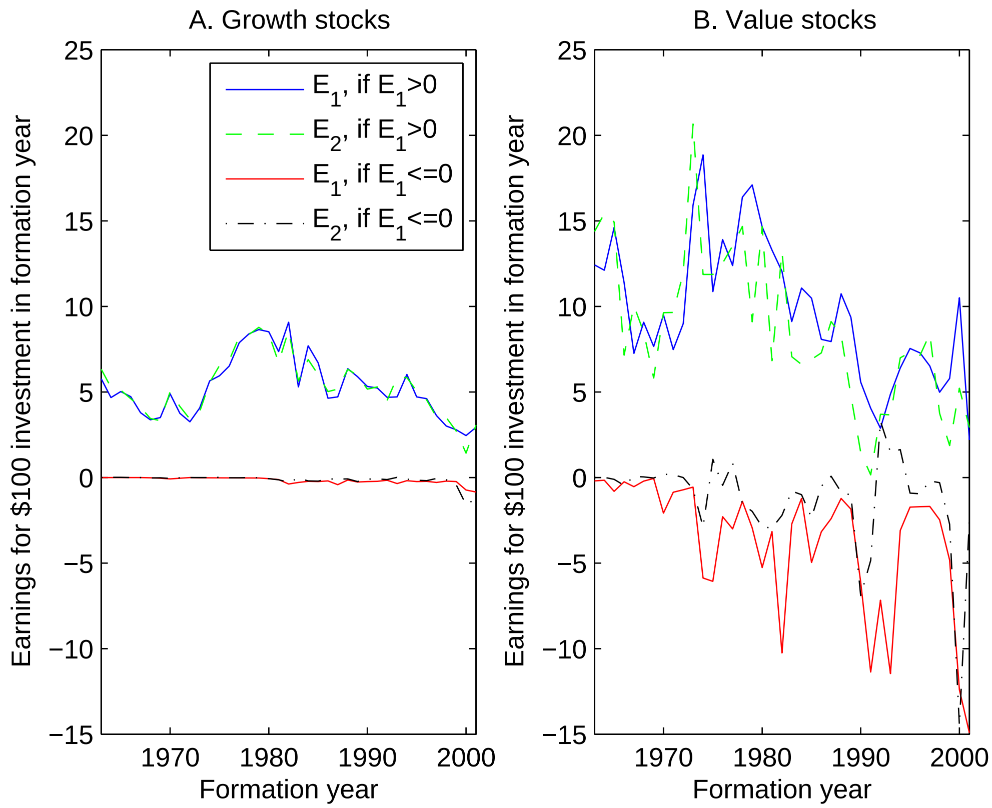

Fig. 4: **Positive and negative earnings for a \$100 investment at the end of year 0, not adjusted for survivorship bias**. In each year t between 1963 and 2001, I sort stocks according to their book-to-market ratios. The growth and value portfolios consist of stocks with book-to-market ratios that are in the lowest and highest quintiles. The breakpoints are computed using NYSE stocks only. I treat earnings with fiscal year ends between July of year $t+s-1$ and June of year $t+s$ as those variables in year $t+s$. Earnings are expressed in year 0 real dollars using the CPI. I require a stock to have data in both years $t+s$ and $t+s-1$ to be included in the computation of the portfolio growth rates in year $t+s$. For each portfolio formation year, earnings are scaled to correspond to a \$100 investment at the end of year 0. I then average across portfolio formation years. I require firms to survive in year 1 and year 2 after portfolio formation. Total earnings in year 1 are equal to the sum of earnings from firms that report positive earnings (E_1, if $E_1 > 0$), and earnings from firms that report negative earnings (E_1, if $E_1 <= 0$). Total earnings in year 2 are equal to the sum of earnings in year 2 from firms that report positive earnings in year 1(E_2, if $E_1 > 0$), and earnings in year 2 from firms that report negative earnings in year 1 (E_2, if $E_1 <= 0$).

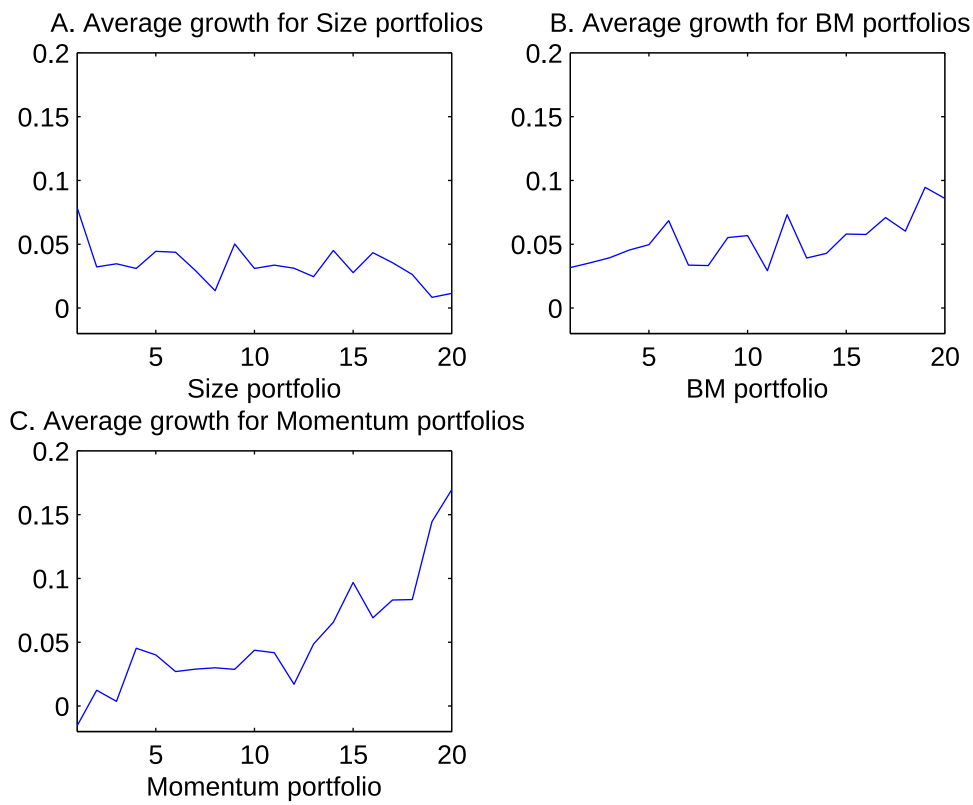

Fig. 5: **Historical average real dividend growth rates in rebalanced portfolios**. 20 rebalanced portfolios, each sorted by size, book-to-market, and momentum, are used. This figure plots $\bar{g}_{i,t-1}$ in the last year, that is, the average annual real dividend growth rate of the rebalanced portfolio i, using information between 1958 and 2010. Portfolio 1 in size, book-to-market, and momentum portfolios corresponds to stocks that are small, with low book-to-market, and with low previous 11-month return (skipping one month), respectively. Portfolio 20 corresponds to stocks that are large, with high book-to-market, and with high previous 11-month return (skipping one month), respectively.

Table 1: Average real dividends in buy-and-hold portfolios for a \$100 investment at the end of year 0. In June of each year t between 1926 and 2001, I sort stocks into value-weighted quintile portfolios according to their book-to-market ratios. The breakpoints are computed using NYSE stocks only. Annual dividends are sums of monthly dividends between July and the following June. Dividends are then converted to year 0 real dollars using the CPI. I then average the portfolio dividends across portfolio formation years. Dividends are constructed using CRSP returns (ret) and returns without dividends ($retx$). Delisting proceeds are reinvested in the remainder of the portfolio. The right panel reports the growth rate of the average dividends. The arithmetic average growth rate is the simple average of g_2, g_3, ..., g_{10}. The geometric average growth rate is $\left(\frac{D_{10}}{D_1}\right)^{\frac{1}{9}} - 1$.

	Average dividends (\$)					Growth rates (%)					
Year	Growth 1	2	3	4	Value 5	Growth 1	2	3	4	Value 5	5-1
Panel A: Modern sample period (formation years 1963-2001)											
1	2.03	3.02	3.66	3.92	3.73						
2	2.13	3.03	3.69	3.91	3.80	5.26	0.19	0.77	-0.47	1.91	-3.34
3	2.22	3.06	3.81	3.96	3.81	4.00	0.94	3.20	1.25	0.18	-3.82
4	2.29	3.13	3.81	4.06	3.76	3.20	2.18	0.00	2.69	-1.32	-4.52
5	2.37	3.13	3.96	4.08	3.81	3.52	0.20	4.05	0.34	1.30	-2.22
6	2.46	3.22	3.97	4.05	3.83	4.00	2.70	0.20	-0.66	0.57	-3.43
7	2.55	3.30	3.99	4.05	3.99	3.67	2.68	0.58	0.01	4.18	0.51
8	2.66	3.44	4.00	4.14	4.04	4.04	4.04	0.19	2.34	1.22	-2.82
9	2.77	3.51	4.10	4.19	4.07	4.21	2.10	2.49	1.08	0.82	-3.39
10	2.89	3.62	4.11	4.35	4.13	4.22	3.32	0.20	3.78	1.46	-2.76
			Arithmetic average			4.01	2.04	1.30	1.15	1.15	-2.86
			Geometric average			4.01	2.03	1.29	1.14	1.14	-2.87
Panel B: Early sample period (formation years 1926-1962)											
1	4.70	5.15	5.29	5.12	4.01						
2	4.84	5.19	5.39	5.44	4.53	3.07	0.66	1.72	6.34	12.98	9.91
3	4.97	5.28	5.55	5.71	4.95	2.67	1.84	3.03	4.89	9.22	6.55
4	5.06	5.41	5.69	5.88	5.41	1.76	2.48	2.51	3.02	9.38	7.61
5	5.15	5.65	5.84	6.13	5.95	1.83	4.31	2.67	4.30	9.88	8.06
6	5.23	5.58	5.92	6.45	6.32	1.46	-1.15	1.39	5.21	6.20	4.75
7	5.31	5.52	5.95	6.53	6.47	1.49	-1.11	0.49	1.22	2.41	0.93
8	5.50	5.72	6.15	6.81	6.82	3.72	3.69	3.30	4.22	5.45	1.72
9	5.70	5.88	6.45	7.12	7.19	3.51	2.68	4.97	4.51	5.39	1.88
10	5.83	6.03	6.64	7.30	7.51	2.42	2.67	3.00	2.52	4.44	2.02
			Arithmetic average			2.44	1.79	2.56	4.03	7.26	4.82
			Geometric average			2.43	1.77	2.56	4.02	7.22	4.78
Panel C: Full sample period (formation years 1926-2001)											
1	3.33	4.06	4.46	4.51	3.87						
2	3.45	4.08	4.51	4.65	4.16	3.76	0.48	1.32	3.30	7.50	3.75
3	3.56	4.14	4.65	4.81	4.37	3.10	1.50	3.10	3.32	4.98	1.88
4	3.64	4.24	4.72	4.95	4.57	2.22	2.37	1.46	2.88	4.58	2.36
5	3.72	4.36	4.88	5.08	4.85	2.37	2.75	3.24	2.63	6.26	3.88
6	3.81	4.37	4.92	5.22	5.04	2.29	0.27	0.89	2.79	3.93	1.65
7	3.89	4.38	4.95	5.26	5.20	2.21	0.32	0.53	0.74	3.10	0.89
8	4.04	4.55	5.04	5.44	5.40	3.83	3.82	2.01	3.48	3.78	-0.05
9	4.19	4.66	5.24	5.61	5.59	3.74	2.46	3.96	3.17	3.63	-0.11
10	4.32	4.80	5.34	5.78	5.78	3.03	2.92	1.87	3.01	3.32	0.30
			Arithmetic average			2.95	1.88	2.04	2.81	4.57	1.62
			Geometric average			2.95	1.87	2.04	2.81	4.56	1.61

Table 2: Average and minimum numbers of stocks. This table reports the average and minimum number of stocks for buy-and-hold portfolios in Table 1. Year refers to the year relative to the portfolio formation year.

