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Do Cash Flows of Growth Stocks Really Grow Faster?

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ABSTRACT

Contrary to conventional wisdom, growth stocks (i.e., low book-to-market stocks) do not have *substantially* higher future cash-flow growth rates than value stocks, in both rebalanced and buy-and-hold portfolios. Efficiency growth, survivorship and look-back biases, and the rebalancing effect help explain the results. These findings suggest that duration alone is unlikely to explain the value premium.

GROWTH STOCKS, DEFINED AS STOCKS WITH LOW book-to-market ratios, have lower future returns than value stocks with high book-to-market ratios. But do growth stocks have *substantially* higher future cash-flow growth rates and longer cash-flow durations? While this question is interesting in its own right, it is important for the following reason. Several recent papers provide an influential *duration-based explanation* for the value premium (Lettau and Wachter (2007, 2011), Croce, Lettau, and Ludvigson (2010)). This 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 than cash flows of value stocks. This duration-based

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explanation seems promising given that Binsbergen, Brandt, and Koijen (2012) find a downward-sloping term structure of equity in the market portfolio and among the leading asset pricing models that they review, only the model of Lettau and Wachter (2007) generates a downward-sloping term structure.[1] This evidence raises the question of whether the difference between the timing of growth and value stocks' cash flows is sufficient to explain the value premium.

Existing empirical evidence on whether the cash flows of growth stocks grow faster is puzzling. While several authors find that the 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 than value stocks. This view is suggested by the name "growth stocks" and is apparently backed by empirical results.[2] Yet it is puzzling because both buy-and-hold and 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. Rebalanced portfolios tend to be used in empirical asset pricing (e.g., Fama and French (1992)), and are likely to be more homogeneous over time, whereas 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 for buy-and-hold portfolios. I explore both approaches.

My results on cash-flow growth rates are as follows. Consistent with existing studies, I find robust evidence that, in rebalanced portfolios, cash flows of value stocks grow faster than growth stocks. Contrary to conventional wisdom, however, 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 buy-and-hold portfolios. First, in the modern sample period (after 1963), dividends in the growth quintile grow only a little faster than those in the value quintile. The difference in long-run growth rates is about 2% per year, which is substantially smaller than the 19% assumed by duration-based explanations of the value premium. Second, in the early sample period (before 1963), dividends of value stocks grow faster than those of growth stocks, at least in the first 10 years after portfolio formation. The difference is statistically significant at the 10% level. In the full sample period, growth and value stocks have approximately the same dividend growth rates

[1] Giglio, Maggiori, and Stroebel (2015) and Lustig, Stathopoulos, and Verdelhan (2013) find a downward term structure of discount rates in the housing and currency carry trade markets, respectively. Boguth et al. (2012) and Schulz (2016) argue that the results in Binsbergen, Brandt, and Koijen (2012) are driven at least in part by microstructure issues and taxes, respectively.

[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 a longer cash-flow duration, a construct that is related to long-run cash-flow growth rates. For a classic paper on the value premium, see Fama and French (1992). Extant literature shows that rebalanced portfolios of value stocks have higher dividend growth rates (see Ang and Liu (2004), Bansal, Dittmar, and Lundblad (2005), Hansen, Heaton, and Li (2008), Chen, Petkova, and Zhang (2008)).

in buy-and-hold portfolios. Third, in the modern sample period, earnings of value stocks grow faster than those of growth stocks, although the difference is sometimes not statistically significant. 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. When I reconcile the different results between rebalanced and buy-and-hold portfolios, I find that rebalanced growth rates should be higher than buy-and-hold growth rates for value stocks, while the opposite is true for growth stocks, under mild conditions.

The conventional wisdom is widely held for at least four reasons. 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 book-to-market, the coefficients are highly negative, even for dividend growth rates 10 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 these four reasons in turn. 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 lower growth rates than value stocks in rebalanced portfolios.[3] Second, the results in Fama and French (1995) pertain to the behavior of the return on equity, which is relevant for studying the growth rate of book equity, but do not imply that cash-flow growth rates for growth stocks are higher. In fact, back-of-the-envelope calculations suggest that the results in Fama and French (1995) imply that growth stocks have lower earnings growth rates than value stocks initially. Changes in the return on equity (i.e., efficiency growth) help explain this 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.[4] Finally, Dechow, Sloan, and Soliman (2004) and Da (2009) are biased toward finding longer cash-flow durations in growth stocks.

This paper builds on previous work that examines growth rates. Lakonishok, Shleifer, and Vishny (1994) show (in their Table V) that equal-weighted portfolios of extreme growth stocks have higher growth rates in some of the three accounting variables they examine (earnings, accounting cash flow, and sales) over 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 largely been overlooked by the literature. Part of my contribution is to extend their work

[3] 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 cross-sectional evidence on this relation.

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

to provide a more complete picture. I find that their results are not driven purely by small stocks, and that their results hold in value-weighted portfolios as well. I also find that the growth rate in the very short term (i.e., 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 I extend the horizon of the analysis from five years to the infinite future. Novy-Marx (2013) reports evidence in his appendix of a mixed relation between various cash-flow changes (scaled by accounting assets and book equity) and the book-to-market ratio. A contemporaneous working paper by Penman et al. (2015) also finds that value stocks have higher earnings growth rates than growth stocks in year 2. However, neither paper addresses survivorship bias in its analyses.[5] 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. Moreover, unlike these papers, I examine the effects of survivorship and look-back biases. I derive an explicit relation between the growth rates of buy-and-hold and rebalanced portfolios, and I show that rebalanced growth rates should be higher than look-back and buy-and-hold growth rates for value stocks, while the opposite is true for growth stocks, under mild conditions (even in the absence of the value premium) and thereby enrich the explanation put forward by Chen, Petkova, and Zhang (2008). I also provide new results and point out biases in existing studies on cash-flow duration. Most important, I examine the implications of these growth rates for asset pricing models and show that duration alone cannot explain the value premium.

Overall, the evidence in this paper is consistent with the expected cash-flow growth rates of growth stocks being not much higher than those of value stocks. Another possibility is that investors expect higher growth rates for growth firms, but these higher growth rates are not borne out by the data. Sample means may not be good measures of expected growth rates, due to either irrational expectations or rare events (e.g., Pastor and Veronesi (2009)).

The rest of the paper is organized as follows. Section I presents variable definitions and data sources. Section II provides evidence that the cash flows of growth stocks do not grow substantially faster than those of value stocks. Section III sheds light on why the conventional wisdom is so widely held. In doing so, I point out survivorship and look-back biases in common empirical procedures. Section IV reports results on the relation between the growth

[5] Another difference between Novy-Marx (2013) and my paper pertains to the choice of scaling variable. For example, while I essentially examine the earnings growth rate $\frac{E_t - E_{t-1}}{E_{t-1}}$, Novy-Marx (2013) examines $\frac{E_t - E_{t-1}}{B_{t-1}}$, which is equal to $\frac{E_t - E_{t-1}}{E_{t-1}} ROE_{t-1}$. To the extent that growth stocks have a higher return on equity, Novy-Marx's results tend to show relatively higher earnings growth rates for growth stocks.

rates of buy-and-hold and annually rebalanced portfolios. Section V provides results of various robustness tests and additional analyses. Finally, Section VI concludes.

I. Data and Variable Definitions

The data used in my study come from CRSP and Compustat. To construct the sample, I begin with stocks with share codes 10 or 11 that are listed on NYSE, NASDAQ, or Amex. I exclude financials and utilities, as in Da (2009).[6] Returns and market equity (*abs*(*prc*)**shrout*) come from CRSP. Accounting variables come from the Compustat fundamental file (North America). Following Davis, Fama, and French (2000), 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 obtain stockholders' equity as follows. I prefer the stockholders' equity number reported by Moody's (collected by Davis, Fama, and French (2000)) or Compustat (*seq*). If neither is available, then I calculate stockholders' equity as the book value of common equity (*ceq*) plus the book value of preferred stock. Note that 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. I also obtain accounting cash flows (earnings plus depreciation and amortization (*dp*)) and revenues (sale) from Compustat. Firm-level dividends are computed from CRSP by multiplying lagged market equity by the difference between returns with and without dividends. I then cumulate 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 using CRSP. Second, CRSP provides information on 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/1,000). For earnings per share, I use Compustat epspx directly. I employ the CRSP adjustment factor (*cfacpr*) 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. Book-to-market equity uses book equity for the fiscal year ending in calendar year $t-1$. Market equity comes from CRSP and corresponds to December of year $t-1$. The breakpoints are computed using NYSE stocks only, following Davis, Fama, and French (2000).

[6] Table IAXXIX in the Internet Appendix, which may be found in the online version of this article, shows that including financials and utilities makes little difference.

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 −30% if the delisting code is between 400 and 600, and to zero 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 but rather are reinvested in the remainder of the portfolio.

All quantities are expressed in real terms using the Consumer Price Index (CPI), which I obtain from the U.S. Bureau of Labor Statistics. Annual aggregate consumption (nondurables and services) and GDP (both available starting in 1929) come from the Bureau of Economic Analysis.

II. Do the Cash Flows of Growth Stocks Grow Faster Than Those of Value Stocks?

A. 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 (e.g., Bansal, Dittmar, and Lundblad (2005), Hansen, Heaton, and Li (2008)), I focus on cash dividends in the primary analysis and explore repurchases as a robustness check.

A.1. Buy-and-Hold Portfolios

Table I 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.[7]

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

[7] 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 to take the average across portfolio formation years.

Table I

Average Real Dividends in Buy-and-Hold Portfolios for a $100 Investment

In June of each year t between 1926 and 2001, I sort stocks into value-weighted quintile portfolios according to their book-to-market ratio. The breakpoints are computed using NYSE stocks only. Dividends are for a $100 investment at the end of year 0. 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 average 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 $(\frac{D_{10}}{D_1})^{\frac{1}{9}} - 1$.

	Average Dividends ($)					Growth Rates (%)						
Year	Growth 1	2	3	4	Value 5	Growth 1	2	3	4	Value 5	5 − 1	t-Stat
Panel A: Modern Sample Period (Formation Years 1963 to 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	(−2.11)
3	2.22	3.06	3.81	3.96	3.81	4.00	0.94	3.20	1.25	0.18	−3.82	(−1.82)
4	2.29	3.13	3.81	4.06	3.76	3.20	2.18	0.00	2.69	−1.32	−4.52	(−1.96)
5	2.37	3.13	3.96	4.08	3.81	3.52	0.20	4.05	0.34	1.30	−2.22	(−0.94)
6	2.46	3.22	3.97	4.05	3.83	4.00	2.70	0.20	−0.66	0.57	−3.43	(−1.65)
7	2.55	3.30	3.99	4.05	3.99	3.67	2.68	0.58	0.01	4.18	0.51	(0.18)
8	2.66	3.44	4.00	4.14	4.04	4.04	4.04	0.19	2.34	1.22	−2.82	(−1.85)
9	2.77	3.51	4.10	4.19	4.07	4.21	2.10	2.49	1.08	0.82	−3.39	(−1.61)
10	2.89	3.62	4.11	4.35	4.13	4.22	3.32	0.20	3.78	1.46	−2.76	(−1.21)
Arithmetic average						4.01	2.04	1.30	1.15	1.15	−2.86	
t-Stat						(5.54)	(2.32)	(1.90)	(1.56)	(1.78)	(−5.55)	
Geometric average						4.01	2.03	1.29	1.14	1.14	−2.87	
t-Stat						(5.53)	(2.32)	(1.91)	(1.56)	(1.78)	(−5.60)	

(*Continued*)

Table I—*Continued*

	Average Dividends ($)					Growth Rates (%)						
Year	Growth 1	2	3	4	Value 5	Growth 1	2	3	4	Value 5	5 − 1	*t*-Stat
Panel B: Early Sample Period (Formation Years 1926 to 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	(1.86)
3	4.97	5.28	5.55	5.71	4.95	2.67	1.84	3.03	4.89	9.22	6.55	(1.54)
4	5.06	5.41	5.69	5.88	5.41	1.76	2.48	2.51	3.02	9.38	7.61	(1.65)
5	5.15	5.65	5.84	6.13	5.95	1.83	4.31	2.67	4.30	9.88	8.06	(1.63)
6	5.23	5.58	5.92	6.45	6.32	1.46	−1.15	1.39	5.21	6.20	4.75	(1.79)
7	5.31	5.52	5.95	6.53	6.47	1.49	−1.11	0.49	1.22	2.41	0.93	(0.29)
8	5.50	5.72	6.15	6.81	6.82	3.72	3.69	3.30	4.22	5.45	1.72	(0.50)
9	5.70	5.88	6.45	7.12	7.19	3.51	2.68	4.97	4.51	5.39	1.88	(0.45)
10	5.83	6.03	6.64	7.30	7.51	2.42	2.67	3.00	2.52	4.44	2.02	(0.42)
Arithmetic average						2.44	1.79	2.56	4.03	7.26	4.82	
t-Stat						(3.00)	(3.46)	(3.10)	(2.60)	(3.53)	(1.85)	
Geometric average						2.43	1.77	2.56	4.02	7.22	4.78	
t-Stat						(2.99)	(3.53)	(3.10)	(2.61)	(3.55)	(1.85)	

