Equity duration and predictability

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This version: January 9, 2020

Abstract

One of the most puzzling findings in asset pricing is that expected returns dominate variation in the dividend-to-price ratio, leaving little room for dividend growth rates. Even more puzzling is that this dominance only emerged after 1945. We develop a present value model to argue that a general increase in equity duration can explain these findings. As cash flows to investors accrue further into the future, shocks to highly persistent expected returns become relatively more important than shocks to growth rates. We provide supportive empirical evidence from dividend strips, the time-series, and the cross-section of stocks.

Key words: Duration, dividend-to-price ratio, return predictability, dividend growth predictability
JEL classification: G12, G17, N2

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*We thank John Campbell, Zhi Da, Hanno Lustig, Stijn van Nieuwerburgh, and seminar participants at the University of Notre Dame for comments and suggestions. All errors are our own.

1 Introduction

Basic economic intuition suggests that changes in expected cash flows, and in particular dividends, should play an important role for equity price movements. Yet, the estimation of classic present value models indicates that changes in expected returns dominate, and that dividend growth rates play only a minor role.[1] This is a puzzling finding – it suggests that the main driver for price movements are not changes in companies' fundamentals, but rather changes in investors' risk appetite (Cochrane, 2011) or "animal spirits" (Keynes, 1936, Shiller, 1981).

Even more puzzling is that this finding only holds in recent (post-1945) U.S. data (which is most frequently analyzed in the literature). If one goes back in time, dividends play a much more prominent role. For example, Golez and Koudijs (2018) show that over the last four centuries, from the beginning of modern stock markets in early 17th century Amsterdam until today, expected returns and dividend growth rates have been equally important, with the dominance of expected return only emerging after 1945.[2] This seems counter-intuitive. Presumably, in today's world, investors are better able to diversify and transfer risk than in any other time period, and to better understand the market. This would suggest that expected returns should be relatively less important in recent decades, not more. The fact that companies today are using alternative forms of payouts such as share repurchases does not explain this puzzle – the dominance of expected returns pre-dates the general use of repurchases, which only starts after 1981.[3]

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[1] See, for example, Campbell and Shiller (1988a), Cochrane (1992), Lettau and Van Nieuwerburgh (2008), and Binsbergen and Koijen (2010).

[2] Schwert (2003), Goyal and Welch (2003), and Chen (2009) provide similar evidence using U.S. stock market data starting in 1870.

[3] Firms only started to repurchase shares on a quantitatively important scale after the SEC changed its rules on manipulative trading in 1982 (Fama and French 2001, Grullon and Michaely 2002, Boudoukh, Michaely, Richardson, and Roberts 2007).

In this paper, we argue that these puzzling empirical facts can be explained by an increase in the duration of equity markets after 1945. While firms' average payout ratio (dividends over earnings) was close to one before 1945, it has dropped to around 40% in recent decades. As firms started to reinvest more of their earnings (or keep them on balance sheet in the form of cash), payouts to investors have been pushed into the future. As a result, investors today receive a majority of their returns in the form of capital appreciation. The market's dividend-to-price ratio has fallen and dividend growth rates have increased. All this implies that the *duration of the equity market* has increased.

An increase in equity duration means that shocks to both expected returns and dividend growth rates have a larger impact on prices. Which effect dominates depends on the persistence of each shock. There is substantial evidence in the literature that expected returns are more persistent. Estimates suggest a persistence of expected returns close to 0.9, while shocks to dividend growth rates rarely exhibit persistence larger than 0.5.[4] As a result, an increase in equity duration increases the relative importance of expected returns. Hence, the dominance of expected returns in the recent period can be seen as a natural consequence of increased equity duration.

We formalize our argument with a simple theoretical framework that builds on the standard Campbell and Shiller (1988) present value model in which we introduce AR(1) processes for expected returns and growth rates. Our main innovation is that we extend this setup by incorporating equity duration. We assume that firm value does not depend on payout policy (Modigliani and Miller 1961) and think of an increase in duration as a decrease in the payout ratio.