	Average number of firms					Minimum number of firms				
Year	Growth 1	2	3	4	Value 5	Growth 1	2	3	4	Value 5
Panel A: Modern sample period (formation years 1963-2001)										
1	658.2	470.0	440.5	476.2	612.6	215	204	213	203	200
2	609.3	438.3	409.3	440.3	553.3	213	200	208	201	188
10	361.3	270.5	241.2	247.2	271.4	173	158	152	153	117
Panel B: Early sample period (formation years 1926-1962)										
1	137.3	136.6	136.7	136.7	135.5	79	80	76	77	74
2	135.8	134.9	134.8	134.8	132.2	78	77	76	77	73
10	121.4	119.7	116.3	115.0	103.4	61	67	66	67	55
Panel C: Full sample period (formation years 1926-2001)										
1	404.6	307.7	292.6	310.9	380.3	79	80	76	77	74
2	378.8	290.5	275.7	291.6	348.3	78	77	76	77	73
10	244.5	197.1	180.4	182.8	189.6	61	67	66	67	55

Table 3: Average real dividends in annually rebalanced portfolios for a \$100 investment at the end of year 0. In June of each year t between 1926 and 2001, I sort stocks into value-weighted quintile portfolios according to their book-to-market ratios. The breakpoints are computed using NYSE stocks only. Dividends in year $t+s$ are sums of monthly dividends between July of year $t+s-1$ and June of year $t+s$. Dividends are then converted to year 0 real dollars using the CPI. I then average the portfolio dividends across portfolio formation years. Portfolios are subsequently rebalanced at the end of each June. Dividends are constructed using CRSP returns (ret) and returns without dividends ($retx$). Delisting proceeds are reinvested in the remainder of the portfolio. The right panel reports the growth rate of the average dividends. The arithmetic average growth rate is the simple average of g_2, g_3, ..., g_{10}. The geometric average growth rate is $\left(\frac{D_{10}}{D_1}\right)^{\frac{1}{9}}-1$.

	Average dividends (\$)					Growth rates (%)					
Year	Growth 1	2	3	4	Value 5	Growth 1	2	3	4	Value 5	5-1
Panel A: Modern sample period (formation years 1963-2001)											
1	2.03	3.02	3.66	3.92	3.73						
2	2.03	3.03	3.70	3.99	3.88	0.20	0.09	1.09	1.63	3.89	3.69
3	2.03	3.05	3.74	4.05	4.04	-0.20	0.74	1.06	1.63	4.21	4.41
4	2.02	3.06	3.80	4.15	4.24	-0.44	0.48	1.49	2.33	4.90	5.34
5	2.02	3.09	3.86	4.22	4.43	0.34	0.91	1.82	1.83	4.42	4.08
6	2.04	3.12	3.91	4.28	4.59	0.89	0.97	1.12	1.31	3.78	2.88
7	2.08	3.18	4.01	4.30	4.80	2.04	1.92	2.55	0.42	4.56	2.52
8	2.14	3.25	4.09	4.33	5.02	2.69	2.02	2.15	0.67	4.50	1.81
9	2.20	3.31	4.20	4.34	5.18	2.88	1.94	2.51	0.27	3.15	0.28
10	2.25	3.41	4.28	4.37	5.39	2.24	2.95	1.99	0.68	4.07	1.83
			Arithmetic average			1.18	1.33	1.75	1.20	4.16	2.98
			Geometric average			1.18	1.33	1.75	1.20	4.16	2.99
Panel B: Early sample period (formation years 1926-1962)											
1	4.70	5.15	5.29	5.12	4.01						
2	4.80	5.18	5.52	5.40	4.49	2.08	0.49	4.30	5.45	11.91	9.84
3	4.85	5.31	5.80	5.70	5.04	1.14	2.58	5.08	5.52	12.23	11.09
4	4.94	5.31	6.05	5.97	5.55	1.89	0.06	4.34	4.86	10.21	8.32
5	5.04	5.41	6.32	6.39	5.96	1.94	1.81	4.46	7.03	7.41	5.47
6	5.03	5.37	6.46	6.70	6.64	-0.09	-0.82	2.08	4.86	11.34	11.43
7	5.00	5.36	6.56	6.86	7.11	-0.74	-0.16	1.68	2.41	7.05	7.79
8	5.08	5.44	6.95	7.32	7.79	1.71	1.53	5.82	6.69	9.51	7.80
9	5.13	5.54	7.26	7.90	8.45	0.95	1.92	4.54	7.92	8.56	7.62
10	5.16	5.59	7.57	8.38	9.25	0.60	0.76	4.31	6.05	9.41	8.81
			Arithmetic average			1.05	0.91	4.07	5.64	9.74	8.69
			Geometric average			1.05	0.90	4.06	5.63	9.72	8.68
Panel C: Full sample period (formation years 1926-2001)											
1	3.33	4.06	4.46	4.51	3.87						
2	3.38	4.07	4.59	4.67	4.18	1.49	0.34	2.95	3.75	7.94	6.45
3	3.40	4.15	4.74	4.85	4.53	0.73	1.88	3.42	3.82	8.41	7.68
4	3.44	4.16	4.90	5.04	4.88	1.18	0.22	3.19	3.78	7.78	6.60
5	3.49	4.22	5.06	5.28	5.18	1.46	1.47	3.41	4.83	6.08	4.62
6	3.50	4.21	5.15	5.46	5.59	0.20	-0.15	1.70	3.40	8.02	7.82
7	3.50	4.24	5.25	5.55	5.93	0.09	0.63	2.01	1.61	6.00	5.91
8	3.57	4.31	5.48	5.78	6.37	2.01	1.72	4.38	4.29	7.43	5.41
9	3.63	4.40	5.69	6.07	6.77	1.54	1.93	3.77	4.98	6.37	4.83
10	3.67	4.47	5.88	6.32	7.27	1.11	1.60	3.43	4.08	7.32	6.20
			Arithmetic average			1.09	1.07	3.14	3.84	7.26	6.17
			Geometric average			1.09	1.07	3.14	3.83	7.26	6.17

Table 4: Positive and negative earnings in buy-and-hold portfolios, for a \$100 investment at the end of year 0, not adjusted for survivorship bias. In June of each year t between 1963 and 2009, I sort stocks according to their book-to-market ratios. The growth and value portfolios consist of stocks with book-to-market equity that are in the lowest and highest quintiles. The breakpoints are computed using NYSE stocks only. I treat earnings with fiscal year ends between July of year $t+s-1$ and June of year $t+s$ as those variables in year $t+s$. Earnings are converted to year 0 real dollars using the CPI. I require a stock to have data in both years $t+s$ and $t+s-1$ to be included in the computation of the portfolio growth rates in year $t+s$. For each portfolio formation year, earnings are scaled to correspond to a \$100 investment at the end of year 0. I then average across portfolio formation years. I require firms to survive in year 1 and year 2 after portfolio formation. Total earnings in year 1 are equal to the sum of earnings from firms that report positive earnings and earnings from firms that report negative earnings. Total earnings in year 2 are equal to the sum of earnings in year 2 from firms that report positive earnings in year 1, and earnings in year 2 from firms that report negative earnings in year 1.

Panel A: Formation years 1963-2001			
Total	year 1	year 2	Growth rate (%)
Growth 1	5.11	5.18	1.43
Value 5	6.10	7.47	22.45
For firms with positive earnings in year 1			
	year 1	year 2	Growth rate (%)
Growth 1	5.28	5.33	0.94
Value 5	9.77	8.69	-11.07
For firms with negative earnings in year 1			
	year 1	year 2	
Growth 1	-0.17	-0.15	
Value 5	-3.67	-1.22	
Panel B: Formation years 1963-2009			
Total	year 1	year 2	Growth rate (%)
Growth 1	5.00	5.11	2.14
Value 5	4.03	6.25	55.02
For firms with positive earnings in year 1			
	year 1	year 2	Growth rate (%)
Growth 1	5.19	5.26	1.26
Value 5	9.10	7.69	-15.46
For firms with negative earnings in year 1			
	year 1	year 2	
Growth 1	-0.19	-0.15	
Value 5	-5.06	-1.44	

Table 5: Regressions of firm-level dividend growth rates on lagged book-to-market ratios. $log(D_{i,t}/D_{i,t-1}) = b_0 + b_1 log(B/M)_{i,t-k} + \epsilon_{i,t}$. I follow the Fama-MacBeth procedure. Newey-West t-statistics with an automatically selected number of lags are reported. $D_{i,t}$ is the dividend from July of year $t-1$ to June of year t computed from CRSP. Variables are winsorized at 1% and 99% in each year. Years negative refers to the number of years in which the coefficient b_1 is negative.

k	$log(BM)_{i,t-k}$	Number of years	Years negative	Years	Avg. Obs.	Adj. R^2
1	-0.069	47	47	1965-2011	1198.75	1.86%
	(-8.09)					
2	-0.042	47	41	1965-2011	1147.62	0.85%
	(-6.14)					
3	-0.030	46	36	1966-2011	1100.89	0.56%
	(-5.90)					
4	-0.028	45	36	1967-2011	1053.11	0.44%
	(-5.87)					
5	-0.024	44	33	1968-2011	1005.71	0.41%
	(-4.57)					
6	-0.022	43	32	1969-2011	960.95	0.33%
	(-4.59)					
7	-0.021	42	33	1970-2011	917.86	0.28%
	(-5.02)					
8	-0.018	41	31	1971-2011	877.61	0.34%
	(-4.07)					
9	-0.014	40	28	1972-2011	838.50	0.30%
	(-3.27)					
10	-0.015	39	27	1973-2011	800.51	0.30%
	(-3.15)					

Table 6: Regressions of firm-level dividend growth rates on lagged book-to-market ratios revisited. $log((D_{i,t} + dl_{i,t})/D_{i,t-1}) = b_0 + b_1 log(B/M)_{i,t-k} + \epsilon_{i,t}$. I follow the Fama-MacBeth procedure. Newey-West t-stat with automatically selected number of lags are reported. $D_{i,t}$ is the dividend from July of year $t-1$ to June of year t computed from CRSP. $dl_{i,t}$ is the delisting proceeds for a firm that is delisted in that year. Variables are winsorized at 1% and 99% in each year. Years negative refers to the number of years in which the coefficient b_1 is negative.

k	$log(BM)_{i,t-k}$	Number of years	Years negative	Years	Avg. Obs.	Adj. R^2
1	-0.033	47	33	1965-2011	1214.09	0.29%
	(-3.08)					
2	-0.000	47	22	1965-2011	1162.66	0.22%
	(-0.03)					
3	0.016	46	18	1966-2011	1115.44	0.15%
	(1.72)					
4	0.021	45	15	1967-2011	1067.33	0.15%
	(2.26)					
5	0.030	44	13	1968-2011	1019.41	0.13%
	(3.22)					
6	0.022	43	17	1969-2011	973.49	0.13%
	(2.06)					
7	0.021	42	17	1970-2011	929.81	0.13%
	(1.88)					
8	0.028	41	17	1971-2011	888.78	0.23%
	(2.10)					
9	0.027	40	15	1972-2011	849.33	0.19%
	(2.13)					
10	0.031	39	11	1973-2011	810.97	0.15%
	(2.45)					

Table 7: Evidence from Gordon's formula. In June of each year t between 1926 and 2001, I sort stocks into value-weighted quintile portfolios according to their book-to-market ratios. The breakpoints are computed using NYSE stocks only. I then compute the average book equity (B_1) and dividends (D_1) in year 1 in buy-and-hold portfolios for a \$100 (P_0) investment at the end of year 0. The accounting variables are adjusted for survivorship bias and expressed in year 0 real dollars. D_1/B_1 refers to the average dividends in year 1 divided by the average book equity in year 1. I also report the T-year average returns for the buy-and-hold portfolio, $\sum_{s=1}^{T}\rho^s r_{is}/\sum_{s=1}^{T}\rho^s$, where $\rho = 0.95$ and r_{is} is the average annual real return in year s after portfolio formation, for portfolio i. When $T = 1$, this produces the average real return in the rebalanced portfolio.