(*Continued*)

Table I—*Continued*

Year	Average Dividends ($)					Growth Rates (%)						
	Growth 1	2	3	4	Value 5	Growth 1	2	3	4	Value 5	5 − 1	t-Stat
Panel C: Full Sample Period (Formation Years 1926 to 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	(1.07)
3	3.56	4.14	4.65	4.81	4.37	3.10	1.50	3.10	3.32	4.98	1.88	(0.64)
4	3.64	4.24	4.72	4.95	4.57	2.22	2.37	1.46	2.88	4.58	2.36	(0.71)
5	3.72	4.36	4.88	5.08	4.85	2.37	2.75	3.24	2.63	6.26	3.88	(1.17)
6	3.81	4.37	4.92	5.22	5.04	2.29	0.27	0.89	2.79	3.93	1.65	(0.79)
7	3.89	4.38	4.95	5.26	5.20	2.21	0.32	0.53	0.74	3.10	0.89	(0.41)
8	4.04	4.55	5.04	5.44	5.40	3.83	3.82	2.01	3.48	3.78	−0.05	(−0.02)
9	4.19	4.66	5.24	5.61	5.59	3.74	2.46	3.96	3.17	3.63	−0.11	(−0.04)
10	4.32	4.80	5.34	5.78	5.78	3.03	2.92	1.87	3.01	3.32	0.30	(0.09)
Arithmetic average						2.95	1.88	2.04	2.81	4.57	1.62	
t-Stat						(4.44)	(4.03)	(3.43)	(2.73)	(3.14)	(0.87)	
Geometric average						2.95	1.87	2.04	2.81	4.56	1.61	
t-Stat						(4.43)	(4.02)	(3.44)	(2.73)	(3.15)	(0.87)	

dividends in this sample period. In year 1, they pay out \$3.73 on average. 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.

The right half of Panel A reports the growth rates of the average dividends. From year 1 to year 2, the average dividends of growth stocks increase by 5.26% (from \$2.03 to \$2.13). This is higher than the growth rate in value stocks of 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 (for year 2 to year 10 period) has almost identical arithmetic averages (e.g., 1.15% for 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 those of value stocks grow at a rate of 1.14%. The difference (value-growth) is −2.87%, which seems relatively small. The t-statistic is −5.60 and therefore statistically significant.

The t-statistics are calculated using the delta method and account for serial correlation as well as cross-correlations. Let $D_{i,t,s}$ denote dividends in year $t+s$ for quintile portfolio i formed in year t. The term $D_{i,s} = \hat{E}_t[D_{i,t,s}]$ is the average dividend in year s for portfolio i. For example, to compute the standard error for $\frac{D_{5,2}}{D_{5,1}} - \frac{D_{1,2}}{D_{1,1}}$, the delta method relies on covariance terms such as $\mathrm{cov}(D_{5,2}, D_{1,1})$. To compute $\mathrm{cov}(D_{5,2}, D_{1,1})$, I take into account the multivariate cross-serial correlations, with a Bartlett kernel of bandwidth $T^{\frac{1}{3}}$, where T is the number of sample periods. Appendix A provides further details on these calculations.

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 to 1962). In the early sample period, value stocks pay less dividends in year 1 than growth stocks (\$4.01 vs. \$4.70) but 10 years later value stocks pay more dividends (\$7.51 vs. \$5.83). In each year between year 2 and year 10, the growth rate of value stocks' average dividends exceeds that of growth stocks. In year 2, the dividends of value stocks grow by 12.98%, dwarfing the 3.07% of growth stocks. The difference, 9.91%, declines substantially over time, however, to 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%, which is statistically significant at the 10% level.

Panel C shows that, over the full sample (1926 to 2001), growth stocks grow at a geometric average of 2.95% per year (from \$3.33 to \$4.32) over 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 number of years since portfolio formation increases, consistent with the idea that growth stocks and value stocks tend to become more alike after initial sorting. The differences in average arithmetic and geometric growth rates are 1.62% and 1.61% per year, respectively, and neither is statistically significantly different from zero. Because average dividends have almost

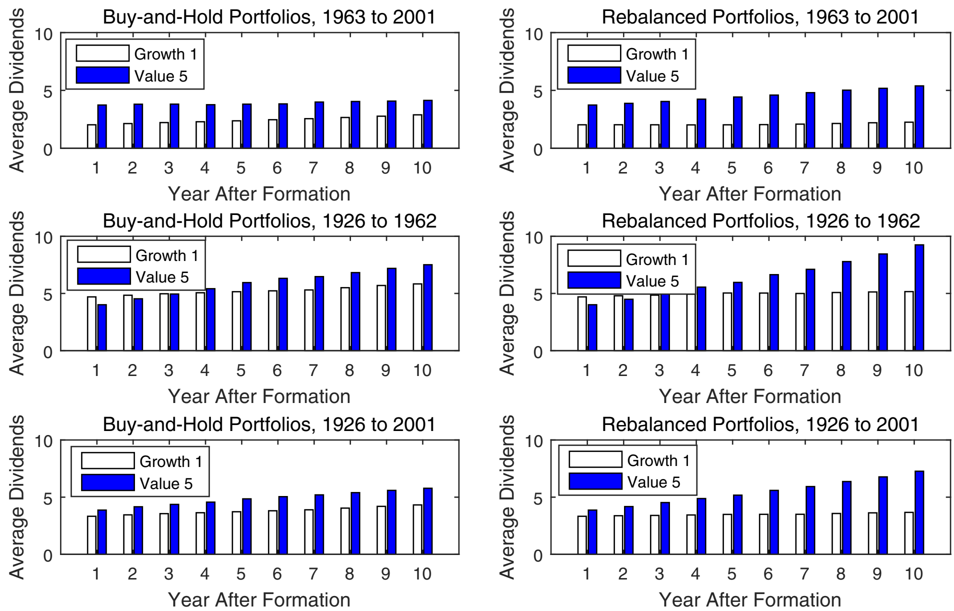

Figure 1. Average dividend for a \$100 investment at the end of year 0. In each year t between 1926 and 2001, I sort stocks into value-weighted quintile portfolios according to their book-to-market ratio. Growth and value portfolios consist of stocks with book-to-market equity in the lowest and highest 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 panels plot average dividends for buy-and-hold portfolios and the right panels for rebalanced portfolios. The top, middle, and bottom panels plot the modern (formation years 1963 to 2001), early (formation years 1926 to 1962), and full (formation years 1926 to 2001) sample periods, respectively. (Color figure can be viewed at wileyonlinelibrary.com)

identical average arithmetic and geometric growth rates, I focus on average geometric growth rates in the remainder of this paper.

The left panels of Figure 1 plot the average dividends of buy-and-hold portfolios over the three sample periods.

A.2. Annually Rebalanced Portfolios

Forming rebalanced portfolios has become second nature for empirical asset pricing researchers. To examine the value premium, 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. Here, I repeat the exercise in Section II.A.1, but now I use rebalanced portfolios. I stress that previous research (e.g., Bansal, Dittmar, and Lundblad (2005) using data after 1967, and Hansen, Heaton, and Li (2008) using data after the World War II) finds that the dividends of rebalanced value portfolios grow faster than those of rebalanced growth portfolios. I report my results based on a longer sample period mainly to compare them against the results for buy-and-hold portfolios.

The results are reported in Table II. Because rebalancing occurs only once a year, average dividends in year 1 are the same across rebalanced and buy-and-hold portfolios. In Panel A (the modern sample period), the average dividends of growth stocks grow from \$2.03 in year 1 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 over the same period, corresponding to a 4.16% annual growth rate. The difference in growth rates is 2.99%, with a t-statistic of 1.37. For the early sample period (Panel B) and the full sample period (Panel C), the difference is 8.68% and 6.17%, with a t-statistic of 3.16 and 3.04, respectively.

These observations can be made from the above results. 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 for 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 the choice of 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 0.3% in year 10, while in rebalanced portfolios the growth rate differential (value-growth) declines only modestly from 6.45% in year 2 to 6.2% in year 10.

The right panels of Figure 1 plot the average dividends of rebalanced portfolios over 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. However, contrary to conventional wisdom, in buy-and-hold portfolios, dividends of growth stocks do not grow much faster than value stocks.

A.3. Long-Run Growth Rates

So far I examine dividends up to 10 years after portfolio formation. I now attempt to characterize the long-run growth rates of dividends into the infinite future. To do so, I use the historical average of dividends over the first T years and assume that beyond year T, cash flows are a perpetuity that grows at the rate of $g_{i\infty}$ per year. I report the results for $T = 20$, but the results are qualitatively the same if I use $T = 10$ or $T = 35$. Motivated by Da (2009), I compute $\bar{g}_i = \sum_{s=2}^{+\infty} \rho^s g_{is} / \sum_{s=2}^{+\infty} \rho^s$, where $\rho = 0.95$ and g_{is} is the growth rate of expected dividends in year s for portfolio i.[8]

[8] 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.

Table II

Average Real Dividends in Annually Rebalanced Portfolios for a $100 Investment

In June of each year t between 1926 and 2001, I sort stocks into value-weighted quintile portfolios according to their book-to-market ratio. The breakpoints are computed using NYSE stocks only. Dividends are for a $100 investment at the end of year 0. 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 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 geometric average growth rate is $(\frac{D_{10}}{D_1})^{\frac{1}{9}} - 1$.

	Average Dividends ($)					Growth Rates (%)						
Year	Growth 1	2	3	4	Value 5	Growth 1	2	3	4	Value 5	5 − 1	t-Stat
Panel A: Modern Sample Period (Formation Years 1963 to 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	(0.95)
3	2.03	3.05	3.74	4.05	4.04	−0.20	0.74	1.06	1.63	4.21	4.41	(1.21)
4	2.02	3.06	3.80	4.15	4.24	−0.44	0.48	1.49	2.33	4.90	5.34	(1.41)
5	2.02	3.09	3.86	4.22	4.43	0.34	0.91	1.82	1.83	4.42	4.08	(1.09)
6	2.04	3.12	3.91	4.28	4.59	0.89	0.97	1.12	1.31	3.78	2.88	(0.78)
7	2.08	3.18	4.01	4.30	4.80	2.04	1.92	2.55	0.42	4.56	2.52	(0.69)
8	2.14	3.25	4.09	4.33	5.02	2.69	2.02	2.15	0.67	4.50	1.81	(0.49)
9	2.20	3.31	4.20	4.34	5.18	2.88	1.94	2.51	0.27	3.15	0.28	(0.07)
10	2.25	3.41	4.28	4.37	5.39	2.24	2.95	1.99	0.68	4.07	1.83	(0.45)
Geometric average						1.18	1.33	1.75	1.20	4.16	2.99	
t-Stat						(1.08)	(1.30)	(2.15)	(1.65)	(2.83)	(1.37)	

(*Continued*)

Table II—*Continued*

	Average Dividends ($)					Growth Rates (%)						
Year	Growth 1	2	3	4	Value 5	Growth 1	2	3	4	Value 5	5 − 1	t-Stat
Panel B: Early Sample Period (Formation Years 1926 to 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	(1.74)
3	4.85	5.31	5.80	5.70	5.04	1.14	2.58	5.08	5.52	12.23	11.09	(1.94)
4	4.94	5.31	6.05	5.97	5.55	1.89	0.06	4.34	4.86	10.21	8.32	(1.78)
5	5.04	5.41	6.32	6.39	5.96	1.94	1.81	4.46	7.03	7.41	5.47	(1.11)
6	5.03	5.37	6.46	6.70	6.64	−0.09	−0.82	2.08	4.86	11.34	11.43	(2.22)
7	5.00	5.36	6.56	6.86	7.11	−0.74	−0.16	1.68	2.41	7.05	7.79	(1.92)
8	5.08	5.44	6.95	7.32	7.79	1.71	1.53	5.82	6.69	9.51	7.80	(1.78)
9	5.13	5.54	7.26	7.90	8.45	0.95	1.92	4.54	7.92	8.56	7.62	(2.12)
10	5.16	5.59	7.57	8.38	9.25	0.60	0.76	4.31	6.05	9.41	8.81	(1.52)
Geometric average						1.05	0.90	4.06	5.63	9.72	8.68	
t-Stat						(1.38)	(1.37)	(4.56)	(4.32)	(4.30)	(3.16)	