Panel A1: Formation years 1963-2001						
	Growth 1	2	3	4	Value 5	5-1
B_1/P_0 (%)	27.83	53.15	74.20	96.04	149.29	
D_1/B_1 (%)	7.28	5.69	4.93	4.09	2.50	
D_1/P_0 (%)	2.03	3.02	3.66	3.92	3.73	1.71
Average return, $\sum_{s=1}^{T}\rho^s r_{is}/\sum_{s=1}^{T}\rho^s$, (%)						
$T = 1$ (Rebalanced)	6.41	7.43	8.68	9.11	12.14	5.73
$T = 10$ (Buy-and-hold)	6.08	7.82	8.17	8.95	9.98	3.90
Panel A2: Formation years 1963-1991						
D_1/P_0 (%)	2.23	3.46	4.16	4.59	4.45	2.21
Average return, $\sum_{s=1}^{T}\rho^s r_{is}/\sum_{s=1}^{T}\rho^s$, (%)						
$T = 1$ (Rebalanced)	6.05	5.96	8.05	9.64	11.34	5.29
$T = 20$ (Buy-and-hold)	7.71	8.52	8.91	9.29	9.66	1.95
Panel A3: Formation years 1963-1976						
D_1/P_0 (%)	2.01	3.54	4.14	4.36	4.02	2.01
Average return, $\sum_{s=1}^{T}\rho^s r_{is}/\sum_{s=1}^{T}\rho^s$, (%)						
$T = 1$ (Rebalanced)	1.99	2.49	4.59	8.53	9.44	7.45
$T = 35$ (Buy-and-hold)	5.75	6.55	7.73	8.10	8.87	3.12
Panel B: Early Sample (1926-1962)						
	Growth 1	2	3	4	Value 5	5-1
B_1/P_0 (%)	41.89	83.24	122.75	196.70	491.62	
D_1/B_1 (%)	11.22	6.19	4.31	2.60	0.82	
D_1/P_0 (%)	4.70	5.15	5.29	5.12	4.01	-0.69
Average return, $\sum_{s=1}^{T}\rho^s r_{is}/\sum_{s=1}^{T}\rho^s$, (%)						
$T = 1$ (Rebalanced)	12.61	11.94	15.39	18.18	23.55	10.94
$T = 10$ (Buy-and-hold)	12.15	11.30	13.07	15.83	17.25	5.10
$T = 20$ (Buy-and-hold)	10.76	10.05	11.44	13.65	14.62	3.86
$T = 35$ (Buy-and-hold)	10.21	9.59	10.83	12.53	13.52	3.31

Table 8: The canonical Macaulay duration and cash-flow duration for portfolio formation years 1963-1991. $Dur^{canonical}$ as the weighted average of cash-flow maturity. Dividends in the next 20 years are based on historical data. Beyond year 20, cash flows are assumed to be a growing perpetuity, in which the terminal growth rate ($g_{i\infty}$) is estimated following the procedures described in the text. The discount rate is the implied cost of equity that equates the present value of future cash flow and the market price. Weights are the fraction of the present value of the dividends in each year in the total market price. $Dur^{cashflow}$, the cash-flow duration, is the Macaulay duration with discount rates of all assets assumed to be the same as the value portfolio. In Panel C, $\bar{g}_i = \sum_{s=2}^{\infty} \rho^s g_{is} / \sum_{s=2}^{\infty} \rho^s$, $\rho = 0.95$ and growth rates beyond year 20 are assumed to be $g_{i\infty}$. BH refers to buy-and-hold portfolios. VW and EW refer to value-weighted and equal-weighted portfolios. The common assumption about the growth rates is based on value-weighted buy-and-hold portfolios in Lettau and Wachter (2007).

	Growth 1	2	3	4	Value 5	5-1
Panel A: Canonical Macaulay duration, $Dur^{canonical}$						
BH, VW	38.49	29.74	26.21	25.14	26.42	-12.07
BH, EW	53.33	40.22	35.18	34.47	41.62	-11.71
Rebalanced, VW	65.77	44.11	35.45	39.11	39.46	-26.31
Rebalanced, EW	178.90	59.40	54.12	59.36	91.79	-87.11
Panel B: Steady-state growth rate beyond year 20, $g_{i\infty}$ (%)						
BH, VW	2.11	1.91	1.88	1.93	1.99	-0.12
BH, EW	5.37	5.32	5.25	5.30	5.51	0.14
Rebalanced, VW	4.03	4.70	5.13	6.01	8.27	4.25
Rebalanced, EW	1.21	4.72	6.56	8.66	13.79	12.58
Panel C: Cash-flow duration, $Dur^{cashflow}$						
BH, VW	30.84	28.32	26.85	25.77	26.42	-4.42
BH, EW	42.71	40.22	38.63	39.07	41.62	-1.09
Rebalanced, VW	14.86	16.32	17.12	17.77	39.46	24.61
Rebalanced, EW	6.57	10.37	12.04	15.07	91.79	85.22
Panel D: $\bar{g}_i$ (%)						
BH, VW	3.30	2.24	1.79	1.28	1.32	-1.98
BH, EW	7.75	6.51	6.06	5.89	6.26	-1.49
Rebalanced, VW	2.43	2.65	3.12	2.89	5.48	3.05
Rebalanced, EW	-1.63	3.73	4.92	6.47	10.81	12.45
Panel E: Common assumption						
$\bar{g}_i$ (%)	14.06	11.07	7.05	1.09	-4.89	-18.94

Table 9: Cash-flow duration in early and full sample periods. This table reports cash-flow duration and $\bar{g}_i$ for the early and full sample periods (corresponding to Panels C and D of Table 8). The early and full sample periods refer to portfolio formation years of 1926-1962 and 1926-1991, respectively.

	Growth 1	2	3	4	Value 5	5-1
Panel A: Early sample period (formation years 1926-1962)						
Cash-flow duration, $Dur^{cashflow}$						
BH, VW	18.07	16.86	17.16	17.64	18.10	0.03
BH, EW	14.18	14.37	15.09	16.78	19.68	5.49
Rebalanced, VW	10.46	11.19	13.89	16.06	26.32	15.86
Rebalanced, EW	6.98	8.70	10.75	13.43	26.93	19.95
$\bar{g}_i$ (%)						
BH, VW	2.04	1.47	1.82	2.45	3.77	1.73
BH, EW	3.75	4.13	4.69	6.39	9.92	6.17
Rebalanced, VW	1.53	1.93	4.10	5.26	8.38	6.85
Rebalanced, EW	0.12	3.49	6.04	8.26	13.81	13.69
Panel B: Full sample period (formation years 1926-1991)						
Cash-flow duration, $Dur^{cashflow}$						
BH, VW	22.01	20.44	20.18	20.26	20.67	-1.34
BH, EW	19.80	19.49	19.88	21.31	24.13	4.34
Rebalanced, VW	11.93	12.98	15.24	16.97	28.26	16.33
Rebalanced, EW	7.41	9.91	12.24	15.50	37.31	29.90
$\bar{g}_i$ (%)						
BH, VW	2.45	1.77	1.83	2.02	2.79	0.34
BH, EW	4.76	4.88	5.17	6.28	8.88	4.11
Rebalanced, VW	1.77	2.13	3.70	4.36	7.03	5.26
Rebalanced, EW	-0.09	3.58	5.68	7.60	12.56	12.65

Table 10: Summary statistics between 1963 Q3 and 2011 Q2. 20 equity portfolios, each sorted by size, book-to-market, and momentum, are used. This table reports summary statistics for returns regressions in Table 11. $qret$ stands for quarterly real returns. $\bar{g}_{i,t-1}$ is the average annual real dividend growth rate of the rebalanced portfolio i, using information between 1958 and year $t-1$. β_i^{dc} is the consumption beta of annual dividend growth rate, estimated in $log(1+g_{i,t}) = b_i^0 + \beta_i^{dc}(log(1+g_{c,t})) + \epsilon_{i,t}$, using all information between 1963 Q3 and 2011 Q2. Here $g_{i,t}$ is the annual real dividend growth rate ending in quarter 2, and $g_{c,t-k}$ is the annual real consumption growth rate ending in quarter 2. γ_i is the Bansal-Dittmar-Lundblad cash-flow risk, measured from the regression $log(1+g_{i,t}) = \gamma_i \left(\frac{1}{8}\sum_{k=1}^{8} log\left(1+g_{c,t-k}\right)\right) + \epsilon_{i,t}$. Here $g_{i,t}$ is the quarterly real dividend growth rate, and $g_{c,t-k}$ is the quarterly real consumption growth rate. When computing γ_i, both $log\left(1+g_{i,t}\right)$ and $log((1+g_{c,t-k})$ are demeaned. Dividends are seasonally adjusted by summing the most recent 4 quarters. $\bar{g}_{i,t-1}$ is winsorized at 1% and 99%.

	N	Mean	Median	Standard deviation
Value weighted				
$qret \times 4$	11,520	0.0855	0.0933	0.4434
$\bar{g}_{i,t-1}$	11,520	0.0331	0.0272	0.0396
β_i^{dc}	11,520	1.9596	1.7122	3.4366
γ_i	11,520	0.8405	0.7618	4.4654
Equal weighted				
$qret \times 4$	11,520	0.1172	0.1020	0.5336
$\bar{g}_{i,t-1}$	11,520	0.0430	0.0343	0.0443
β_i^{dc}	11,520	2.2876	2.2173	2.5286
γ_i	11,520	0.0950	0.1348	3.0137

Table 11: Fama-MacBeth regressions of rebalanced portfolio returns on historical average growth rates and cash-flow risks between 1963 Q3 and 2011 Q2. The first-stage regressions are estimated in each quarter. 20 equity portfolios, sorted by size, book-to-market, and momentum, respectively, are used. The left-hand-side variable is the quarterly real returns multiplied by 4. $\bar{g}_{i,t-1}$ is the average annual real dividend growth rate of the rebalanced portfolio i, using information between 1958 and year $t-1$. Variable definitions are the same as in Table 10. Panels A and B report results for value-weighted and equal-weighted portfolios, respectively. N and R^2 are the number of portfolios and average R^2, respectively.