(*Continued*)

Table II—*Continued*

Year	Average Dividends ($)					Growth Rates (%)						
	Growth 1	2	3	4	Value 5	Growth 1	2	3	4	Value 5	5 − 1	*t*-Stat
Panel C: Full Sample Period (Formation Years 1926 to 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	(1.72)
3	3.40	4.15	4.74	4.85	4.53	0.73	1.88	3.42	3.82	8.41	7.68	(2.08)
4	3.44	4.16	4.90	5.04	4.88	1.18	0.22	3.19	3.78	7.78	6.60	(2.08)
5	3.49	4.22	5.06	5.28	5.18	1.46	1.47	3.41	4.83	6.08	4.62	(1.41)
6	3.50	4.21	5.15	5.46	5.59	0.20	−0.15	1.70	3.40	8.02	7.82	(2.21)
7	3.50	4.24	5.25	5.55	5.93	0.09	0.63	2.01	1.61	6.00	5.91	(2.14)
8	3.57	4.31	5.48	5.78	6.37	2.01	1.72	4.38	4.29	7.43	5.41	(1.74)
9	3.63	4.40	5.69	6.07	6.77	1.54	1.93	3.77	4.98	6.37	4.83	(1.67)
10	3.67	4.47	5.88	6.32	7.27	1.11	1.60	3.43	4.08	7.32	6.20	(1.48)
Geometric average						1.09	1.07	3.14	3.83	7.26	6.17	
t-Stat						(1.61)	(1.81)	(4.27)	(3.83)	(4.44)	(3.04)	

I calibrate $g_{i\infty}$ as follows. In buy-and-hold portfolios, dividend-price ratios converge substantially over time. I focus first on 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 forecast only 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 forecast only 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 next 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. Finally, I then take the average of the direct and indirect terminal growth rates.

Panel A of Table III reports the steady-state terminal growth rates, $g_{i\infty}$, for the modern sample period. I consider both buy-and-hold and rebalanced portfolios, as well as both value-weighted and equal-weighted portfolios. I find that $g_{i\infty}$ 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.

Panel B reports $\bar{g_i} = \sum_{s=2}^{\infty} \rho^s g_{is} / \sum_{s=2}^{\infty} \rho^s$, $\rho = 0.95$. The results suggest that in buy-and-hold portfolios, growth stocks grow a little faster than value stocks, but in rebalanced portfolios, value stocks clearly have higher cash-flow growth rates.[9]

To put these numbers in perspective, I next examine a common set of assumptions under the duration-based explanation of the value premium. In that setting, dividend shares of extreme individual growth stocks are assumed to grow at 20% over the first 25 years, while dividend shares of extreme

[9] In a seminal paper, Da (2009) proposes measuring a pure cash-flow-based duration as this infinite sum of dividend growth rates. To compute this value, he first uses a log linearization to transform the cash-flow duration into the difference between an infinite sum of *ROE*s and the log dividend-to-book ratio. His finding that growth stocks have longer cash-flow durations is driven primarily by his assumption on the terminal *ROE*s. In particular, he assumes that, beyond year 7, *ROE* is equal to the average *ROE* over the first seven years. Given that Panel A of Figure 2 shows clear convergence of *ROE* over time, this assumption is biased toward finding longer cash-flow durations for growth stocks. There are two 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, and (2) I use simple dividend growth rates, while Da (2009) uses average log dividend growth rates.

Table III

$\overline{\mathbf{g_i}}$

Panels A and B report results for the modern sample period (portfolio formation years 1963 to 1991). Dividends in the first 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. Panel A reports $g_{i\infty}$. In Panel B, $\bar{g_i} = \sum_{s=2}^{\infty} \rho^s g_{is} / \sum_{s=2}^{\infty} \rho^s$, $\rho = 0.95$. BH refers to buy-and-hold portfolios. VW and EW refer to value-weighted and equal-weighted portfolios. In Panel C, the common assumption about growth rates is based on value-weighted buy-and-hold portfolios in the duration-based explanation of the value premium. Panels D and E report $\bar{g_i}$ for the early and full sample periods (corresponding to Panel B of Table V). The early and full sample periods refer to portfolio formation years of 1926 to 1962 and 1926 to 1991, respectively.

	Growth 1	2	3	4	Value 5	5 − 1
			Panel A: $g_{i\infty}$ (%), Modern Sample Period			
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 B: $\bar{g_i}$ (%), Modern Sample Period			
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 C: Common Assumption			
$\bar{g_i}$ (%)	14.06	11.07	7.05	1.09	−4.89	−18.94
			Panel D: $\bar{g_i}$ (%), Early Sample Period			
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 E: $\bar{g_i}$ (%), Full Sample Period			
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

individual value stocks are assumed to shrink at 20% per year over the first 25 years, with the cycle reversing over the next 25 years and then repeating itself thereafter. These assumptions imply that the portfolio of growth stocks also grows substantially faster than the portfolio of value stocks. This share process further implies that the quintile portfolio of growth stocks grows at a rate $\bar{g_i}$ of 14.06% per year, while the quintile portfolio of value stocks grows at a rate of −4.89%. The difference (value-growth) is −18.94% per year. (See Figure IA1 and Section I of the Internet Appendix for more details on these calculations.) These assumptions together imply that $\bar{g}_i$ differs substantially between growth and value stocks, with the difference being around 19% per year, as reported in Panel C. This number is substantially larger than my estimate of 1.98% for the modern sample period. 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 D of Table III reports $\bar{g}_i$ for the early sample period (formation years 1926 to 1962). In value-weighted buy-and-hold portfolios, value stocks have slightly higher $\bar{g}_i$ than growth stocks (3.77% vs. 2.04%). To reconcile the finding in Table I that dividends of value stocks grow much 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 higher $\bar{g}_i$ than growth stocks (9.92% vs. 3.75%). In rebalanced portfolios, as for the modern sample, value stocks have clearly higher $\bar{g}_i$ than growth stocks in both value-weighted (8.38% vs. 1.53%) and equal-weighted (13.81% vs. 0.12%) portfolios. Panel E reports $\bar{g}_i$ for the full sample period (formation years 1926 to 1991). The results for the full sample period are qualitatively the same as those for the early sample period.

Can duration alone explain the value premium? The results suggest that this is unlikely to be the case. First, in the modern sample period, buy-and-hold portfolios of growth stocks grow a little faster than those of value stocks, but the difference is far smaller than assumed under a duration-based explanation. 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 at 1.73% per year) and equal-weighted portfolios (the difference is 6.17% per year), and yet the value premium is even larger than that in the modern sample period.[10]

B. Evidence from Dividend Shares

Section II.A focuses on average dividends and the growth rates of average dividends. To more easily map to time series models of dividends, I now study the behavior of dividend shares.

B.1. Dividend Shares

In Table I, I scale dividends to correspond to a \$100 investment in each portfolio formation year and then average across portfolio formation years. In Table IV, I now scale dividends by total dividends (the sum of dividends in five portfolios). Initial investment is proportional to the market capitalization of

[10] I stress that I do not rule out duration as a partial explanation for the value premium in the modern sample period.

Table IV

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 ratio. 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 $t+s$. The 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	t-Stat
Panel A: Modern Sample Period (Formation Years 1963 to 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	(−1.70)
3	31.67	22.19	19.67	16.96	9.51	1.96	−1.25	0.41	−0.91	−2.59	−4.55	(−2.37)
4	32.21	22.18	19.42	17.02	9.18	1.72	−0.05	−1.30	0.36	−3.54	−5.26	(−2.87)
5	32.70	21.98	19.52	16.75	9.05	1.51	−0.88	0.55	−1.60	−1.36	−2.87	(−1.21)
6	33.22	22.09	19.35	16.38	8.96	1.60	0.50	−0.87	−2.19	−1.05	−2.65	(−1.34)
7	33.79	22.03	19.12	16.01	9.06	1.71	−0.30	−1.22	−2.25	1.16	−0.55	(−0.27)
8	34.28	22.23	18.70	15.85	8.94	1.45	0.93	−2.18	−1.00	−1.31	−2.76	(−1.63)
9	34.79	22.12	18.65	15.57	8.87	1.49	−0.49	−0.26	−1.79	−0.76	−2.25	(−1.36)
10	35.00	22.21	18.22	15.79	8.77	0.62	0.41	−2.31	1.45	−1.15	−1.77	(−1.01)
Geometric Average						1.65	−0.26	−0.95	−1.11	−1.17	−2.82	
t-Stat						(4.07)	(−0.70)	(−2.81)	(−2.54)	(−5.62)	(−6.71)	
Panel B: Early Sample Period (Formation Years 1926 to 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	(0.86)
3	42.89	24.76	17.13	10.31	4.91	0.28	−1.30	−0.27	1.07	2.97	2.69	(0.73)
4	42.52	24.85	17.27	10.21	5.15	−0.87	0.37	0.85	−0.96	4.75	5.61	(1.18)
5	42.37	25.07	17.05	10.13	5.37	−0.35	0.90	−1.28	−0.75	4.38	4.74	(1.19)
6	42.54	24.80	16.92	10.18	5.56	0.40	−1.09	−0.79	0.51	3.47	3.07	(0.96)

(*Continued*)

Table IV—*Continued*

Year	Dividend Shares (%)					Growth Rates of Shares (%)						
	Growth 1	2	3	4	Value 5	Growth 1	2	3	4	Value 5	5 − 1	t-Stat
Panel B: Early Sample Period (Formation Years 1926 to 1962)												
7	42.49	24.79	16.81	10.24	5.67	−0.12	−0.02	−0.65	0.59	1.92	2.04	(0.81)
8	42.51	24.68	16.66	10.41	5.74	0.05	−0.47	−0.91	1.65	1.36	1.31	(0.51)
9	42.60	24.27	16.84	10.54	5.75	0.22	−1.66	1.09	1.21	0.15	−0.07	(−0.03)
10	42.61	24.27	16.94	10.51	5.68	0.01	0.00	0.60	−0.30	−1.32	−1.33	(−0.64)
Geometric Average						0.03	−0.60	−0.33	0.72	2.37	2.34	
t-Stat						(0.05)	(−1.89)	(−0.67)	(0.52)	(1.69)	(1.23)	
Panel C: Full Sample Period (Formation Years 1926 to 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	(−0.16)
3	37.13	23.44	18.43	13.72	7.27	1.01	−1.27	0.11	−0.20	−0.83	−1.84	(−1.00)
4	37.23	23.48	18.37	13.70	7.21	0.26	0.16	−0.33	−0.12	−0.82	−1.08	(−0.46)
5	37.41	23.49	18.32	13.53	7.26	0.47	0.04	−0.29	−1.29	0.63	0.16	(0.07)
6	37.76	23.41	18.17	13.36	7.30	0.94	−0.33	−0.83	−1.21	0.58	−0.36	(−0.20)
7	38.02	23.37	17.99	13.20	7.41	0.70	−0.16	−0.96	−1.19	1.44	0.73	(0.46)
8	38.28	23.42	17.71	13.20	7.38	0.69	0.21	−1.60	0.00	−0.32	−1.01	(−0.65)
9	38.59	23.17	17.77	13.12	7.35	0.80	−1.09	0.35	−0.64	−0.41	−1.22	(−0.87)
10	38.70	23.21	17.60	13.22	7.26	0.29	0.20	−0.97	0.77	−1.21	−1.50	(−1.12)
Geometric Average						0.75	−0.43	−0.66	−0.44	0.04	−0.71	
t-Stat						(1.71)	(−1.68)	(−2.13)	(−0.69)	(0.05)	(−0.68)	

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 adds 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 30.2% to 35%, 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 the −2.87% reported in Table I. The difference is highly statistically significant with a t-statistic of −6.71.

This result does not hold in the early sample period (Panel B). From year 1 to year 10, the average dividend share of growth stocks barely changes from 42.5% to 42.61%, corresponding to an annual growth rate of 0.03%. For value stocks, the share increases from 4.6% to 5.68%, corresponding to a 2.37% growth rate per year. The difference (value-growth) is 2.34% (with a t-statistic of 1.23), which is somewhat smaller than the 4.78% reported in Table I.