		Panel A: Value-weighted				Panel B: Equal-weighted			
	N	$\bar{g}_{i,t-1}$	β_i^{dc}	γ_i	R^2	$\bar{g}_{i,t-1}$	β_i^{dc}	γ_i	R^2
		All portfolios				All portfolios			
1	60	0.49			6.55%	0.67			9.25%
		(4.03)				(6.96)			
2	60		0.0025		4.84%		0.0049		7.29%
			(2.13)				(2.68)		
3	60			0.0048	5.93%			0.0073	6.72%
				(4.98)				(6.37)	
4	60	0.48	0.0018		12.35%	0.68	0.0005		14.89%
		(3.54)	(1.34)			(6.96)	(0.26)		
5	60	0.29		0.0033	9.16%	0.59		0.0023	13.56%
		(2.40)		(3.72)		(4.70)		(1.57)	
6	60	0.28	-0.0009	0.0038	15.42%	0.63	-0.0001	0.0020	21.94%
		(3.02)	(-0.46)	(2.70)		(5.53)	(-0.03)	(0.97)	
		Size portfolios				Size portfolios			
7	20	0.28			13.92%	0.66			16.15%
		(0.85)				(2.58)			
8	20	0.28	0.0036		23.00%	0.66	0.0027		27.60%
		(0.92)	(1.63)			(2.73)	(1.00)		
9	20	0.32	0.0039	-0.0007	20.97%	0.68	0.0043	-0.0027	25.81%
		(1.04)	(1.96)	(-0.58)		(2.78)	(1.46)	(-2.12)	
		B/M portfolios				B/M portfolios			
10	20	0.66			8.42%	0.78			25.49%
		(2.45)				(5.22)			
11	20	0.49	0.0024		12.66%	0.77	0.0006		28.62%
		(2.23)	(2.12)			(4.71)	(0.39)		
12	20	0.51	0.0015	0.0009	13.37%	0.76	0.0001	0.0009	28.60%
		(2.29)	(1.12)	(0.81)		(4.84)	(0.04)	(0.37)	
		Momentum portfolios				Momentum portfolios			
13	20	0.59			21.66%	0.55			18.32%
		(3.38)				(2.78)			
14	20	0.60	-0.0004		24.69%	0.56	-0.0043		26.96%
		(3.31)	(-0.27)			(3.02)	(-1.77)		
15	20	0.37	-0.0022	0.0035	32.91%	0.44	-0.0027	0.0027	35.34%
		(2.26)	(-0.90)	(1.43)		(2.94)	(-1.28)	(1.24)	

Table 12: Average of dividend growth rates in buy-and-hold portfolios (%). In June of each year t between 1926 and 2001, I sort stocks into value-weighted quintile portfolios according to their book-to-market ratios. The breakpoints are computed using NYSE stocks only. Dividends in year $t+s$ are sums of monthly dividends between July of year $t+s-1$ and June of year $t+s$. Dividends are then converted to real terms using the CPI. I first compute the growth rate of dividends and then average the growth rates across portfolio formation years. Dividends are constructed using CRSP returns (*ret*) and returns without dividends (*retx*). Delisting proceeds are reinvested in the remainder of the portfolio. Average (the bottom line in each panel) refers to the arithmetic average of year 2 through year 10.

Year	Growth 1	2	3	4	Value 5	5-1
Panel A: Modern sample period (formation years 1963-2001)						
2	5.29	0.62	0.38	0.10	1.72	-3.57
3	4.12	0.82	3.67	1.79	0.29	-3.82
4	3.62	2.51	1.18	2.37	-1.21	-4.83
5	3.89	1.58	3.54	0.55	6.57	2.68
6	4.30	3.44	2.64	0.25	1.94	-2.36
7	4.18	2.46	1.70	0.24	5.62	1.43
8	4.34	3.85	0.84	3.80	2.86	-1.48
9	4.23	2.38	2.34	2.13	4.52	0.29
10	4.08	3.64	1.57	8.57	3.40	-0.68
Average	4.23	2.37	1.99	2.20	2.86	-1.37
Panel B: Early sample period (formation years 1926-1962)						
2	3.34	1.34	1.11	12.81	37.61	34.27
3	3.03	0.98	3.81	10.38	145.43	142.40
4	2.11	2.79	4.11	7.83	40.66	38.55
5	2.27	3.01	2.44	3.17	26.78	24.50
6	2.88	1.23	3.32	9.29	16.91	14.03
7	3.46	3.12	2.91	8.01	18.53	15.08
8	4.40	3.55	3.45	9.44	12.11	7.71
9	4.68	2.58	5.73	8.31	43.53	38.85
10	4.13	3.56	3.93	4.55	7.38	3.25
Average	3.37	2.46	3.42	8.20	38.77	35.40
Panel C: Full sample period (formation years 1926-2001)						
2	4.34	0.97	0.74	6.29	19.19	14.85
3	3.59	0.90	3.74	5.97	70.95	67.36
4	2.89	2.65	2.61	5.03	19.18	16.29
5	3.10	2.28	3.00	1.82	16.41	13.31
6	3.61	2.36	2.97	4.65	9.23	5.62
7	3.83	2.78	2.29	4.02	11.91	8.08
8	4.37	3.70	2.11	6.54	7.36	2.99
9	4.45	2.48	3.99	5.14	23.51	19.06
10	4.10	3.60	2.72	6.62	5.34	1.23
Average	3.81	2.41	2.69	5.12	20.34	16.53

Table 13: Average dividend shares and the growth rates of shares in buy-and-hold portfolios. In June of each year t between 1926 and 2001, I sort stocks into value-weighted quintile portfolios according to their book-to-market ratios. The breakpoints are computed using NYSE stocks only. Dividends in year $t + s$ are sums of monthly dividends between July of year $t + s - 1$ and June of year $t + s$. Initial investment is proportional to the market capitalization of each portfolio at the end of year 0. I first compute the percentage of dividends in each portfolio as a fraction of total dividends (the sum of the dividends in five portfolios). The shares add up to 100% in each year. I then average the shares across portfolio formation years. The right panel reports the growth rate of the average shares.

	Dividend shares (%)					Growth rates of shares (%)					
Year	Growth 1	2	3	4	Value 5	Growth 1	2	3	4	Value 5	5-1
Panel A: Modern sample period (formation years 1963-2001)											
1	30.20	22.74	19.85	17.46	9.75						
2	31.06	22.47	19.59	17.11	9.77	2.83	-1.16	-1.31	-2.00	0.19	-2.64
3	31.67	22.19	19.67	16.96	9.51	1.96	-1.25	0.41	-0.91	-2.59	-4.55
4	32.21	22.18	19.42	17.02	9.18	1.72	-0.05	-1.30	0.36	-3.54	-5.26
5	32.70	21.98	19.52	16.75	9.05	1.51	-0.88	0.55	-1.60	-1.36	-2.87
6	33.22	22.09	19.35	16.38	8.96	1.60	0.50	-0.87	-2.19	-1.05	-2.65
7	33.79	22.03	19.12	16.01	9.06	1.71	-0.30	-1.22	-2.25	1.16	-0.55
8	34.28	22.23	18.70	15.85	8.94	1.45	0.93	-2.18	-1.00	-1.31	-2.76
9	34.79	22.12	18.65	15.57	8.87	1.49	-0.49	-0.26	-1.79	-0.76	-2.25
10	35.00	22.21	18.22	15.79	8.77	0.62	0.41	-2.31	1.45	-1.15	-1.77
					Arithmetic average	1.65	-0.25	-0.94	-1.10	-1.16	-2.81
					Geometric average	1.65	-0.26	-0.95	-1.11	-1.17	-2.82
Panel B: Early sample period (formation years 1926-1962)											
1	42.50	25.61	17.44	9.85	4.60						
2	42.77	25.08	17.17	10.20	4.77	0.64	-2.06	-1.54	3.53	3.81	3.17
3	42.89	24.76	17.13	10.31	4.91	0.28	-1.30	-0.27	1.07	2.97	2.69
4	42.52	24.85	17.27	10.21	5.15	-0.87	0.37	0.85	-0.96	4.75	5.61
5	42.37	25.07	17.05	10.13	5.37	-0.35	0.90	-1.28	-0.75	4.38	4.74
6	42.54	24.80	16.92	10.18	5.56	0.40	-1.09	-0.79	0.51	3.47	3.07
7	42.49	24.79	16.81	10.24	5.67	-0.12	-0.02	-0.65	0.59	1.92	2.04
8	42.51	24.68	16.66	10.41	5.74	0.05	-0.47	-0.91	1.65	1.36	1.31
9	42.60	24.27	16.84	10.54	5.75	0.22	-1.66	1.09	1.21	0.15	-0.07
10	42.61	24.27	16.94	10.51	5.68	0.01	0.00	0.60	-0.30	-1.32	-1.33
					Arithmetic average	0.03	-0.59	-0.32	0.73	2.39	2.36
					Geometric average	0.03	-0.60	-0.33	0.72	2.37	2.34
Panel C: Full sample period (formation years 1926-2001)											
1	36.19	24.13	18.68	13.76	7.24						
2	36.76	23.74	18.42	13.75	7.33	1.58	-1.63	-1.41	-0.07	1.31	-0.27
3	37.13	23.44	18.43	13.72	7.27	1.01	-1.27	0.11	-0.20	-0.83	-1.84
4	37.23	23.48	18.37	13.70	7.21	0.26	0.16	-0.33	-0.12	-0.82	-1.08
5	37.41	23.49	18.32	13.53	7.26	0.47	0.04	-0.29	-1.29	0.63	0.16
6	37.76	23.41	18.17	13.36	7.30	0.94	-0.33	-0.83	-1.21	0.58	-0.36
7	38.02	23.37	17.99	13.20	7.41	0.70	-0.16	-0.96	-1.19	1.44	0.73
8	38.28	23.42	17.71	13.20	7.38	0.69	0.21	-1.60	0.00	-0.32	-1.01
9	38.59	23.17	17.77	13.12	7.35	0.80	-1.09	0.35	-0.64	-0.41	-1.22
10	38.70	23.21	17.60	13.22	7.26	0.29	0.20	-0.97	0.77	-1.21	-1.50
					Arithmetic average	0.75	-0.43	-0.66	-0.44	0.04	-0.71
					Geometric average	0.75	-0.43	-0.66	-0.44	0.04	-0.71

Table 14: Average earnings-to-GDP ratio and the growth rates of the ratio in buy-and-hold portfolios, adjusted for survivorship bias. In June of each year t between 1926 and 2001, I sort stocks into value-weighted quintile portfolios according to their book-to-market ratios. The breakpoints are computed using NYSE stocks only. I treat earnings with fiscal year ends between July of year $t+s-1$ and June of year $t+s$ as earnings in year $t+s$. Initial investment is proportional to the market capitalization of each portfolio at the end of year 0. I first compute the earnings-to-GDP ratio for each portfolio in each year. I then average the ratios across portfolio formation years. The right panel reports the growth rate of the average ratios. The arithmetic average growth rate from year 2 to year 10 is reported. The geometric average growth rate is $\left(\frac{ER_{10}}{ER_1}\right)^{\frac{1}{9}} - 1$, where ER_t refers to the average earnings-to-GDP ratio in year t.

	Earnings as a percentage of GDP(%)					Growth rates (%)					
Year	Growth 1	2	3	4	Value 5	Growth 1	2	3	4	Value 5	5-1
-5	0.67	0.63	0.59	0.55	0.38						
-4	0.70	0.62	0.57	0.54	0.37	3.99	-0.74	-3.60	-2.07	-2.59	-6.58
-3	0.72	0.63	0.56	0.53	0.35	3.20	0.66	-2.32	-1.63	-4.45	-7.66
-2	0.76	0.63	0.55	0.50	0.32	5.05	0.38	-1.61	-5.65	-7.71	-12.76
-1	0.81	0.64	0.54	0.48	0.27	6.88	1.42	-0.71	-5.22	-17.27	-24.15
0	0.87	0.65	0.55	0.43	0.18	7.50	1.64	0.53	-9.79	-30.79	-38.29
1	0.87	0.64	0.51	0.41	0.14	0.06	-1.65	-5.97	-4.95	-21.77	-21.83
2	0.84	0.64	0.49	0.41	0.18	-4.08	-0.53	-4.29	0.34	24.28	28.36
3	0.84	0.62	0.50	0.41	0.20	-0.17	-2.93	1.33	0.52	8.66	8.83
4	0.86	0.61	0.50	0.42	0.19	2.33	-1.10	-0.22	1.20	-3.92	-6.24
5	0.87	0.61	0.50	0.41	0.19	1.60	0.27	0.29	-1.37	1.24	-0.36
6	0.89	0.62	0.50	0.41	0.21	2.58	1.23	-0.15	-0.31	8.58	6.00
7	0.92	0.63	0.51	0.37	0.23	3.41	1.88	2.25	-9.02	12.37	8.96
8	0.92	0.65	0.47	0.38	0.23	-0.37	2.48	-7.12	1.79	0.01	0.38
9	0.94	0.62	0.49	0.37	0.23	2.67	-3.72	2.56	-1.70	0.81	-1.86
10	0.98	0.64	0.49	0.38	0.21	3.86	3.50	0.34	2.79	-8.63	-12.49
				Arithmetic Average		1.31	0.12	-0.56	-0.64	4.82	3.51
				Geometric Average		1.29	0.09	-0.60	-0.69	4.42	3.14

Table 15: Cash-flow duration using different horizons. This table reports a variant of Table 8. Dividends in the first T years are based on historical data. The terminal growth rate beyond year T is inferred from the fundamental-to-price ratios at the end of year T. When $T = 10$, I use portfolio formation years from 1963-2001. When $T = 35$, I use portfolio formation years from 1963-1976.

	growth 1	2	3	4	value	5-1
Panel A: T=10						
Cash-flow duration						
BH, VW	32.44	30.20	28.40	28.52	29.70	-2.74
Rebalanced, VW	15.24	15.95	16.80	18.97	34.77	19.54
$\bar{g}_i$ (%)						
BH, VW	2.77	1.86	1.54	1.45	1.56	-1.21
Rebalanced, VW	2.09	2.37	2.76	3.17	5.76	3.67
Panel B: T=35						
Cash-flow duration						
BH, VW	34.01	29.42	29.39	27.40	31.28	-2.73
Rebalanced, VW	13.00	14.15	16.11	16.02	48.22	35.22
$\bar{g}_i$ (%)						
BH, VW	2.65	1.25	1.44	1.32	1.55	-1.10
Rebalanced, VW	0.87	1.16	2.26	2.54	5.51	4.64

Table 16: Dividends and repurchases in the modern sample period, in B/M portfolios. Panel A reports the average dividends plus repurchases corresponding to a \$100 investment in buy-and-hold portfolios at the end of year 0. Dividends and repurchases are expressed in year 0 real dollars using the CPI. Panels A and B use portfolio formation years from 1963-2001. Panels A and B are a variation of Panel A in Table 1, including repurchases. Panels C and D repeat Table 8, except that now I include repurchases in dividends. Panels C and D use portfolio formation years from 1963-1991. BH and Reb. refer to buy-and-hold and rebalanced portfolios, respectively. VW and EW refer to value-weighted and equal-weighted portfolios, respectively.

	Panel A: Avg. dividends + repurchases (\$)					Panel B: Growth rates (%)					
year	Growth 1	2	3	4	Value 5	Growth 1	2	3	4	Value 5	5-1
1	2.73	3.96	4.80	5.09	5.05						
2	2.89	3.99	4.90	5.03	5.23	5.86	0.87	1.98	-1.20	3.41	-2.44
3	3.09	4.12	5.09	5.24	5.18	6.81	3.16	3.91	4.09	-0.78	-7.58
4	3.26	4.23	5.05	5.39	5.36	5.55	2.88	-0.80	2.96	3.41	-2.14
5	3.41	4.40	5.24	5.31	5.74	4.43	3.90	3.85	-1.43	7.05	2.62
6	3.57	4.62	5.34	5.61	5.87	4.72	5.00	1.77	5.63	2.28	-2.44
7	3.78	4.86	5.52	5.56	6.16	5.85	5.27	3.51	-0.92	4.98	-0.86
8	3.92	5.11	5.42	5.77	6.33	3.87	5.05	-1.84	3.68	2.64	-1.23
9	4.09	5.29	5.73	5.59	6.32	4.36	3.49	5.67	-3.13	-0.02	-4.38
10	4.31	5.50	5.71	5.93	6.16	5.20	4.02	-0.27	6.20	-2.52	-7.72
				Arithmetic average		5.18	3.74	1.98	1.76	2.27	-2.91
				Geometric average		5.18	3.73	1.95	1.71	2.24	-2.94

	Panel C: cash-flow duration					Panel D: $\bar{g}_i$, (%)					
	Growth 1	2	3	4	Value 5	Growth 1	2	3	4	Value 5	5-1
BH, VW	22.99	20.86	19.22	18.89	18.61	3.67	2.58	1.71	1.41	1.30	-2.37
BH, EW	25.99	24.40	23.18	23.25	24.12	7.67	6.73	6.06	5.92	6.43	-1.24
Reb., VW	13.70	14.33	14.68	15.00	23.58	3.01	3.13	3.21	3.05	5.61	2.60
Reb., EW	7.23	11.14	12.72	15.32	43.73	0.40	5.66	6.66	7.90	12.11	11.71

7 Appendix

7.1 Dividend share process in Lettau and Wachter (2007)

Lettau and Wachter (2007) assume a deterministic share process for firms. This share process basically assumes that cash flows of extreme growth firms grow at 20% per year for 25 years, cash flows of extreme value firms shrink at 20% for 25 years, and then the cycle reverses and repeats itself. Fig. A1 plots the resulting dividend shares of quintile buy-and-hold portfolios over time, after aggregating firms into portfolios. The dividend share of the growth quintile increases from 1.37% in the 4th quarter of year 1 to 6.93% in the 4th quarter of year 10, and to 62.52% in the 4th quarter of year 25. The dividend share of the value quintile decreases from 56.66% in the 4th quarter of year 1 to 11.30% in the 4th quarter of year 10, and to 1.40% in the 4th quarter of year 25. The cycle then reverses and repeats itself. This share process is subsequently used by Lettau and Wachter (2011) and Croce, Lettau, and Ludvigson (2010).

When computing $\bar{g}_i = \sum_{s=2}^{+\infty} \rho^s g_{is} / \sum_{s=2}^{+\infty} \rho^s$, I first compute the expected market dividends assuming that $z_t = 0$ and $x_t = 0$. I then compute the expected dividends for each portfolio and each quarter, using the parameter values in Lettau and Wachter (2007). They are then aggregated into annual dividends. Growth rates are then computed based on expected annual dividends.

7.2 Portfolio growth rates adjusted for survivorship bias

I develop a five-step procedure for the value-weighted portfolios. A similar procedure can be carried out for equal-weighted portfolios.

Step 1: I compute the fundamental-to-price ratio in year $t+s$, FP_{t+s}, for a portfolio that is formed in year t, as the value-weighted average of firm fundamental per share to price per share ratios, $\frac{Fps_{t+s}}{Pps_{t+s-1}}$. All firms that are available in year $t+s-1$, but not necessarily in $t+s$, are included. If a firm exits the portfolio in year $t+s$, its fundamental value is set to zero. In the next steps, I ensure that delisting proceeds are accounted for in the future.[23]

Step 2: I compute value-weighted buy-and-hold portfolio returns and returns without dividends ret_{t+s} and $retx_{t+s}$. It is important to include delisting returns in this step.

Step 3: Once I have the return series, I compute the price series for any given amount of investment in an

[23] One could also take the delisting proceeds out as a form of dividends. The results are qualitatively the same, but the growth rates of portfolios are more volatile due to outliers.

early year, say, \$1 investment in, year $t-7$, as follows: $P_{t-7}=1$, and

$$P_{t+s}=P_{t+s-1}(1+retx_{t+s}). \tag{14}$$

Step 4: I multiply $P_{t+s-1}FP_{t+s}$ to get the survivorship bias adjusted portfolio fundamental value F_{t+s}^{SA}.

Step 5: I first scale the accounting variable to correspond to a \$1 investment in portfolio formation year t, $\tilde{F}_{t+s}^{SA}=\frac{F_{t+s}^{SA}}{P_t}$. Variables are then converted to year 0 real dollars using the CPI. I then average across portfolio formation years before computing growth rate, $g_s^F=\frac{E[\tilde{F}_{t+s}]}{E[\tilde{F}_{t+s-1}]}-1$.

If no firm ever exits the portfolio, then this procedure should yield the same value as the simple growth rates in Section 3.2.2. When firms do exit the portfolio, this procedure automatically accounts for survivorship bias, because it includes all firms that are alive in year $t+s-1$. It accounts for the delisting proceeds, because when computing returns, we implicitly assume that proceeds are reinvested when firms exit the portfolio.

7.3 Four models of time-varying expected returns and expected growth rates

I first present three simple models with time-varying expected returns. The first model has time-varying market price of risk, which is a continuous-time version of Campbell and Cochrane (1999)'s habit formation model. The second model has time-varying amount of risk, which captures the conditional heteroskedasticity in the long-run risk model. The third model has both time-varying price of risk and amount of risk.

In the following three simple models, the dividend process can be understood as that of the market portfolio (D_t^M) or individual stocks (D_t^i). For ease of exposition, the superscripts are dropped out throughout this section. To focus on time-varying market price of risk and time-varying amount of risk, I assume the interest rate to be constant.

After the first three simple models, I then consider a fourth model in which both the market price of risk and the expected growth rate are time varying.

7.3.1 Model 1: Time-varying price of risk

Assume that the pricing kernel follows:

$$\frac{dM_t}{M_t}=-rdt-x_tdB_t^M, \tag{15}$$

where r is the constant interest rate, and x_t is the time-varying market price of risk. x_t can be roughly thought of as the time-varying risk-aversion coefficient for the representative agent. Without formally writing down a utility function, I assume that the market price of risk follows a mean-reverting process:

$$dx_t = \phi_x(\bar{x} - x_t)dt + \sigma_x dB_t^M, \tag{16}$$

where ϕ_x measures the convergence speed of x_t to the long-run average price of risk $\bar{x}$. Without loss of generality, I assume that the innovation to x_t is perfectly correlated with innovations to the pricing kernel process.

The dividend process is assumed to be:

$$\frac{dD_t}{D_t} = gdt + \sigma_D^M dB_t^M + \sigma_D^Z dB_t^Z, \tag{17}$$

where g is the expected dividend growth rate. $\sigma_D^M dB_t^M$ denotes the systematic component of the dividend process, where $\sigma_D^Z dB_t^Z$ is the idiosyncratic component of the dividend process. Under these assumptions, the stock price has the following semi-closed-form solution that involves an integral of closed-form quantities.

Under these conditions, the price of the stock is

$$P_t = D_t \int_0^{+\infty} e^{gN+A(N)+B(N)x_t} dN, \tag{18}$$

where $A(N)$ and $B(N)$ are defined in Section 7.4.

The instantaneous expected excess return is:

$$\mu_R = x_t \left(\sigma_D^M + \frac{\int_0^{+\infty} e^{gN+A(N)+B(N)x_t} B(N)\sigma_x dN}{\int_0^{+\infty} e^{gN+A(N)+B(N)x_t} dN} \right), \tag{19}$$

and

$$\begin{aligned} \sigma_R^2 &= (\sigma_D^M)^2 + 2\sigma_D^M \sigma_x \frac{\int_0^{+\infty} e^{gN+A(N)+B(N)x_t} B(N)dN}{\int_0^{+\infty} e^{gN+A(N)+B(N)x_t} dN} \\ &\quad + \sigma_x^2 \left(\frac{\int_0^{+\infty} exp(gN + A(N) + B(N)x_t)B(N)dN}{\int_0^{+\infty} e^{gN+A(N)+B(N)x_t} dN} \right)^2 + (\sigma_D^Z)^2. \end{aligned} \tag{20}$$

I now define a very-short-duration claim. In this economy, consider the following instrument I_T that pays a liquidating dividend Y_T. The expectation of Y_T at time is denoted as Y_t. Further assume that the cash-flow expectation evolves as follows $\frac{dY_t}{Y_t} = \sigma_D^M dB_t^M + \sigma_D^Z dB_t^Z$. Then the expected instantaneous return of this instrument is $x_t(\sigma_D^M + B(N)\sigma_x)$, where $N = T - t$, and $B(N)$ is defined in Section 7.4. The very-short-duration claim is the limiting case of such I_T as $T \to t$. The expected return on the very-short-duration claim is:

$$\lim_{N \to 0} x_t(\sigma_D^M + B(N)\sigma_x) = x_t \sigma_D^M \tag{21}$$

the expected return in a model with constant cash-flow risk σ_D^M and constant market price of risk equal to x_t.