The results over the full sample (1926 to 2001) in Panel C are qualitatively the same as, but quantitatively a little different from, those in Table I. While Table I shows that over the full sample period, dividends grow faster in value stocks, Table IV 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 38.7%, corresponding to an annual growth rate of 0.75%. For value stocks, shares are almost constant, going from 7.24% to 7.26%, which corresponds to a grow rate of 0.04% per year. The difference (value-growth) is −0.71%, and again is not statistically significant (with a t-statistic of −0.68). This difference is lower than its counterpart in Table I of 1.61% (t-statistic = 0.87).

To understand the quantitative difference between these two sets of results, I believe the higher cash-flow covariance of value stocks with the aggregate quantity is key. Denote the total dividends to portfolio i (where $i = g$ for growth stocks, $i = v$ for value stocks, and $i = m$ for the total market) in year t by $D_{i,t}$. Thus, while Table I computes $\frac{D_{g,t+1}}{D_{g,t}} - 1$ and $\frac{D_{v,t+1}}{D_{v,t}} - 1$, Table IV computes $\frac{D_{g,t+1}}{D_{g,t}} \times \frac{D_{m,t}}{D_{m,t+1}} - 1$ and $\frac{D_{v,t+1}}{D_{v,t}} \times \frac{D_{m,t}}{D_{m,t+1}} - 1$.

In Table I, the $5 - 1$ difference is basically $E[\frac{D_{v,t+1}}{D_{v,t}} - \frac{D_{g,t+1}}{D_{g,t}}]$, and in Table IV, this becomes $E[(\frac{D_{v,t+1}}{D_{v,t}} - \frac{D_{g,t+1}}{D_{g,t}}) \times \frac{D_{m,t}}{D_{m,t+1}}]$.

Note that $E[XY] = E[X]E[Y] + \text{cov}(X, Y)$. Let $X = \frac{D_{v,t+1}}{D_{v,t}} - \frac{D_{g,t+1}}{D_{g,t}}$ and $Y = \frac{D_{m,t}}{D_{m,t+1}}$, in which case $XY = (\frac{D_{v,t+1}}{D_{v,t}} - \frac{D_{g,t+1}}{D_{g,t}}) \times \frac{D_{m,t}}{D_{m,t+1}}$. Thus, Table I computes $E[X]$, while Table IV computes $E[XY]$. To understand how $E[XY]$ can be negative when $E[X]$ is positive, note that $E[Y]$ is around 0.96, and thus multiplying by $E[Y]$ has little effect. Therefore, cov(X, Y) must be negative, that is, $\frac{D_{v,t+1}}{D_{v,t}} - \frac{D_{g,t+1}}{D_{g,t}}$ must be negatively correlated with $\frac{D_{m,t}}{D_{m,t+1}}$, the inverse of market dividend growth rates. This is consistent with the view and empirical findings that value stocks have a higher cash-flow covariance with the aggregate quantity.

The results in Table IV confirm that dividends of growth stocks do not outgrow those of value stocks substantially.

B.2. Analysis of Dividend Shares in Buy-and-Hold Portfolios

The previous section reports summary statistics for dividend shares in the first 10 years after portfolio formation. But researchers often need to draw inferences on long-run growth rates beyond 10 years. To do so, researchers typically assume that dividend shares follow a mean-reverting process. To facilitate a comparison with existing research, here I estimate AR(1) models based on log dividend shares.[11] These results also provide a robustness check for the results in Section II.A.3. I estimate two versions of the AR(1) model. One version assumes that the logarithm of the share of portfolio dividends relative to total dividends (hereafter dividend share) follows an AR(1) model, while the other assumes that the logarithm of the share of portfolio dividends relative to aggregate consumption (hereafter dividend consumption share) follows an AR(1) model. Table V report the results.

Let $s_{i,t,s}$=ln($S_{i,t,s}$) and denote $s_{i,s}$ by the average of $s_{i,t,s}$ across t. I now estimate

$$s_{i,s} = \phi * s_{i,s-1} + (1-\phi)\bar{s}_i + \epsilon_{i,s}. \quad (1)$$

To make interpretation easier, I let $d_{i,t,s}$ and $d_{m,t,s}$ denote the logarithm of portfolio and total dividends. I then construct the long-run relative growth rate, *lrrgrowth*, according to

$$\frac{\Sigma_{s=2}^{+\infty}\rho^s E[\Delta d_{i,t,s} - \Delta d_{m,t,s}]}{\Sigma_{s=2}^{+\infty}\rho^s} = \frac{(1-\rho)(1-\phi)(\bar{s}_i - s_{i,1})}{1-\rho\phi}. \quad (2)$$

The left-hand side of (2) is basically the log version of the long-run growth rate in Section II.A.3 relative to total consumption growth. The right-hand side uses equation (3) in Da (2009).

I therefore report the long-run relative growth rate $lrrgrowth = \frac{(1-\rho)(1-\phi)(\bar{s}_i - s_{i,1})}{1-\rho\phi}$, where $\rho = 0.95$. Note that the long-run relative growth rate captures the long-run average growth rate *relative* to the benchmark (total dividends or consumption).

The left panel of Table V reports results based on log dividend shares. In the modern sample period (Panel A), the long-run relative growth rate for growth stocks is estimated to be 0.8% per year, and that for value stocks is estimated to be −0.4%. The difference of −1.21% is statistically significant but economically small. In the early sample period (Panel B), the long-run relative growth rate for the dividends of growth stocks is only 0.04%, which is lower than that of value stocks at 3.17%. The difference is statistically significant. In the full sample period (Panel C), these numbers are 0.39% for growth stocks

[11] Santos and Veronesi (2010) present a model where the dividend share follows an AR(1) process in a continuous-time setting.

Table V

AR(1) Model for Average Log Dividend Shares and Average Log Dividend Consumption 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 ratio. 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 $t+s$. The initial investment is proportional to the market capitalization of each portfolio at the end of year 0. I first compute the percentage of dividends, $S_{i,t,s}$, in each portfolio i 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 take the logarithm of shares $s_{i,t,s} = \log(S_{i,t,s})$. I average the log dividend shares, $s_{i,t,s}$, across portfolio formation years t and refer to the average as $s_{i,s}$. I estimate an AR(1) model for average log dividend shares, $s_{i,s} = \phi * s_{i,s-1} + (1-\phi)\bar{s}_i + \epsilon_{i,s}$. The long-run relative growth rate is $lrrgrowth = \frac{(1-\rho)(1-\phi)(\bar{s}_i - s_{i,1})}{1-\rho\phi}$, where $\rho = 0.95$. The right panel reports the AR(1) model for average log shares of portfolio dividends in aggregate consumption. The availability of consumption data starts in 1929. Standard errors are based on Driscoll and Kraay (1998) and account for cross-correlations, autocorrelations, and cross-autocorrelations with a lag of 2.

	Log Dividend Shares				Log Dividend Consumption Shares			
	$s_{i,1}$	ϕ	$\bar{s}_i$	$lrrgrowth$ (%)	$s_{i,1}$	ϕ	$\bar{s}_i$	$lrrgrowth$ (%)
Panel A: Modern Sample Period (Formation Years 1963 to 2001)								
1	−1.26	0.85	−1.06	0.80	−5.02	0.82	−4.92	0.44
2	−1.50	0.85	−1.55	−0.17	−5.26	0.82	−5.38	−0.48
3	−1.66	0.85	−1.76	−0.37	−5.42	0.82	−5.59	−0.66
4	−1.90	0.85	−2.03	−0.50	−5.66	0.82	−5.85	−0.79
5	−2.58	0.85	−2.68	−0.40	−6.33	0.82	−6.51	−0.70
5 − 1				−1.21				−1.14
(p-Value)				(0.000)				(0.000)
Panel B: Early Sample Period (Formation Years 1926 to 1962 (Left Panel) or 1929 to 1962 (Right Panel))								
1	−0.88	0.78	−0.87	0.04	−4.58	0.81	−4.71	−0.52
2	−1.40	0.78	−1.46	−0.29	−5.12	0.81	−5.30	−0.76
3	−1.82	0.78	−1.85	−0.12	−5.57	0.81	−5.67	−0.42
4	−2.46	0.78	−2.33	0.54	−6.21	0.81	−6.15	0.24
5	−3.86	0.78	−3.11	3.17	−7.49	0.81	−6.93	2.32
5 − 1				3.13				2.84
(p-Value)				(0.000)				(0.002)
Panel C: Full Sample Period (Formation Years 1926 to 2001 (Left Panel) or 1929 to 2001 (Right Panel))								
1	−1.08	0.79	−0.98	0.39	−4.82	0.85	−4.81	0.02
2	−1.45	0.79	−1.50	−0.22	−5.20	0.85	−5.36	−0.64
3	−1.74	0.79	−1.79	−0.22	−5.49	0.85	−5.64	−0.60
4	−2.17	0.79	−2.16	0.04	−5.91	0.85	−6.01	−0.37
5	−3.20	0.79	−2.88	1.37	−6.87	0.85	−6.70	0.69
5 − 1				0.98				0.67
(p-Value)				(0.000)				(0.006)

and 1.37% for value stocks. The difference of 0.98% is statistically significant but economically small.

The right panel of Table V repeats the results based on log dividend consumption shares rather than log dividend shares. The long-run relative growth rate for growth stocks is 0.44% and that for value stocks is −0.7%. The difference of −1.14% per year is, again, statistically significant but the economic magnitude is small. In the early and full sample periods, the differences are positive at 2.84% and 0.67% per year, respectively, and both are statistically significant.

Comparing across Tables V and IV, I conclude that the robust finding is that growth stocks do grow faster than value stocks in the modern sample period, but the economic magnitude is small. Growth stocks actually grow more slowly than value stocks in the early sample period. In the full sample period, the results are mixed, and as a first-order approximation, one can view growth and value stocks as having the same growth rates in dividends in buy-and-hold portfolios.

B.3. Long-Horizon Growth Rates of Annually Rebalanced Portfolios

Longer-horizon growth rates are potentially more informative for the long-run trends in dividends. I now report the growth rates for rebalanced portfolios across different horizons. I examine horizons up to 35 years and I focus on the full sample period.

Table VI shows that, at the one-year horizon, the average dividend growth rate of growth stocks is 1.86%, while that of value stocks is 35.41%. The difference is 33.55%. This magnitude is large but the Newey-West (1987) t-statistic with an automatically selected length is only 1.72. As the horizon increases, the t-statistic actually drops to 1.32 at 35 years. Note that these are averages of growth rates, not growth rates of average dividends. Further analysis shows that the relatively low t-statistics are driven by a few positive outliers in the growth rates of value stocks that make the normal distribution a poor approximation of the data. I address the outliers using two methods. Under the first approach, I take the growth rates as given and perform a moving-block bootstrap with an automatically selected length (see Politis and White (2004), Politis, White, and Patton (2009)); the two-sided p-value is highly significant at 0.001 at a horizon of one year and is less than 0.0001 at a horizon of 35 years. These results are reported in the last column of Panel A.

Under the second approach, I winsorize the difference in growth rates at $Q3 + 1.5 * (Q3 - Q1)$ and $Q1 - 1.5 * (Q3 - Q1)$, where $Q1$ and $Q3$ are the 25^{th} and 75^{th} percentiles. Panel B shows that the average winsorized one-year difference is 9.71% with the Newey-West (1987) t-statistic now 2.42. The inferences are the same at other horizons. For example, at the 35-year horizon, the average winsorized difference is 661.51% with a t-statistic of 4.08.

Panel B also reports the growth rates of dividend shares, dividend consumption shares, and log dividends at various horizons for the rebalanced portfolios. Consistent with the results for simple dividend growth rates, value stocks grow faster than growth stocks in annually rebalanced portfolios.

Table VI

Long-Horizon Growth Rates in Dividends (%) of Annually Rebalanced Portfolios in the Full Sample Period

In June of each year t between 1926 and 2010, I sort stocks into value-weighted quintile portfolios according to their book-to-market ratio. The breakpoints are computed using NYSE stocks only. Annual dividends are sums of monthly dividends between July and the following June. Portfolios are subsequently rebalanced at the end of each June. I then compute the share of portfolio dividends in total dividends (sum of five portfolios). Dividends are constructed using CRSP returns (*ret*) and returns without dividends (*retx*). Delisting proceeds are reinvested in the remainder of the portfolio. Panel A reports the simple growth rate in portfolio dividends (D_{it}). t-statistics are from the Newey-West (1987) procedure with an automatically selected number of lags. Two-sided p-values are from a moving-block bootstrap with an automatically selected length. Panel B reports the difference (portfolio 5 − portfolio 1) in winsorized simple growth rates of dividends (D_{it}), dividend shares ($\frac{D_{it}}{D_t}$), dividend consumption shares ($\frac{D_{it}}{C_t}$), and first difference of log dividends ($\ln(D_{it})$). In Panel B, the difference in growth rates is winsorized at $Q3 + 1.5 * (Q3 - Q1)$ and $Q1 - 1.5 * (Q3 - Q1)$, where $Q1$ and $Q3$ are the 25th and 75th percentiles.