In loose terms, a model of constant expected returns dictates that the expected return is the product of risk aversion and dividend risk. In a model with time-varying risk aversion, the average expected return is not equal to the average risk aversion multiplied by the average dividend risk. When risk aversion is countercyclical, the long-run average return is greater than the product of the average risk aversion and the average dividend risk. This inequality is reversed when the risk aversion is procyclical.

Formally, I prove the following proposition.

Proposition 1. *This model of time-varying market price of risk does not change the expected return of the very-short-duration claim. The necessary and sufficient condition for the model to generate a higher equity premium than $\sigma_M \sigma_D^M$ is $\sigma_x < 0$; that is, the market price of risk is countercyclical. Under the above condition, stocks with higher expected growth rates have higher expected returns, all else being equal.*

Proof: *See Section 7.4.*

Panel A of Fig. A2 plots the expected excess returns of stocks that only differ in their dividend growth rate g. The parameters used in this plot are $x_t = 0.3$, $\sigma_D^M = 0.005$, $\phi_x = 5.05$, $\bar{x} = 0.3$ and the interest rate is 10%. A high interest rate of 10% is chosen only for computational convenience. But the shape of the curve is not affected by a particular choice of interest rate as long as the expected growth rate is not so high that the price is infinite. As the expected growth rate g increases from 0 to 10%, the expected excess stock return increases from approximately 4% to 9%. These parameters are chosen to illustrate the working of time-varying market price of risk on the equity premium. If the market price of risk x_t is constant (equal to $\bar{x}$, then that stock's equity premium would be $\sigma_D^M * \bar{x} = 0.005 * 0.3 = 0.15\%$. With time-varying price of risk x_t, the model can deliver a much higher equity premium.[24]

[24]This model matches the facts about the equity premium, the volatility puzzle, and predictability. The advantage of this model is that we do not have to model the heteroskedasticity of the dividend in order to get closed-form solutions. However, with a countercyclical market price of risk, it cannot replicate the leverage effects. Thus, this model is not suitable for drawing inferences about the time-series behavior of stock return volatility. The other drawback of this model is that sometimes the market price of risk can be negative.

7.3.2 Model 2: Time-varying amount of risk

I consider another model with time-varying amount of risk. In this model, the market price of risk is constant. However, the amount of risk is time varying. This model also generates time-varying expected returns and the cross-sectional implication on growth rates.

In this model, I assume that the pricing kernel follows:

$$\frac{dM_t}{M_t} = -rdt - \sigma_M dB_t^M, \tag{22}$$

where r is the constant interest rate and σ_M is the constant market price of risk.

The dividend process is assumed to be:

$$\frac{dD_t}{D_t} = gdt + x_t dB_t^M + \sigma_D^Z dB_t^Z, \tag{23}$$

where g is the constant expected growth rate. $x_t dB_t^M$ is the systematic component of the dividend process, and $\sigma_D^Z dB_t^Z$ is the idiosyncratic component of the dividend process. The time-varying amount of risk is assumed to follow a mean-reverting process:

$$dx_t = \phi_x(\bar{x} - x_t)dt + \sigma_x dB_t^M, \tag{24}$$

where ϕ_x measures the speed of convergence of x_t to the long-run amount of risk $\bar{x}$. σ_x is the volatility of the x_t process. For convenience, I assume that x_t is perfectly correlated with the innovations of the pricing kernel.

The stock price, expected return, and volatility have semi-closed-form solutions that involve the integral of closed-form quantities. The solutions can be found in Section 7.4. In this economy, the very-short-duration claim is the limit of instrument I_T that pays a liquidating dividend of Y_T, the expectation of which follows the process: $\frac{dY_t}{Y_t} = x_t dB_t^M + \sigma_D^Z dB_t^Z$, where x_t follows the process as in equation (24). With this, I prove the following proposition.

Proposition 2. *This model of time-varying amount of risk does not change the expected return of the very-short-duration claim. The necessary and sufficient condition for the average expected return of the stock to be greater than $r + \bar{x}\sigma_M$ is that $\sigma_x < 0$; that is, the cash flow is more risky when times are bad. In this case, after controlling for cash flow risk x_t, the expected return is increasing in g.*

Proof: *See Section 7.4.*

7.3.3 Model 3: Time-varying price of risk and amount of risk

I now consider the third model, with both time-varying price of risk and amount of risk. Although this model involves both time-varying market price of risk and time-varying cash-flow risk, it does not nest the above two models. This model generates time-varying expected returns and the cross-sectional implication on growth rates.

In this model, I assume the pricing kernel to follow:

$$\frac{dM_t}{M_t} = -rdt - \sqrt{x_t}dB_t^M, \tag{25}$$

where r is the constant interest rate, and $\sqrt{x_t}$ is the market price of risk. To obtain semi-closed-form solutions, I assume that the process x_t follows the square-root process of

$$dx_t = \phi_x(\bar{x} - x_t)dt + \sigma_x\sqrt{x_t}dB_t^M, \tag{26}$$

where ϕ_x measures the speed of convergence of x_t to the long-run value $\bar{x}$. $\sigma_x\sqrt{x_t}$ is the volatility of the x_t process. I assume that x_t is perfectly correlated with the innovations of the pricing kernel.

I assume that the dividend process also follows a square-root process:

$$\frac{dD_t}{D_t} = gdt + \sigma_D^M\sqrt{x_t}dB_t^M + \sigma_D^Z dB_t^Z, \tag{27}$$

where g is the constant expected growth rate. $\sigma_D^M\sqrt{x_t}dB_t^M$ is the systematic component of the dividend process, and $\sigma_D^Z dB_t^Z$ is the idiosyncratic component of the dividend process.

The very-short-duration claim in this economy is the limit of instrument I_T that pays a liquidating dividend of Y_T, the expectation of which follows the process: $\frac{dY_t}{Y_t} = \sigma_D^M\sqrt{x_t}dB_t^M + \sigma_D^Z dB_t^Z$. This model also implies that stocks with higher growth rates have higher expected returns, all else being equal.

Proposition 3. *This model of time-varying price of risk and amount of risk does not change the expected return of the very-short-duration claim. The necessary and sufficient condition for the unconditional expected return of the stock to be greater than $r + \bar{x}\sigma_x$ is that $\sigma_x < 0$; that is, the market price of risk is countercyclical and the cash flow is more risky when times are bad. In this case, controlling for cash-flow risk σ_D^M, the expected return is increasing in g.*

Proof: *See Section 7.4.*

To recap, the two robust predictions from all three models are: (1) Models of time-varying expected returns do not change the expected return on a very-short-duration claim. (2) In the cross section, the expected return increases in the expected dividend growth rate, controlling for cash flow risk. I test the second prediction in the next section.

7.3.4 Model 4: Time-varying market price of risk and expected growth rate

Assume that the pricing kernel follows:

$$\frac{dM_t}{M_t} = -rdt - x_t dB_t^M, \tag{28}$$

where r is the constant interest rate, and x_t is the time-varying market price of risk. x_t can be roughly thought of as the time-varying risk-aversion coefficient for the representative agent. Without formally writing down a utility function, I assume that the market price of risk follows a mean-reverting process:

$$dx_t = \phi_x(\bar{x} - x_t)dt + \sigma_x dB_t^x, \tag{29}$$

where ϕ_x measures the convergence speed of x_t to the long-run average price of risk $\bar{x}$. Without loss of generality, I assume that the innovation to x_t is perfectly correlated with innovations to the pricing kernel process.

The dividend process is assumed to be:

$$\frac{dD_t}{D_t} = g_t dt + \sigma_D dB_t^D, \tag{30}$$

where g_t is the expected dividend growth rate.

The expected growth rate follows the process:

$$dg_t = \phi_g(\bar{g} - g_t)dt + \sigma_g dB_t^g, \tag{31}$$

The correlation between B_t^M, B_t^x, B_t^D, and B_t^g is assumed to be ρ_{xM}, ρ_{DM}, ρ_{gM}, ρ_{xD}, ρ_{xg}, and ρ_{Dg}.

Under these conditions, the price of the $t+N$ dividend strip at time t is:

$$P_t = D_t e^{A(N)+B(N)x_t+C(N)g_t}, \tag{32}$$

where $A(N)$, $B(N)$, and $C(N)$ are defined in Section 7.4.

The instantaneous expected excess return is:

$$\mu_R = x_t\left(\sigma_D\rho_{DM} + B(N)\sigma_x\rho_{xM} + C(N)\sigma_g\rho_{gM}\right), \tag{33}$$

and

The return process is:

$$\frac{dP_t}{P_t} = (r + \mu_R)dt + \sigma_D dB_t^D + B(N)\sigma_x dB_t^x + C(N)\sigma_g dB_t^g, \tag{34}$$

which implies that the return volatilities

$$\sigma_R^2 = \sigma_D^2 + B(N)^2\sigma_x^2 + C(N)^2\sigma_g^2 + 2B(N)\sigma_D\sigma_x\rho_{xD} + 2\sigma_D C(N)\sigma_g\rho_{Dg} + 2B(N)C(N)\sigma_x\sigma_g\rho_{xg}. \tag{35}$$

Proposition 4. *This model of time-varying price of risk and expected growth does not change the expected return of the very-short-duration claim. The term structure of the expected return depends on both* ρ_{xM} *and* ρ_{gM}*, among other parameters. Under the assumption that* $\rho_{xM} < 0$*, as well as the regularity conditions that* $\phi_x + \rho_{xM}\sigma_x > 0$*, 1. If* $\rho_{gM} > 0$*, then the term structure of equity return is largely upward sloping. 2. If* $\rho_{gM} < 0$ *and* $\rho_{gM}\sigma_g + \phi_g\rho_D M\sigma_D < 0$*, then the term structure is largely downward sloping. 3. If* $\rho_{gM} < 0$ *and* $\rho_{gM}\sigma_g + \phi_g\rho_D M\sigma_D > 0$*, then the term structure is largely upward sloping iff* $-\frac{\rho_{gM}\sigma_g + \phi_g\rho_{DM}\sigma_D}{\phi_g(\phi_x + \rho_{xM}\sigma_x)}\sigma_x\rho_{xM} + \frac{\sigma_g\rho_{gM}}{\phi_g} > 0$.

"Largely" means comparing $N = 0$ *and* $N = +\infty$*. In general, the term structure of the expected return does not have to be monotonic.*

Proof: *See Section 7.4.*

7.4 Proofs

Proposition 1 stated in the text follows from the following expanded exposition.

The price of the stock is

$$P_t = D_t \int_0^{+\infty} e^{gN + A(N) + B(N)x_t} dN, \tag{36}$$

where

$$B(N) = -\frac{\sigma_D^M(1 - e^{-(\phi_x+\sigma_x)N})}{\phi_x + \sigma_x}, \tag{37}$$

$$A(N) = A_1 B(N)^2 + A_2[\sigma_D^M N + B(N)] - rN, \tag{38}$$

$A_1 = -\frac{\sigma_x^2}{4(\phi_x+\sigma_x)}$, and $A_2 = -\frac{\phi_x\bar{x} + \sigma_D^M\sigma_x}{\phi_x+\sigma_x} + \frac{\sigma_D^M\sigma_x^2}{2(\phi_x+\sigma_x)^2}$.

There are some regularity conditions that have to be satisfied. These are: 1) $\sigma_D^M > 0$ (positive cash-flow risk); 2) $x_t > 0$ (positive market price of risk); 3) $\phi_x + \sigma_x > 0$ and $g + A_2\sigma_D^M - r < 0$ (conditions for price of the stock to be finite). Under the above conditions, the following holds for the stock that pays a continuous stream of dividends according to $\frac{dD_t}{D_t} = gdt + \sigma_D^M dB_t^M + \sigma_D^Z dB_t^Z$.

The price-dividend ratio is increasing in g and decreasing in σ_D^M (cash-flow risk). The volatility is increasing in σ_D^M (cash-flow risk).