Panel A: Simple Growth Rate (%)

Horizon	Growth 1	2	3	4	Value 5	5 − 1	p-Value
1 year	1.86	2.11	4.03	8.07	35.41	33.55	(0.001)
(t-stat)	(1.71)	(2.08)	(4.40)	(2.47)	(1.81)	(1.72)	
2 years	3.86	3.79	8.77	18.29	74.09	70.23	(0.002)
(t-stat)	(1.84)	(1.87)	(3.84)	(1.78)	(1.70)	(1.63)	
5 years	7.47	7.37	19.42	35.16	303.61	296.14	(0.003)
(t-stat)	(1.44)	(1.38)	(2.86)	(1.90)	(1.41)	(1.39)	
10 years	12.34	15.08	34.5	70.81	998.51	986.17	(0.002)
(t-stat)	(1.49)	(1.75)	(3.96)	(2.18)	(1.30)	(1.29)	
20 years	26.11	28.1	83.62	162.13	2359.21	2333.1	(0.000)
(t-stat)	(2.13)	(1.75)	(4.24)	(2.08)	(1.31)	(1.33)	
35 years	26.19	27.47	164.96	408.27	7740.53	7714.34	(0.000)
(t-stat)	(2.75)	(2.14)	(4.65)	(2.06)	(1.31)	(1.32)	

Panel B: Difference (5 − 1) in Winsorized Growth Rates of Various Measures (%)

Horizon	D_{it}	t-Stat	$\frac{D_{it}}{D_t}$	t-Stat	$\frac{D_{it}}{C_t}$	t-Stat	$\ln(D_{it})$	t-Stat
1 year	9.71	(2.42)	8.34	(2.19)	8.10	(1.96)	7.19	(2.00)
2 years	17.84	(2.36)	14.18	(1.82)	16.15	(2.21)	11.45	(1.57)
5 years	42.80	(2.33)	34.04	(1.87)	40.11	(2.48)	29.51	(1.88)
10 years	95.96	(2.75)	69.89	(2.68)	69.58	(2.69)	54.39	(2.65)
20 years	204.90	(3.44)	148.48	(3.18)	100.62	(3.32)	108.51	(3.55)
35 years	661.51	(4.08)	354.31	(3.48)	210.08	(3.84)	184.64	(5.74)

III. Why Is the Conventional Wisdom So Widely Held?

The evidence so far shows that, in rebalanced portfolios, dividends of value stocks grow faster than those of growth stocks. However, contrary to conventional wisdom, in buy-and-hold portfolios, dividends of growth stocks do not grow substantially faster than value stocks. This raises the question of why the conventional wisdom is so widely held. I think the answer is that there are many good reasons to believe the conventional wisdom. In Sections III.A to

III.C, I examine three reasons that seem to support the conventional wisdom and then explain why these do not contradict my findings. In doing so, I also highlight the importance of efficiency growth, survivorship bias, and look-back bias. Unless otherwise stated, I focus on value-weighted buy-and-hold portfolios in this section.

A. Earnings

A.1. Evidence Suggesting Growth Stocks Grow Faster

Fama and French (1995) show that growth stocks have persistently higher returns on equity than value stocks. I update their results in Panel A of Figure 2. In each year t between 1963 and 2001, I first sort stocks into value-weighted quintile portfolios according to their book-to-market ratios. Then, for each portfolio, I look at the return on equity 5 years before and 10 years after portfolio formation. The return on equity in year $t+s$ for a portfolio formed in year t is computed as $ROE_{t+s} = \frac{E_{t+s}}{B_{t+s-1}}$, which I convert to real terms using the CPI.

Portfolio earnings (E) and book equity (B) are the sum of firm earnings and book equity in the given 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 $t+s$.[12] I follow Fama and French (1995) and require that a stock 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 from 1963 to 2001, that is, $ROE_s = E[ROE_{t+s}]$, where taking the expectation means averaging over portfolio formation years t. Because I track a portfolio 5 years before and 10 years after its formation year, I employ accounting information between 1957 and 2011.

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

A.2. Back-of-the-Envelope Calculations

I argue that the results in Fama and French (1995) on return on equity pertain to the growth rates of book equity but not necessarily to those of cash flows.[13] Indeed, I argue that the results in Fama and French (1995) on return on equity imply that the earnings growth rates are initially higher for

[12] 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.

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

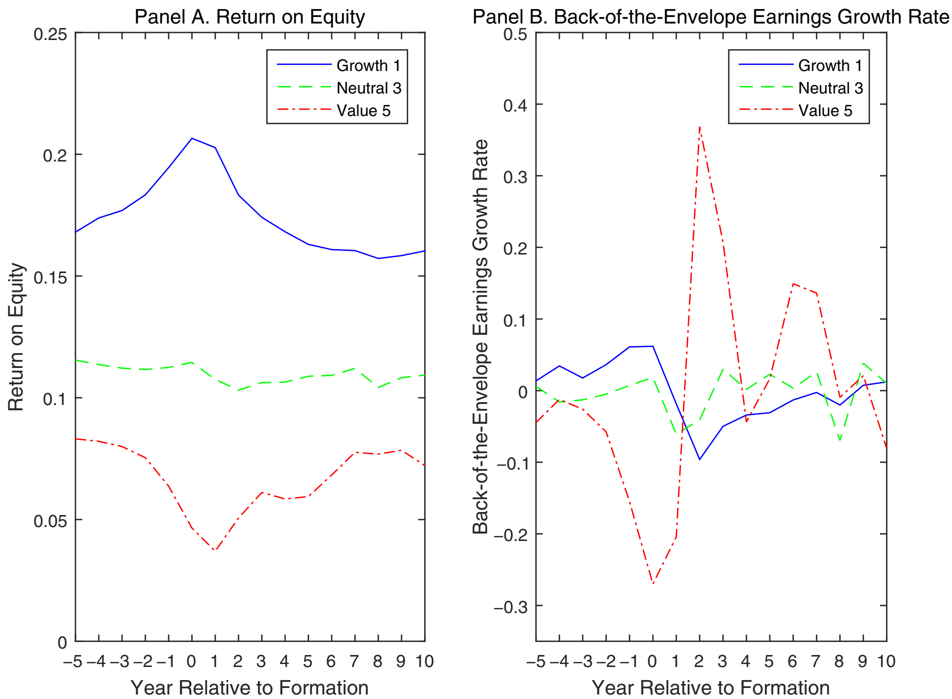

Figure 2. Return on equity and back-of-the-envelope earnings growth rate for buy-and-hold portfolios sorted by book-to-market ratio. In each year t between 1963 and 2001, I sort stocks into value-weighted quintile portfolios according to their book-to-market ratio. Growth, neutral, and value portfolios consist of stocks with book-to-market ratios 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 that a stock 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 back-of-the-envelope earnings growth rates, which are computed based on information in Panel A and the following formula: $\frac{E_s}{E_{s-1}} - 1 = (1-po)ROE_s + (\frac{ROE_s}{ROE_{s-1}} - 1)$, where E_s, ROE_s, and po refer to earnings, return on equity, and the dividend payout ratio, respectively. The quantity po is assumed to be 0.5 in the back-of-the-envelope calculations. (Color figure can be viewed at wileyonlinelibrary.com)

value stocks.[14] Consider the following back-of-the-envelope calculation for the earnings growth rate in year s:

$$\frac{E_s}{E_{s-1}} - 1 = \frac{\frac{E_s}{B_{s-1}}}{\frac{E_{s-1}}{B_{s-2}}} \frac{B_{s-1}}{B_{s-2}} - 1. \tag{3}$$

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

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

$$\frac{E_s}{E_{s-1}} - 1 = (1 - po)ROE_s + \left(\frac{ROE_s}{ROE_{s-1}} - 1\right). \tag{4}$$

The first term on the right-hand side of equation (4), $(1 - po)ROE_s$, is commonly referred to as the sustainable growth rate. The second term, $\frac{ROE_s}{ROE_{s-1}} - 1$, is referred to as efficiency growth. A standard result is that when 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 efficiency growth cannot be ignored.

For value stocks, the sustainable growth rate, $(1 - po)ROE_s$, is lower than that for growth stocks, but the efficiency growth rate, $\frac{ROE_s}{ROE_{s-1}} - 1$, is higher than that for growth stocks. It turns out that 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 $0.183/0.203 + 0.5 * 0.183 - 1 = -0.4\%$.

I plot the back-of-the-envelope calculations in Panel B of Figure 2. Prior to and in the first year after portfolio formation, growth stocks have higher earnings growth rates 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%), but starting in year 4, the earnings growth rates of the three portfolios become more similar.

In the Internet Appendix, 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 differences in the growth rates in these variables are smaller than those in book equity. The results suggest that cash-flow growth can be qualitatively different from firm growth in the presence of efficiency growth (mean-reversion in the return on equity). I speculate that competition is one factor behind the observed efficiency growth.

A.3. Earnings Growth Rates Adjusted for Survivorship Bias

In the analysis above, I require that a firm be alive in year $t + s - 1$ and year $t + s$ 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 $t + s$. Requiring that the firm have a valid data entry in year $t + s$ therefore gives rise to survivorship bias. Suppose that growth stocks (such as Internet firms) tend to become extremely successful (e.g., Google) or die. If we look only at the firms that survive, we may see a picture that is different from investors' actual experiences. As shown in Table IAXVIII, delistings and exits have become pervasive in the modern sample period.

To account for survivorship bias, it is important when computing the growth rate in year $t+s$ that I not look just at the firms that are alive in year $t+s$. Instead, I need to 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 B, I develop a five-step procedure to construct an earnings per share growth rate that accounts for survivorship bias. The key idea is to first construct the price series using *ret* and *retx*. Because CRSP keeps track of delisting, this price series is free of survivorship bias. I then 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 Figure 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 thereafter. In year 0, the earnings for value stocks are \$5.54. This figure declines to \$4.10 in year 1 and rebounds strongly to \$5.98 in year 2.

Panel B of Figure 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 using the back-of-the-envelope calculations in Panel B of Figure 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%).[15] In year 3, the earnings growth rate of value stocks (19.7%) still exceeds that of growth stocks (2.5%), but 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 the Internet Appendix, 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.

[15] The results reported in Table IAXIX in the Internet Appendix show that the difference is not statistically significant (t-statistic = 1.39). Table IAXXV shows that the geometric average growth rate from year 1 to year 10 in the earnings-to-GDP ratio is statistically significantly different between value and growth stocks at the 10% level (t-statistic = 1.67).

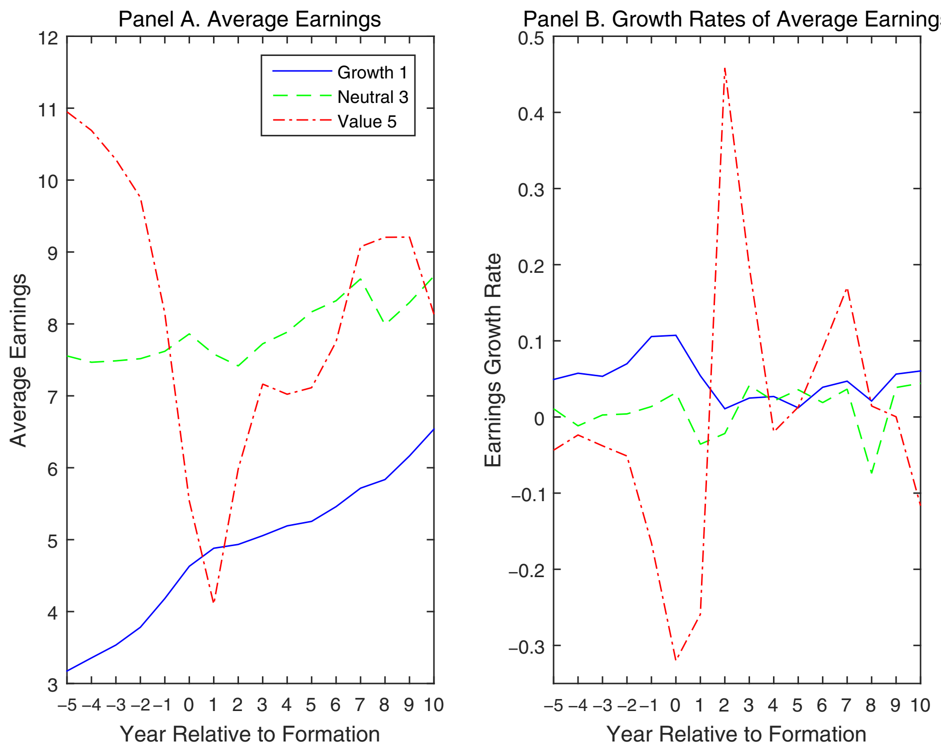

Figure 3. Average earnings for a \$100 investment at the end of year 0 and the earnings growth rate, adjusted for survivorship bias. In each year t between 1963 and 2001, I sort stocks according to their book-to-market ratio. Growth, neutral, and value portfolios consist of stocks with book-to-market ratios 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 from 1963 to 2001. Panel B plots the growth rates for the average earnings. (Color figure can be viewed at wileyonlinelibrary.com)

A.4. The Growth Rate in Year 1 and Look-Back Bias

The analysis above shows that earnings of value stocks significantly outgrow those of growth stocks in years 2 and 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. In the above exercise, the investment of \$100 occurs at the end of year 0. Therefore, the denominator of the growth rate in year 1 corresponds to earnings that accrue between year −1 and year 0, that is, strictly in the past. Cash-flow duration, however, addresses whether future cash flows concentrate more in the near future or the distant future. But the growth rate in year 1 pertains to 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 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.[16]

To illustrate, consider the end of year 0. Suppose that a stock paid out dividends of D_0 over the last year. Next year it will pay D_1, and after that the payouts will be D_2, D_3, D_4, ... Note that D_1, D_2, D_3, D_4,... can all be stochastic. 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 duration should thus be the same for these two stocks, although these two stocks clearly have different growth rates in year 1. I therefore recommend not including the look-back growth rates in estimating the cash-flow duration.

A.5. Negative Earnings in Year 1

Value stocks experience a substantial decline in 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 separately examine firms with positive and negative earnings in year 1. To do so, I look at firms that survive in year 1 and year 2. For each portfolio formation year, I scale real earnings 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.

Table VII reports the results. Panel A considers the 1963 to 2001 sample period. 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.[17] These figures grow to \$5.18 and \$7.47, respectively, in year 2. 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

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

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

Table VII

Positive and Negative Earnings in Buy-and-Hold Portfolios, for a $100 Investment, Not Adjusted for Survivorship Bias

In June of each year t between 1963 and 2009, I sort stocks according to their book-to-market ratio. Growth and value portfolios consist of stocks with book-to-market equity in the lowest and highest quintiles. The breakpoints are computed using NYSE stocks only. Earnings correspond to a $100 investment at the end of year 0. 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 that a stock have data in 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 that firms 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 to 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 to 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

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 results.

In Section III.A.2, I show that, as long as ROE is time-varying, efficiency growth can drive a wedge between book-equity growth and earnings growth. The analysis in this section depicts an extreme case in which this wedge occurs. When firms have negative earnings, a decline in firm size (as measured by book equity) can be good news for earnings if it means that losses in earnings shrink.

B. Firm-Level Dividends and Survivorship Bias

In Table VIII, I provide another piece of evidence that suggests that the 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:

$$\log(D_{i,t}/D_{i,t-1}) = b_0 + b_1 \log(B/M)_{i,t-k} + \epsilon_{i,t}. \tag{5}$$

To do so, I use the Fama-MacBeth (1973) procedure over the period 1965 to 2011, for k between 1 and 10, where $D_{i,t}$ is the dividend from July of year $t-1$ to June of year t computed from CRSP. Variables are winsorized at the 1% and 99% levels each year. Table VIII reports the results. "Years negative" refers to the number of years in which the coefficient b_1 is negative. I report Newey-West (1987) t-statistics with an automatically selected number of lags.

Table VIII shows that book-to-market equity appears to strongly forecast negative dividend growth. When $k = 1$, the coefficient b_1 is negative in 47 of 47 years. The average coefficient is −0.069 and is highly statistically significant. In year 2, the coefficient b_1 is negative in 41 of 47 years, with an average coefficient of −0.042. The coefficient is significantly negative even after 10 years.

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

Table IX shows a different picture from Table VIII. Although the coefficient on 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

Table VIII
Regressions of Firm-Level Dividend Growth Rates on Lagged Book-to-Market Ratios

I follow the Fama-MacBeth (1973) procedure and estimate $\log(D_{i,t}/D_{i,t-1}) = b_0 + b_1 \log(B/M)_{i,t-k} + \epsilon_{i,t}$. Newey-West (1987) t-statistics with an automatically selected number of lags are reported in parentheses. $D_{i,t}$ is the dividend from July of year $t-1$ to June of year t computed from CRSP. Variables are winsorized at the 1% and 99% levels 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	1,198.75	1.86%
	(−8.09)					
2	−0.042	47	41	1965–2011	1,147.62	0.85%
	(−6.14)					
3	−0.030	46	36	1966–2011	1,100.89	0.56%
	(−5.90)					
4	−0.028	45	36	1967–2011	1,053.11	0.44%
	(−5.87)					
5	−0.024	44	33	1968–2011	1,005.71	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)					

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 that regressions are equal weighted in nature. Accounting for survivorship bias is more important in small firms, since large firms are less likely to exit.

It is often argued that growth stocks such as Amazon, Google, and Facebook have grown tremendously. But they have not paid out dividends yet, and that is why I do not observe high dividend growth rates for growth stocks. To examine this issue, I now look at the market capitalization shares of growth versus value portfolios and track them over time.

Table X reports each portfolio's average market capitalization share as a percentage of total market cap (the sum of market cap 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 the market cap in each portfolio as a fraction of total market cap, which adds up to 100% in each year. I then

Table IX

Regressions of Firm-Level Dividend Growth Rates on Lagged Book-to-Market Ratios, Revisited

I follow the Fama-MacBeth (1973) procedure and estimate $\log((D_{i,t} + dl_{i,t})/D_{i,t-1}) = b_0 + b_1 \log(B/M)_{i,t-k} + \epsilon_{i,t}$. Newey-West (1987) t-statistics with an automatically selected number of lags are reported in parentheses. $D_{i,t}$ 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 the 1% and 99% levels 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	1,214.09	0.29%
	(−3.08)					
2	−0.000	47	22	1965–2011	1,162.66	0.22%
	(−0.03)					
3	0.016	46	18	1966–2011	1,115.44	0.15%
	(1.72)					
4	0.021	45	15	1967–2011	1,067.33	0.15%
	(2.26)					
5	0.030	44	13	1968–2011	1,019.41	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)					

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 0 to year 10, the average market cap share of growth stocks decreases from 42.05% to 39.1%, corresponding to an annual growth rate of −0.72%. For value stocks, the share increases from 7.34% to 8%, corresponding to an annual growth rate of 0.86%. The difference (value-growth) of 1.59% per year is not statistically significant with a t-statistic of 1.54.

In the early sample period (Panel B), from year 0 to year 10, the average market cap share of growth stocks increases slightly from 45.07% to 46.97%, corresponding to an annual growth rate of 0.41%. For value stocks, the share increases from 4.92% to 5.09%, corresponding to a 0.34% growth rate per year. The difference (value-growth) is −0.08% with a t-statistic of −0.1.

The results for the full sample (1926 to 2001) are reported in Panel C. From year 0 to year 10, the average market cap share of growth stocks decreases slightly from 43.52% to 42.93%, corresponding to an annual growth rate of

Table X

Average Market Capitalization 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 ratio. The breakpoints are computed using NYSE stocks only. The initial investment is proportional to the market capitalization of each portfolio at the end of year 0. I first compute the percentage of market cap in each portfolio as a fraction of total market cap (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.

	Market Capitalization Shares (%)					Growth Rates of Shares (%)						
Year	Growth 1	2	3	4	Value 5	Growth 1	2	3	4	Value 5	5 − 1	t-Stat
Panel A: Modern Sample Period (Formation Years 1963 to 2001)												
0	42.05	21.90	15.78	12.92	7.34							
1	41.77	21.90	15.87	12.95	7.51	−0.66	−0.04	0.53	0.25	2.34	3.00	(1.47)
2	41.48	21.96	15.92	13.06	7.59	−0.71	0.28	0.35	0.82	0.95	1.66	(0.73)
3	41.30	21.87	15.99	13.19	7.65	−0.41	−0.40	0.40	0.97	0.89	1.31	(0.52)
4	41.04	21.98	16.07	13.10	7.80	−0.63	0.51	0.50	−0.62	1.96	2.59	(1.13)
5	40.67	22.15	15.99	13.26	7.93	−0.91	0.75	−0.46	1.22	1.57	2.48	(1.05)
6	40.31	22.23	16.15	13.33	7.98	−0.88	0.36	1.02	0.47	0.65	1.52	(0.79)
7	39.95	22.28	16.22	13.52	8.04	−0.92	0.22	0.43	1.43	0.76	1.68	(0.86)
8	39.53	22.50	16.31	13.56	8.10	−1.05	1.02	0.52	0.33	0.78	1.83	(0.85)
9	39.32	22.62	16.32	13.69	8.06	−0.53	0.53	0.07	0.92	−0.57	−0.04	(−0.02)
10	39.10	22.85	16.32	13.72	8.00	−0.55	1.02	0.03	0.22	−0.64	−0.10	(−0.05)
Geometric Average						−0.72	0.42	0.34	0.60	0.86	1.59	
t-Stat						(−1.62)	(1.13)	(0.86)	(1.02)	(1.32)	(1.54)	
Panel B: Early Sample Period (Formation Years 1926 to 1962)												
0	45.07	24.47	16.15	9.39	4.92							
1	45.12	24.10	16.21	9.56	5.01	0.11	−1.50	0.37	1.76	1.87	1.76	(0.68)
2	45.00	24.12	16.24	9.64	5.00	−0.25	0.07	0.19	0.80	−0.19	0.06	(0.02)
3	44.91	24.20	16.34	9.61	4.94	−0.21	0.34	0.62	−0.29	−1.20	−0.99	(−0.38)
4	45.02	24.23	16.12	9.61	5.02	0.25	0.10	−1.34	0.02	1.61	1.36	(0.62)

(*Continued*)

Table X—*Continued*

	Market Capitalization Shares (%)					Growth Rates of Shares (%)						
Year	Growth 1	2	3	4	Value 5	Growth 1	2	3	4	Value 5	5 − 1	t-Stat
Panel B: Early Sample Period (Formation Years 1926 to 1962)												
5	45.40	23.80	16.07	9.63	5.11	0.83	−1.78	−0.36	0.21	1.83	0.99	(0.46)
6	45.78	23.33	16.10	9.66	5.13	0.85	−1.97	0.20	0.36	0.29	−0.56	(−0.28)
7	46.11	22.97	16.08	9.68	5.16	0.72	−1.54	−0.13	0.20	0.63	−0.09	(−0.06)
8	46.37	22.99	15.82	9.68	5.14	0.56	0.08	−1.61	−0.02	−0.33	−0.89	(−0.46)
9	46.64	22.92	15.63	9.67	5.14	0.58	−0.28	−1.20	−0.14	−0.02	−0.60	(−0.37)
10	46.97	22.59	15.56	9.79	5.09	0.71	−1.43	−0.47	1.27	−1.04	−1.75	(−0.85)
Geometric Average						0.41	−0.79	−0.38	0.42	0.34	−0.08	
t-Stat						(1.89)	(−2.41)	(−1.37)	(0.59)	(0.56)	(−0.10)	
Panel C: Full Sample Period (Formation Years 1926 to 2001)												
0	43.52	23.15	15.96	11.20	6.16							
1	43.40	22.97	16.03	11.30	6.29	−0.27	−0.79	0.45	0.86	2.15	2.43	(1.60)
2	43.19	23.01	16.08	11.39	6.33	−0.48	0.17	0.27	0.81	0.51	0.99	(0.60)
3	43.06	23.01	16.16	11.44	6.33	−0.31	−0.02	0.51	0.45	0.09	0.40	(0.23)
4	42.98	23.08	16.09	11.40	6.45	−0.18	0.30	−0.41	−0.36	1.83	2.01	(1.30)
5	42.97	22.95	16.03	11.49	6.56	−0.02	−0.54	−0.41	0.80	1.67	1.69	(1.08)
6	42.98	22.76	16.13	11.54	6.59	0.01	−0.81	0.62	0.43	0.51	0.50	(0.38)
7	42.95	22.61	16.15	11.65	6.64	−0.07	−0.66	0.16	0.93	0.71	0.78	(0.59)
8	42.86	22.74	16.07	11.67	6.66	−0.21	0.56	−0.51	0.19	0.36	0.57	(0.38)
9	42.88	22.77	15.98	11.73	6.64	0.06	0.13	−0.54	0.49	−0.36	−0.42	(−0.36)
10	42.93	22.73	15.95	11.81	6.58	0.12	−0.18	−0.21	0.64	−0.79	−0.92	(−0.68)
Geometric Average						−0.14	−0.19	−0.01	0.52	0.66	0.80	
t-Stat						(−0.44)	(−0.58)	(−0.03)	(1.09)	(1.37)	(1.08)	

-0.14%. For value stocks, this share increases slightly from 6.16% to 6.58%, corresponding to a 0.66% growth rate per year. The difference (value-growth) is 0.8% and again is not statistically significant (with a t-statistic of 1.08).