1) When $\sigma_x < 0$ (countercyclical market price of risk), the unconditional expected return of the stock is greater than $r + \bar{x}\sigma_D^M$, thus helping to produce a higher equity premium. Controlling for cash-flow risk σ_D^M the expected return is increasing in g.

2) When $\sigma_x = 0$ (constant discount rate), the volatility and expected returns are only determined by cash-flow risk and do not depend on g. The expected return is $r + x_t\sigma_M = r + \bar{x}\sigma_M$.

3) When $\sigma_x > 0$ (procyclical market price of risk), the unconditional expected return of a stock is less than $r + \bar{x}\sigma_D^M$, thus, in this case, the time-varying market price of risk does not help us with the equity premium puzzle. In the cross section, the expected return is decreasing in g. The volatility decreases in g at first and eventually increases in g.

To show the above, first consider an instrument that pays a liquidating dividend D_T at time T. With abuse of notation, let $D_t = E[D_T|F_t]$ denote the expectation of D_T at time t. By the law of iterated expectations, D_t is a Martingale. Suppose the expectation evolves according to $\frac{dD_t}{D_t} = \sigma_D^M dB_t^M + \sigma_D^z dB_t^z$. The price of this instrument S_t has to satisfy the following condition:

$$E\left[\frac{dS_t}{S_t}\right] - rdt = -E_t\left[\frac{dS_t}{S_t}\frac{dM_t}{M_t}\right], \tag{39}$$

by definition of the pricing kernel. I posit that S is a function of D_t,x_t and $N = T - t$, time to expiration. Then S has to satisfy the following Partial Differential Equation:

$$\begin{aligned} &\tfrac{\partial S}{\partial x}\phi_x(\bar{x} - x_t) + \tfrac{1}{2}\tfrac{\partial^2 S}{\partial x^2}\sigma_x^2 + \tfrac{\partial^2 S}{\partial x \partial D}D_t\sigma_x\sigma_D^M + \tfrac{1}{2}\tfrac{\partial^2 S}{\partial D^2}D_t^2[(\sigma_D^M)^2 + (\sigma_D^z)^2] - \tfrac{\partial S}{\partial N} - rS \\ &\qquad = \tfrac{\partial S}{\partial x}\sigma_x x_t + \tfrac{\partial S}{\partial D}\sigma_D^M x_t D_t, \end{aligned} \tag{40}$$

with the boundary condition $S(D, x, 0) = D$. It can be verified that the solution to the above equation is $S_t = D_t e^{A(N)+B(N)x_t}$ where $A(N)$ and $B(N)$ are specified as in the text.

Now suppose the expectation evolves according to $dD_t/D_t = gdt + \sigma_D^M dB_t^M + \sigma_D^z dB_t^z$ (so it is not a rational expectation). Redo the PDE; it is easy to find that the price of this instrument is now $S_t = D_t e^{gN+A(N)+B(N)x_t}$. The price of the stock, which has a real dividend that evolves according to: $\frac{dD_t}{D_t} = gdt + \sigma_D^M dB_t^M + \sigma_D^z dB_t^z$, is the sum of all S, i.e. $P_t = D_t \int_0^\infty e^{gN+A(N)+B(N)x_t} dN$.

The instantaneous return $\frac{dP_t+D_t dt}{P_t}$ can be derived with a straightforward application of Ito's Lemma. The expected excess return is $x_t\left(\sigma_D^M+\frac{\int_0^{+\infty}e^{gN+A(N)+B(N)x_t}B(N)\sigma_x dN}{\int_0^{+\infty}e^{gN+A(N)+B(N)x_t}dN}\right)$. Since B(N) is negative (immediate from the functional form of B(N)), and x_t,σ_D^M,$exp(gN+A(N)+B(N)x_t)$ are assumed to be positive, the necessary and sufficient condition for the expected return to be greater than $x_t\sigma_D^M$ is that $\sigma_x<0$. Noting that the unconditional expectation of x_t is $\bar{x}$, we show that the necessary and sufficient condition for the unconditional expected return to be greater than $\bar{x}\sigma_D^M$ is $\sigma_x<0$.

To prove the expected return increases in the expected growth rate, it suffices to show that $f=\frac{\int_0^{+\infty}e^{gN+A(N)+B(N)x_t}B(N)\sigma_x dN}{\int_0^{+\infty}e^{gN+A(N)+B(N)x_t}dN}$ is an increasing function of g when $\sigma_x<0$. For ease of exposition, define $Z=e^{gN+A(N)+B(N)x_t}$. Therefore,

$$\begin{aligned}\frac{\partial f}{\partial N} &= \frac{\int_0^{+\infty}e^Z NB(N)\sigma_x dN\int_0^{+\infty}e^Z dN-\int_0^{+\infty}e^Z B(N)\sigma_x dN\int_0^{+\infty}e^Z NdN}{\left(\int_0^{+\infty}e^Z dN\right)^2}\\ &= E^g[NB(N)\sigma_x]-E^g[B(N)\sigma_x]E^g[N]\\ &= Cov^g[N,B(N)\sigma_x], \qquad (41)\end{aligned}$$

where E^g is defined on the probability density over N: $\frac{e^Z}{\int_0^{+\infty}e^Z dN}$. Because $B(N)$ is monotonically decreasing in N, $Cov^g[N,B(N)\sigma_x]$>0, $iff\ \sigma_x$<0.

To prove that

$$\lim_{N\to 0}x_t(\sigma_D^M+B(N)\sigma_x)=x_t\sigma_D^M, \qquad (42)$$

plug in the functional form of B(N), and it follows immediately.

For Model 2, consider the following instrument that pays a liquidating dividend Y_T. The expectation of Y_T at time t is denoted as Y_t. Further assume that the cash-flow expectation follows: $\frac{dY_t}{Y_t}=x_t dB_t^M+\sigma_D^Z dB_t^Z$, where x_t follows the same process as above. Then the expected instantaneous return of this instrument is $\sigma_M(x_t+B(N)\sigma_x)$, where $N=T-t$. Furthermore,

$$\lim_{N\to 0}\sigma_M(x_t+B(N)\sigma_x)=\sigma_M x_t, \qquad (43)$$

the expected return that would be in a model with a constant cash-flow risk that is equal to x_t and a constant market price of risk σ_M.

For the stock that pays a continuous stream of dividend according to: $\frac{dD_t}{D_t}=gdt+x_t dB_t^M+\sigma_D^Z dB_t^Z$, the price of the stock is

$$P_t=D_t\int_0^{+\infty}e^{gN+A(N)+B(N)x_t}dN, \qquad (44)$$

where

$$B(N) = \frac{\sigma_M(1 - e^{(\sigma_x - \phi_x)N})}{\sigma_x - \phi_x}, \tag{45}$$

$$A(N) = A_1 B(N)^2 + A_2[\sigma_M N + B(N)] - rN, \tag{46}$$

$$A_1 = \frac{\sigma_x^2}{4(\sigma_x - \phi_x)}, \tag{47}$$

and

$$A_2 = \frac{\phi_x \bar{x} - \sigma_M \sigma_x}{\sigma_x - \phi_x} + \frac{\sigma_M \sigma_x^2}{2(\sigma_x - \phi_x)^2}. \tag{48}$$

The instantaneous return of the stock is

$$\begin{aligned} \frac{dP_t + D_t dt}{P_t} &= \left(r + \sigma_M \left(x_t + \frac{\int_0^{+\infty} e^{gN + A(N) + B(N)x_t} B(N)\sigma_x dN}{\int_0^{+\infty} e^{gN + A(N) + B(N)x_t} dN}\right)\right) dt \\ &+ \left(x_t + \frac{\int_0^{+\infty} e^{gN + A(N) + B(N)x_t} B(N)\sigma_x dN}{\int_0^{+\infty} e^{gN + A(N) + B(N)x_t} dN}\right) dB_t^M + \sigma_D^Z dB_t^Z. \end{aligned} \tag{49}$$

For Model 3, consider the following instrument that pays a liquidating dividend Y_T. The expectation of Y_T at time t is denoted as Y_t. Further assume that the cash-flow expectation follows an information structure that is $\frac{dY_t}{Y_t} = \sigma_D^M \sqrt{x_t} dB_t^M + \sigma_D^Z dB_t^Z$, where x_t follows the same process as above. Then the expected instantaneous return of this instrument is $\sqrt{x_t}(\sigma_D^M \sqrt{x_t} + B(N)\sigma_x)$, where $N = T - t$. See below for the functional form of B(N). Furthermore,

$$\lim_{N \to 0} \sqrt{x_t}(\sigma_D^M \sqrt{x_t} + B(N)\sigma_x) = \sigma_D^M x_t, \tag{50}$$

the expected return that would be in a model with a constant cash-flow risk that is equal to $\sigma_D^M \sqrt{x_t}$ and a constant market price of risk $\sqrt{x_t}$.

For the stock that pays a continuous stream of dividends according to $\frac{dD_t}{D_t} = gdt + \sigma_D^M \sqrt{x_t} dB_t^M + \sigma_D^Z dB_t^Z$, the price of the stock is then

$$P_t = D_t \int_0^{+\infty} e^{gN + A(N) + B(N)x_t} dN, \tag{51}$$

where

$$B(N) = -\frac{2\sigma_D^M (e^{\delta N} - 1)}{(\delta + \sigma_D^M \sigma_x - \phi_x - \sigma_x)(e^{\delta N} - 1) + 2\delta}, \tag{52}$$

$$A(N) = \frac{\phi_x \sigma_D^M \bar{x}}{\sigma_x^2} (2log(\frac{2\delta}{(\sigma_D^M \sigma_x - \phi_x - \sigma_x + \delta)(e^{\delta N} - 1) + 2\delta}) + (\sigma_D^M \sigma_x - \phi_x - \sigma_x + \delta)N) - rN, \tag{53}$$

and

$$\delta = \sqrt{(\sigma_D^M \sigma_x - \phi_x - \sigma_x)^2 + 2\sigma_x^2}. \tag{54}$$

The instantaneous return of the stock is

$$\frac{dP_t + D_t dt}{P_t} = \left(r + \sqrt{x_t}\left(\sigma_D^M \sqrt{x_t} + \frac{\int_0^{+\infty} e^{gN+A(N)+B(N)x_t} B(N)\sigma_x dN}{\int_0^{+\infty} e^{gN+A(N)+B(N)x_t} dN}\right)\right) dt \tag{55}$$

$$+ \left(\sigma_D^M \sqrt{x_t} + \frac{\int_0^{+\infty} e^{gN+A(N)+B(N)x_t} B(N)\sigma_x dN}{\int_0^{+\infty} e^{gN+A(N)+B(N)x_t} dN}\right) dB_t^M + \sigma_D^Z dB_t^Z. \tag{56}$$

To see Proposition 4, note that $P_t = D_t e^{A(N)+B(N)x_t+C(N)g_t}$ implies that $\frac{\partial P_t}{\partial D_t} = \frac{P_t}{D_t}$, $\frac{\partial P_t}{\partial x_t} = P_t B(N)$, $\frac{\partial P_t}{\partial g_t} = P_t C(N)$, $\frac{\partial P_t}{\partial N} = P_t\left(A'(N) + B'(N)x_t + C'(N)g_t\right)$, $\frac{\partial^2 P_t}{\partial D_t^2} = 0$, $\frac{\partial^2 P_t}{\partial x_t^2} = P_t B^2(N)$, $\frac{\partial^2 P_t}{\partial g_t^2} = P_t C^2(N)$, $\frac{\partial^2 P_t}{\partial D_t \partial x_t} = \frac{P_t}{D_t} B(N)$, $\frac{\partial^2 P_t}{\partial D_t \partial g_t} = \frac{P_t}{D_t} C(N)$, $\frac{\partial^2 P_t}{\partial x_t \partial g_t} = P_t B(N) C(N)$. The pricing kernel implies that,

$$E\left[\frac{dP_t}{P_t}\right] - rdt = -E_t\left[\frac{dP_t}{P_t}\frac{dM_t}{M_t}\right], \tag{57}$$

Using Ito's Lemma, I can derive that, $g_t - (A'(N) + B'(N)x_t + C'(N)g_t) + B(N)\phi_x(\bar{x} - x_t) + C(N)\phi_g(\bar{g} - g_t) + \frac{1}{2}B^2(N)\sigma_x^2 + \frac{1}{2}C^2(N)\sigma_g^2 + B(N)\sigma_D\sigma_x\rho_{Dx} + C(N)\sigma_D\sigma_g\rho_{Dg} + B(N)C(N)\sigma_x\sigma_g\rho_{xg} = r + x_t(\sigma_D\rho_{DM} + B(N)\sigma_x\rho_{xM} + C(N)\sigma_g\rho_{gM})$.