Table X indicates that my main results are unlikely to be driven by growth stocks' particular dividend policy. To reconcile the fact that Amazon, Google, and Facebook have exhibited tremendous growth with my main results, I note that these three firms are the most successful growth firms, but a typical growth firm is far less successful than these three firms. When we examine a broad portfolio's market cap, growth stocks do not appear to grow faster than value stocks. Focusing on the most successful growth firms is thus itself a form of survivorship bias, which likely contributed to the conventional wisdom.

C. 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 the 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, 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 Figure 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 XI reports results 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. The quantity D_1/B_1 equals the average real dividend in year 1 divided by the average real book equity in year 1. In Panel A1, I focus on the modern sample period (1963 to 2001). Sorting on book-to-market clearly results in a large spread in $\frac{B_1}{P_0}$ that ranges from 0.28 (growth) to 1.49 (value). However, $\frac{D_1}{B_1}$ is substantially higher for low book-to-market stocks, at 7.28% for growth stocks versus only 2.5% for 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 to 1991 or the 1963 to 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 (4.7%).

Table XI

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 are 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 return 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.

	Growth 1	2	3	4	Value 5	5 − 1
Panel A1: Formation Years 1963 to 2001						
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 to 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 to 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 to 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

Next, I examine the spread in returns (the value premium). I report the T-year average return 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 is 5.73%, 5.29%, 7.45%, and 10.94% for the 1963 to 2001, 1963 to 1991, 1963 to 1976, and the early sample period, respectively. Note that the value premium exceeds the spread in the dividend-price ratio 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. For the modern sample period, the value premium is 3.9%, 1.95%, and 3.12% for $T = 10$, $T = 20$, and $T = 35$, respectively. At the same time, the spread in the dividend-price ratio is 1.71%, 2.21%, 2.01%, respectively. For the early sample period, the value premium is 5.1%, 3.86%, and 3.31% for $T = 10$, $T = 20$, and $T = 35$, respectively, and 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.

The 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.

IV. The Relation between the 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, dividends of growth stocks grow a little faster than those of 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 that the opposite is true for growth stocks. The intuition is as follows. Consider an 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.

A. Notation

I begin by introducing notation. 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 exposition, 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 can thus buy $\frac{P_{i,t+1}}{P_{j,t+1}}$ shares of stock j. 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

$$g_{t+2} = \frac{D_{j,t+2}\frac{P_{i,t+1}}{P_{j,t+1}}}{D_{i,t+1}} - 1. \tag{6}$$

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

$$g^{BH}_{t,t+s} = \frac{D_{i,t+s}}{D_{i,t+s-1}} - 1, \quad \text{for} \quad s \geq 2. \tag{7}$$

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:

$$g^{LB}_{t,t+1} = \frac{D_{i,t+1}}{D_{i,t}} - 1. \tag{8}$$

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

B. 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, $g_{t+2} \geq g^{LB}_{t+1,t+2}$, because

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

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 will understate 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 rate. For the value portfolio, $g_{t+2} \geq g^{BH}_{t+1,t+2}$ if

$$\frac{D_{j,t+2}}{P_{j,t+1}} \geq \frac{D_{i,t+2}}{P_{i,t+1}}. \tag{10}$$

This is because

$$1 + g_{t+2} = \frac{D_{j,t+2}\frac{P_{i,t+1}}{P_{j,t+1}}}{D_{i,t+1}} = \frac{D_{j,t+2}}{P_{j,t+1}}\frac{P_{i,t+1}}{D_{i,t+1}} \geq \frac{D_{i,t+2}}{P_{i,t+1}}\frac{P_{i,t+1}}{D_{i,t+1}} = \frac{D_{i,t+2}}{D_{i,t+1}} = 1 + g^{BH}_{t,t+2}. \tag{11}$$

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 will understate 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 Section V.F of the Internet Appendix, 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-to-price ratio. But sorting on the book-to-market ratio preserves the rankings in the accounting cash-flow-to-price ratio, the dividend-to-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.

V. Additional Tests

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, $E[\frac{D_s}{D_{s-1}}] - 1$. In both settings, $E[.]$ refers to taking the sample average across portfolio formation years. These two quantities may be different due to Jensen's inequality.

Panel A of Table XII reports results for the modern sample period (formation years 1963 to 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 (value-growth) is −3.57%. The average of the growth rates from year 2 to year 10 is 4.23% for the growth quintile and 2.86% for the value quintile. The difference of −1.37% is statistically significant with a two-sided p-value of 0.049, from a moving-block bootstrap with an automatically selected length. The average cumulative growth rate from year 1 to year 10 is 46.73% for growth stocks and 19.35% for value stocks. The difference is −27.38% and is statistically significant. The winsorized $5 - 1$ difference for the average one-year growth rate is −2.61% and for the nine-year cumulative growth rate is −28.02%, similar to the averages based on the raw data. The Newey-West(1987) t-statistics are −6.08 and −3.89, respectively.

Panel B reports results for the early sample period (formation years 1926 to 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 from year 2 to year 10 is 3.37% for the growth quintile and 38.77% for the value quintile. The difference is 35.4%, with a p-value of 0.16. The average cumulative growth rate from year 1 to year 10 is 27.02% for growth stocks and 1,221.97% for value stocks. The difference is 1,194.95% with a p-value of 0.063. As the Internet Appendix shows, there are outliers in the early sample period. Once I winsorize the outliers at $Q3 + 1.5 * (Q3 - Q1)$ and $Q1 - 1.5 * (Q3 - Q1)$, the difference for the average one-year growth rate is 7.63% and that for the average nine-year growth rate is 130.99%. The Newey-West (1987) t-statistics are 1.69 and 1.76, significant at the 10% level.

Panel C reports the results for the full sample period (formation years 1926 to 2001). 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 from year 2 to year 10 is 3.81% for the growth quintile and 20.34% for the value quintile. The difference is 16.53% and not statistically significant. The average cumulative growth rate from year 1 to year 10 is 37.13% for growth stocks and 604.84% for value stocks. The difference is 567.7% and is not statistically significant. Once I winsorize the outliers, the difference in the average one-year growth rate for the full sample period is 0.71% and that for the

Table XII

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 ratio. 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 refers to the arithmetic average of year 2 to year 10. Cumulative refers to the average cumulative growth rate from year 1 to year 10. Two-sided p-values are from a moving-block bootstrap with an automatically selected length.

Year	Growth 1	2	3	4	Value 5	5 − 1	p-Value	Winsorized 5 − 1	t-Stat
Panel A: Modern Sample Period (Formation Years 1963 to 2001)									
2	5.29	0.62	0.38	0.10	1.72	−3.57	(0.038)	−3.50	(−1.89)
3	4.12	0.82	3.67	1.79	0.29	−3.82	(0.038)	−3.82	(−2.26)
4	3.62	2.51	1.18	2.37	−1.21	−4.83	(0.000)	−4.83	(−2.89)
5	3.89	1.58	3.54	0.55	6.57	2.68	(0.164)	−2.51	(−0.98)
6	4.30	3.44	2.64	0.25	1.94	−2.36	(0.119)	−3.93	(−1.92)
7	4.18	2.46	1.70	0.24	5.62	1.43	(0.744)	−0.74	(−0.38)
8	4.34	3.85	0.84	3.80	2.86	−1.48	(0.220)	−2.45	(−3.80)
9	4.23	2.38	2.34	2.13	4.52	0.29	(0.963)	−0.52	(−0.27)
10	4.08	3.64	1.57	8.57	3.40	−0.68	(0.786)	−1.21	(−0.61)
Average	4.23	2.37	1.99	2.20	2.86	−1.37	(0.049)	−2.61	(−6.08)
t-Stat	(6.01)	(2.77)	(2.37)	(2.08)	(2.08)	(−1.31)			
Cumulative	46.73	23.59	14.54	15.14	19.35	−27.38	(0.000)	−28.02	(−3.89)
t-Stat	(5.09)	(2.29)	(2.14)	(1.70)	(1.77)	(−3.59)			
Panel B: Early Sample Period (Formation Years 1926 to 1962)									
2	3.34	1.34	1.11	12.81	37.61	34.27	(0.002)	16.05	(2.01)
3	3.03	0.98	3.81	10.38	145.43	142.40	(0.063)	15.39	(1.90)
4	2.11	2.79	4.11	7.83	40.66	38.55	(0.058)	11.05	(1.68)
5	2.27	3.01	2.44	3.17	26.78	24.50	(0.107)	7.95	(1.41)
6	2.88	1.23	3.32	9.29	16.91	14.03	(0.057)	8.93	(1.51)

(*Continued*)

Table XII—*Continued*

Year	Growth 1	2	3	4	Value 5	5 − 1	p-Value	Winsorized 5 − 1	t-Stat
Panel B: Early Sample Period (Formation Years 1926 to 1962)									
7	3.46	3.12	2.91	8.01	18.53	15.08	(0.042)	3.21	(0.95)
8	4.40	3.55	3.45	9.44	12.11	7.71	(0.230)	2.33	(0.70)
9	4.68	2.58	5.73	8.31	43.53	38.85	(0.325)	1.43	(0.50)
10	4.13	3.56	3.93	4.55	7.38	3.25	(0.392)	2.29	(0.62)
Average	3.37	2.46	3.42	8.20	38.77	35.40	(0.160)	7.63	(1.69)
t-Stat	(4.23)	(4.12)	(3.32)	(2.64)	(2.14)	(1.91)			
Cumulative	27.02	16.20	26.41	100.23	1,221.97	1,194.95	(0.063)	130.99	(1.76)
t-Stat	(2.49)	(3.44)	(3.67)	(1.64)	(1.38)	(1.34)			
Panel C: Full Sample Period (Formation Years 1926 to 2001)									
2	4.34	0.97	0.74	6.29	19.19	14.85	(0.278)	1.97	(0.82)
3	3.59	0.90	3.74	5.97	70.95	67.36	(0.680)	1.56	(0.53)
4	2.89	2.65	2.61	5.03	19.18	16.29	(0.057)	−0.13	(−0.05)
5	3.10	2.28	3.00	1.82	16.41	13.31	(0.086)	1.85	(0.73)
6	3.61	2.36	2.97	4.65	9.23	5.62	(0.188)	0.52	(0.25)
7	3.83	2.78	2.29	4.02	11.91	8.08	(0.060)	0.52	(0.31)
8	4.37	3.70	2.11	6.54	7.36	2.99	(0.412)	−0.44	(−0.26)
9	4.45	2.48	3.99	5.14	23.51	19.06	(0.389)	0.46	(0.27)
10	4.10	3.60	2.72	6.62	5.34	1.23	(0.809)	0.12	(0.06)
Average	3.81	2.41	2.69	5.12	20.34	16.53	(0.687)	0.71	(0.39)
t-Stat	(6.52)	(4.36)	(3.80)	(2.76)	(1.96)	(1.56)			
Cumulative	37.13	19.99	20.32	56.57	604.84	567.70	(0.738)	2.69	(0.16)
t-Stat	(4.48)	(3.33)	(3.51)	(1.74)	(1.27)	(1.19)			

average nine-year growth rate is 2.69%. The Newey-West (1987) t-statistics are 0.39 and 0.16. Once I winsorize the outliers, there is basically zero difference in the growth rates of value stocks and growth stocks in the buy-and-hold portfolios for the full sample period.

In sum, the results on the winsorized growth rates in this table are similar to those in Table I. 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 sample period. 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. Table XII involves winsorizing the data while Table I uses all actual data without altering them. For this reason, I report the growth rates of average dividends in Table I as the baseline result, and only include Table XII as a robustness check.

In the Internet Appendix, I provide a number of additional robustness checks. The main results are robust to different definitions of growth rates, different cash-flow variables, different scaling variables for earnings, alternative horizons when computing long-run growth rates, and including repurchases as a form of dividends.

VI. Conclusions

Conventional wisdom holds that growth stocks, defined as low book-to-market stocks, have substantially higher future cash-flow growth rates (and therefore 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. Furthermore, in some settings the cash flows of value stocks appear to grow faster. This finding suggests that the duration-based explanation alone is unlikely to resolve the value premium. I also show that efficiency growth, survivorship bias, and look-back bias help explain the difference between my results and conventional wisdom.

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Appendix A: Standard Errors for Growth Rates of Average Dividends

I now provide detailed calculations for the standard errors of each of the following variables. The key is to use the delta method and keep track of serial correlations and cross-correlations. I first introduce notation.

$D_{i,t,s}$: Dividends in year $t+s$ ($s = 1, 2, ..., N$) for quintile portfolio i ($i = 1, 2, ..., 5$) formed in year t ($t = 1, 2, ..., T$).

$\hat{E}_t[D_{i,t,s}]$: Sample mean of dividends in holding year s of quintile portfolio i,

$$\hat{E}_t[D_{i,t,s}] = \frac{1}{T}\sum_t D_{i,t,s}.$$

$S_{(i,s)(j,m)}$: Estimator of asymptotic covariance between $\hat{E}_t[D_{i,t,s}]$ and $\hat{E}_t[D_{j,t,m}]$,

$$\begin{aligned} S_{(i,s)(j,m)} &= \operatorname{cov}\left(\sqrt{T}\left(\hat{E}_t[D_{i,t,s}] - E_t[D_{i,t,s}]\right), \sqrt{T}\left(\hat{E}_t[D_{j,t,m}] - E_t[D_{j,t,m}]\right)\right) \\ &= T * \operatorname{cov}\left(\hat{E}_t[D_{i,t,s}], \hat{E}_t[D_{j,t,m}]\right). \end{aligned}$$

$S_{(i,s)(j,m)}$ takes into account autocorrelation up to lag k across t. In implementation, I use $k = round(T^{\frac{1}{3}})$:

$$S_{(i,s)(j,m)} = \sum_{l=-k}^{k} w\left(\frac{l}{k+1}\right)\hat{\Gamma}_{(i,s)(j,m)}(l),$$

where

$$\hat{\Gamma}_{(i,s)(j,m)}(l) = \hat{E}_t[u_{i,t,s}u_{j,t-l,m}],$$

$$u_{i,t,s} = D_{i,t,s} - \hat{E}_t[D_{i,t,s}],$$

and

$$w\left(\frac{l}{k+1}\right) = 1 - \left|\frac{l}{k+1}\right|.$$

The population mean of S is given as

$$E_t[S_{(i,s)(j,m)}] = \sum_{l=-\infty}^{\infty} \Gamma_{(i,s)(j,m)}(l).$$

(1) $\hat{g}_{i,s}$: The growth rate of the average dividend of portfolio i in year s,

$$\hat{g}_{i,s} = \frac{\hat{E}_t[D_{i,t,s}]}{\hat{E}_t[D_{i,t,s-1}]} - 1 = f\left(\hat{E}_t[D_{i,t,s}], \hat{E}_t[D_{i,t,s-1}]\right)$$

$$\approx f\left(E_t[D_{i,t,s}], E_t[D_{i,t,s-1}]\right) + f_1(i,s)\left(\hat{E}_t[D_{i,t,s}] - E_t[D_{i,t,s}]\right)$$

$$+\ f_2(i,s)\left(\hat{E}_t[D_{i,t,s-1}] - E_t[D_{i,t,s-1}]\right),$$

where f_1 is the derivative with respect to the first argument of f and f_2 is the derivative with respect to the second argument of f.
Taking derivatives yields $f_1(i,s) = \frac{1}{\hat{E}_t[D_{i,t,s-1}]}$ and $f_2(i,s) = -\frac{\hat{E}_t[D_{i,t,s}]}{(\hat{E}_t[D_{i,t,s-1}])^2}$.
Using the delta method,

$$\begin{aligned} \operatorname{var}(\hat{g}_{i,s}) = \frac{1}{T}(&f_1(i,s)f_1(i,s)S_{(i,s)(i,s)} + f_2(i,s)f_2(i,s)S_{(i,s-1)(i,s-1)} \\ &+ 2f_1(i,s)f_2(i,s)S_{(i,s)(i,s-1)}), \end{aligned} \tag{A1}$$

and

$$s.e.(\hat{g}_{i,s}) = \sqrt{\mathrm{var}(\hat{g}_{i,s})}.$$

(2) $\hat{g}_{5,s} - \hat{g}_{1,s}$: The difference in the growth rates of average dividends in year s between the value (5) and growth (1) quintiles,

$$\hat{g}_{5,s} - \hat{g}_{1,s} = \frac{\hat{E}_t[D_{5,t,s}]}{\hat{E}_t[D_{5,t,s-1}]} - \frac{\hat{E}_t[D_{1,t,s}]}{\hat{E}_t[D_{1,t,s-1}]},$$

$$\mathrm{var}(\hat{g}_{5,s} - \hat{g}_{1,s}) = \mathrm{var}(\hat{g}_{5,s}) + \mathrm{var}(\hat{g}_{1,s}) - 2\mathrm{cov}(\hat{g}_{5,s}, \hat{g}_{1,s}).$$

Note that $\mathrm{var}(\hat{g}_{5,s})$ and $\mathrm{var}(\hat{g}_{1,s})$ can be computed from equation (A1), and $\mathrm{cov}(\hat{g}_{5,s}, \hat{g}_{1,s})$ can be computed from

$$\mathrm{cov}(\hat{g}_{5,s}, \hat{g}_{1,s}) = \frac{1}{T}(f_1(5,s)f_1(1,s)S_{(5,s)(1,s)} + f_1(5,s)f_2(1,s)S_{(5,s)(1,s-1)} + f_2(5,s)f_1(1,s)S_{(5,s-1)(1,s)} + f_2(5,s)f_2(1,s)S_{(5,s-1)(1,s-1)}).$$

(3) $\hat{g}_i$: The average growth rate of the average dividends of quintile portfolio i,

$$\hat{g}_i = \frac{1}{N}\sum_s \hat{g}_{i,s},$$

$$\mathrm{var}(\hat{g}_i) = \mathrm{var}\left(\frac{1}{N}\sum_s \hat{g}_{i,s}\right) = \frac{1}{N^2}\sum_{s,m}\mathrm{cov}(\hat{g}_{i,s}, \hat{g}_{i,m}), \tag{A2}$$

where

$$\mathrm{cov}(\hat{g}_{i,s}, \hat{g}_{i,m}) = \frac{1}{T}(f_1(i,s)f_1(i,m)S_{(i,s)(i,m)} + f_1(i,s)f_2(i,m)S_{(i,s)(i,m-1)} + f_2(i,s)f_1(i,m)S_{(i,s-1)(i,m)} + f_2(i,s)f_2(i,m)S_{(i,s-1)(i,m-1)}).$$

It should be noted that we allow all possible correlations between the different holding years s and m. This is different from autocorrelation along the dimension of portfolio formation year t.

(4) $\hat{g}_5 - \hat{g}_1$: The difference in the average growth rates of average dividends between value (5) and growth (1) quintiles,

$$\hat{g}_5 - \hat{g}_1 = \frac{1}{N}\sum_s(\hat{g}_{5,s} - \hat{g}_{1,s}),$$

$$\mathrm{var}(\hat{g}_5 - \hat{g}_1) = \mathrm{var}(\hat{g}_5) + \mathrm{var}(\hat{g}_1) - 2\mathrm{cov}(\hat{g}_5, \hat{g}_1),$$

where $\text{var}(\hat{g}_5)$ and $\text{var}(\hat{g}_1)$ can be computed from equation (A2), and $\text{cov}(\hat{g}_5, \hat{g}_1)$ can be computed from

$$\text{cov}\left(\hat{g}_5, \hat{g}_1\right) = \text{cov}\left(\frac{1}{N}\sum_s \hat{g}_{5,s}, \frac{1}{N}\sum_m \hat{g}_{1,m}\right) = \frac{1}{N^2}\sum_{s,m} \text{cov}\left(\hat{g}_{5,s}, \hat{g}_{1,m}\right),$$

where

$$\text{cov}\left(\hat{g}_{5,s}, \hat{g}_{1,m}\right) = \frac{1}{T}\big(f_1(5,s)f_1(1,m)S_{(5,s)(1,m)} + f_1(5,s)f_2(1,m)S_{(5,s)(1,m-1)} + f_2(5,s)f_1(1,m)S_{(5,s-1)(1,m)} + f_2(5,s)f_2(1,m)S_{(5,s-1)(1,m-1)}\big).$$

(5) $\tilde{g}_i$: The geometric average growth rate of average dividends of quintile portfolio i,

$$\tilde{g}_i = \left(\frac{\hat{E}_t[D_{i,t,10}]}{\hat{E}_t[D_{i,t,1}]}\right)^{\frac{1}{9}} - 1 = h\left(\hat{E}_t[D_{i,t,10}], \hat{E}_t[D_{i,t,1}]\right),$$

$$\text{var}(\tilde{g}_i) = \frac{1}{T}(h_1(i)h_1(i)S_{(i,10)(i,10)} + h_2(i)h_2(i)S_{(i,1)(i,1)} + 2h_1(i)h_2(i)S_{(i,10)(i,1)}), \tag{A3}$$

where h_1 is the derivative with respect to the first argument of h, and h_2 is the derivative with respect to the second argument of h:

$$h_1(i) = \frac{1}{9}\left(\frac{\hat{E}_t[D_{i,t,10}]}{\hat{E}_t[D_{i,t,1}]}\right)^{-\frac{8}{9}} \frac{1}{\hat{E}_t[D_{i,t,1}]},$$

$$h_2(i) = \frac{1}{9}\left(\frac{\hat{E}_t[D_{i,t,10}]}{\hat{E}_t[D_{i,t,1}]}\right)^{-\frac{8}{9}} \left(-\frac{\hat{E}_t[D_{i,t,10}]}{\hat{E}_t[D_{i,t,1}]^2}\right).$$

(6) $\tilde{g}_5 - \tilde{g}_1$: The difference in the geometric average growth rates of average dividends between quintile 5 and quintile 1 portfolios,

$$\text{var}(\tilde{g}_5 - \tilde{g}_1) = \text{var}(\tilde{g}_5) + \text{var}(\tilde{g}_1) - 2\text{cov}(\tilde{g}_5, \tilde{g}_1),$$

where $\text{var}(\tilde{g}_5)$ and $\text{var}(\tilde{g}_1)$ can be computed from equation (A3), and $\text{cov}(\tilde{g}_5, \tilde{g}_1)$ can be computed from

$$\text{cov}(\tilde{g}_5, \tilde{g}_1) = \frac{1}{T}(h_1(5)h_1(1)S_{(5,10)(1,10)} + h_1(5)h_2(1)S_{(5,10)(1,1)} + h_2(5)h_1(1)S_{(5,1)(1,10)} + h_2(5)h_2(1)S_{(5,1)(1,1)}).$$

In most tables in the paper, I only report t-statistics for the difference between value and growth stocks. Table IAXVII in the Internet Appendix reports detailed t-statistics for all quantities reported in Table I in the paper.

Appendix B: Portfolio Growth Rates Adjusted for Survivorship Bias

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

Step 1: Compute the fundamental-to-price ratio in year $t+s$, FP_{t+s}, for a portfolio formed in year t, as the value-weighted average of the ratio of firm fundamental per share to price per share, $\frac{Fps_{t+s}}{Pps_{t+s-1}}$. 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.[18]

Step 2: 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: After obtaining the return series, compute the price series for any given amount of investment in an early year, say, \$1 investment in year $t-7$, as follows: $P_{t-7} = 1$ and

$$P_{t+s} = P_{t+s-1}(1 + retx_{t+s}). \tag{B1}$$

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

Step 5: Scale the accounting variable to correspond to a \$1 investment in portfolio formation year t, $\tilde{F}^{SA}_{t+s} = \frac{F^{SA}_{t+s}}{P_t}$. Then convert variables to year 0 real dollars using the CPI. Next, average across portfolio formation years before computing the growth rate, $g^F_s = \frac{E[\tilde{F}_{t+s}]}{E[\tilde{F}_{t+s-1}]} - 1$.

If no firm ever exits the portfolio, then this procedure should yield the same value as the simple growth rates in Table VII and Section III.A.5. 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 also accounts for delisting proceeds because when computing returns, we implicitly assume that proceeds are reinvested when firms exit the portfolio.

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[18] 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.

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Supporting Information

Additional Supporting Information may be found in the online version of this article at the publisher's website:

Appendix S1: Internet Appendix.