This implies a set of PDEs. $1 - C'(N) - C(N)\phi_g = 0$, $-B'(N) - B(N)\phi_x = \sigma_D\rho_{DM} + B(N)\sigma_x\rho_{xM} + C(N)\sigma_g\rho_{gM}$, and $-A'(N) + B(N)\phi_x\bar{x} + C(N)\phi_g\bar{g} + \frac{1}{2}B^2(N)\sigma_x^2 + \frac{1}{2}C^2(N)\sigma_g^2 + B(N)\sigma_D\sigma_x\rho_{Dx} + C(N)\sigma_D\sigma_g\rho_{Dg} + B(N)C(N)\sigma_x\sigma_g\rho_{xg} = r$. The initial conditions are $A(0) = B(0) = C(0) = 0$.

The solutions are: $C(N) = \frac{1-e^{-\phi_g N}}{\phi_g}$, $B(N) = d_1 + d_2 e^{-\phi_g N} + d_3 e^{-\phi_x^* N}$, where $\phi_x^* = \phi_x + \rho_{xM}\sigma_x$, $d_1 = -\frac{\rho_{gM}\sigma_g + \phi_g\rho_{DM}\sigma_D}{\phi_g\phi_x^*}$, $d_2 = \frac{\rho_{gM}\sigma_g}{\phi_g(\phi_x^* - \phi_g)}$, and $d_3 = \frac{-\rho_{gM}\sigma_g + \rho_{DM}\sigma_D(\phi_x^* - \phi_g)}{\phi_x^*(\phi_x^* - \phi_g)}$. Also, $A(N) = a_0 + a_1 N + a_2 e^{-\phi_g N} + a_3 e^{-\phi_x^* N} + a_4 e^{-2\phi_g N} + a_5 e^{-(\phi_g + \phi_x^*)N} + a_6 e^{-2\phi_x^* N}$, where $a_1 = -r + \bar{g} + \frac{\sigma_g^2}{2\phi_g^2} + \frac{\sigma_D\sigma_g\rho_{Dg}}{\phi_g} + d_1(\phi_x\bar{x} + \sigma_D\sigma_x\rho_{Dx} + \frac{\sigma_x\sigma_g\rho_{xg}}{\phi_g}) + \frac{1}{2}d_1^2\sigma_x^2$, $a_2 = \frac{1}{\phi_g}(\bar{g} - d_2\phi_x\bar{x} - d_1 d_2\sigma_x^2 - d_2\sigma_D\sigma_x\rho_{Dx}) + \frac{1}{\phi_g^2}(\sigma_D\sigma_g\rho_{Dg} + (d_1 - d_2)\sigma_x\sigma_g\rho_{xg}) + \frac{1}{\phi_g^3}\sigma_g^2$, $a_3 = -\frac{d_3}{\phi_x^*}(\phi_x\bar{x} + d_1\sigma_x^2 + \sigma_D\sigma_x\rho_{Dx} + \frac{\sigma_x\sigma_g\rho_{xg}}{\phi_g})$, $a_4 = \frac{1}{4\phi_g}(\frac{2d_2\sigma_x\sigma_g\rho_{xg}}{\phi_g} - d_2^2\sigma_x^2 - \frac{\sigma_g^2}{\phi_g^2})$, $a_5 = \frac{d_3}{\phi_g + \phi_x^*}(\frac{\sigma_x\sigma_g\rho_{xg}}{\phi_g} - d_2\sigma_x^2)$, $a_6 = -\frac{d_3^2\sigma_x^2}{4\phi_x^*}$, and $a_0 = -(a_2 + a_3 + a_4 + a_5 + a_6)$. It is useful to note that $d_1 + d_2 + d_3 = 0$. To prove the proposition, note that when $N = 0$, the expected return is $\mu_R = x_t\sigma_D\rho_{DM}$. When $N = +\infty$, $\mu_R = x_t\left(\sigma_D\rho_{DM} - \frac{\rho_{gM}\sigma_g + \phi_g\rho_{DM}\sigma_D}{\phi_g\phi_x^*}\sigma_x\rho_{xM} + \frac{\sigma_g\rho_{gM}}{\phi_g}\right)$. The regularity conditions include $\phi_x^* > 0$, $\phi_g > 0$, $\sigma_D > 0$, $\sigma_x > 0$, $\sigma_g > 0$, and $\rho_{DM} > 0$.

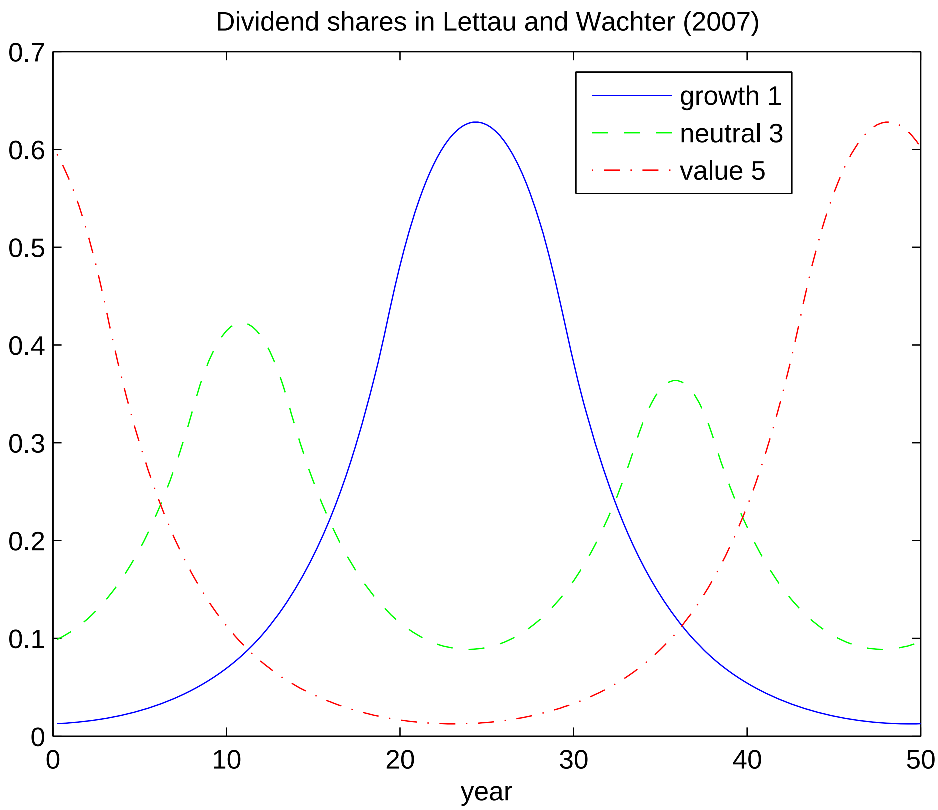

Fig. A1: **Dividend shares in Lettau and Wachter (2007).** This figure plots the dividend shares of quintile buy-and-hold portfolios. It plots the dividend shares of the growth (blue solid line), the neutral (green dashed line), and the value (red dash-dot line) portfolios. The share of the growth quintile increases from 1.30% in the first quarter to 62.52% in the 4th quarter of year 25. The share of the value quintile decreases from 59.49% in the first quarter to 1.40% in the 4th quarter of year 25. The cycle then reverses and repeats itself. This share process is subsequently used in Lettau and Wachter (2011) and Croce, Lettau, and Ludvigson (2010).

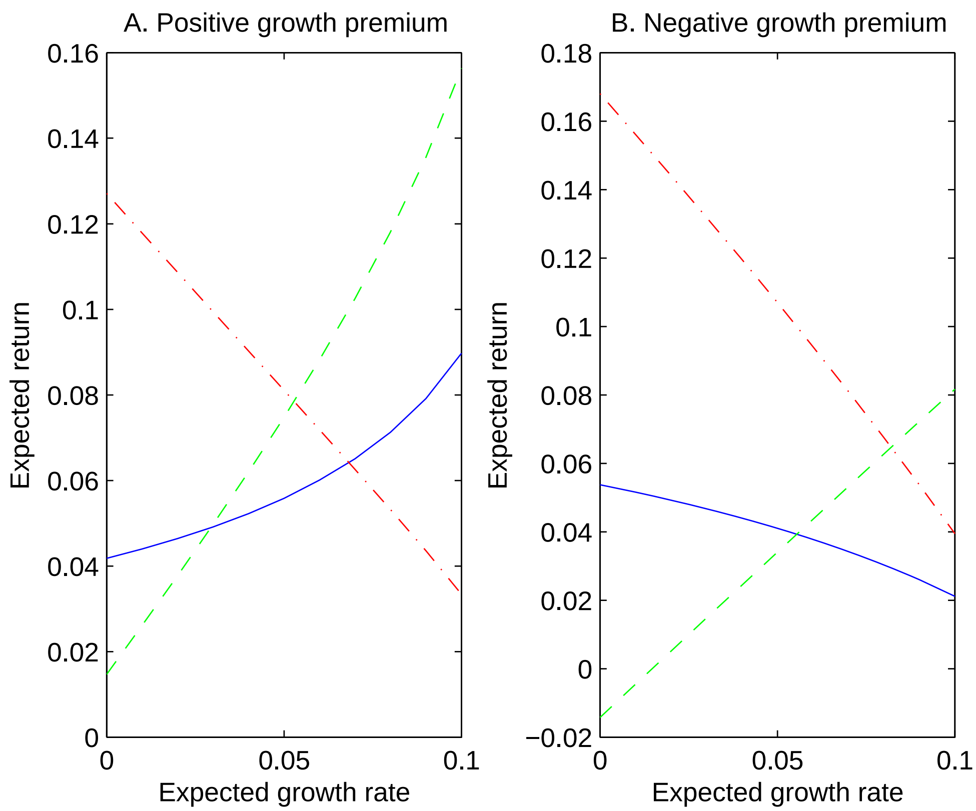

Fig. A2: **Plot of the expected excess return (blue solid line), the expected capital gain (green dashed line), and the dividend yield (red dash-dot line) against the expected dividend growth rate g under Model 1.** In Model 1, the pricing kernel M_t follows $\frac{dM_t}{M_t} = -rdt - x_t dB_t^M$, where x_t, the market price of risk, is mean reverting and follows $\frac{dx_t}{x_t} = \phi_x(\bar{x} - x_t)dt - \sigma_x dB_t^M$. The stock's dividend process is assumed to follow $\frac{dD_t}{D_t} = gdt + \sigma_D^M dB_t^M + \sigma_D^Z dB_t^Z$, where B_t^Z is orthogonal to B_t^M. In Panel A, the market price of risk is countercyclical and there is a positive growth premium. The parameter values used here are: $x_t = 0.3$, $\sigma_D^M = 0.005$, $\phi_x = 5.05$, $\sigma_x = -5$, $\bar{x} = 0.3$, $r = 0.10$. In Panel B, the market price of risk is procyclical and there is a negative growth premium. The parameter values used here are: $x_t = 0.6$, $\sigma_D^M = 0.2$, $\phi_x = 0.01$, $\sigma_x = 0.2$, $\bar{x} = 0.6$, $r = 0.10$.