[4] Binsbergen and Koijen (2010), Koijen and Van Nieuwerburgh (2011), Golez (2014) and Trojani and Piatti (2017). Fama and French (1989) already observed that that fluctuations in expected returns persist beyond the business cycle and capture changes in long-term business conditions (e.g. Great Depression vs post-war boom), while changes in expected dividend growth rates seem much more aligned with business cycle. Greenwood and Shleifer (2014) show that *subjective* expected returns (inferred from survey evidence) are highly persistent. In fact, in the data analyzed by De la O and Meyers (2019), subjective expectations are more persistent for returns than for dividend growth rates (we thank Ricardo de la O for providing us with this information).

Within this framework, we analyze, both analytically and in simulations, how a change in equity duration affects the relative impact of expected returns and growth rates. As in Binsbergen and Koijen (2010), the relative impact depends on the persistence of shocks to expected returns and growth rates. The main new insight from our framework is that an increase in equity duration increases the relative impact of the more persistent expected return shock. In simulations, we also match several other empirical regularities, such as a higher persistence of the dividend-to-price ratio and higher volatility of returns for longer-duration assets.

We provide three pieces of empirical evidence in support of this framework. First, we analyze a simple case where duration plays an unambiguous role: dividend strips on the stock market. These derivative assets are a claim on the market's aggregate dividends payment over a period of approximately one-and-a-half years. As such, they are a short duration version of the market itself. Consistent with our argument, we find that the relative contribution of expected returns to stock price variation is substantially smaller for dividend strips than for the market. Second, we carefully analyze the historical time series since the early 17th century. We show that the payout ratio of firms was significantly lower after 1945 than before. We show that the drop in the payout ratio is contemporaneous to the increased role of expected returns. Third, we look at the cross-section of U.S. stocks since 1945. We sort firms into portfolios according to their payout ratios. Consistent with our argument, we show that the relative contribution of expected returns falls with the payout ratio.

Throughout the paper, we follow most of the literature and focus on cash dividends as the most important form of cash flows to investors. Dividends have remained a large and important form of payout even with the rise of repurchases after 1981. The percentage of public firms paying dividends today is roughly equal to that in 1981 (De la O 2019). Moreover, Brav, Graham, Harvey, and Michaely (2005) and De la O (2019) show that firms typically use dividends to pay out permanent earnings, while repurchases are used to pay out transitory shocks. Stock prices should be most sensitive to changes in permanent earnings. This implies that, from an asset pricing point of view, dividends are the most relevant form of payout. In robustness tests we do consider repurchases (Boudoukh, Michaely, Richardson, and Roberts, 2007 and Larrain and Yogo, 2008), in particular when we calculate payout ratios for individual firms. We obtain qualitatively similar results.

Related literature. Our paper fits into a fast growing literature that analyzes the implications of duration for asset pricing in general. Binsbergen, Brandt, and Koijen (2012), Binsbergen, Hueskes, Koijen and Vrugt (2013), Binsbergen and Koijen (2017), Gormsen (2019), and Bansal, Miller, Song and Yaron (2019) link the duration of equity claims to their expected returns, showing that there is a (time-varying) equity term structure. Dechow, Sloan and Soliman (2004), Lettau and Wachter (2007), Da (2009), Weber (2018), Gormsen and Lazarus (2019), Chen and Li (2019), Gonçalves (2019), and Li and Wang (2019) use the duration of individual stocks to explain cross-sectional differences in returns. In comparison, our paper has a different objective. We abstract away from the term structure of returns and use duration to explain the relative predictability of returns and growth rates.

We contribute to a large (and by now well established) literature on return and dividend growth predictability (see Cochrane 2011 and Koijen and Van Nieuwerburgh 2011 for overviews). Our key contribution to this literature is that we provide a formalized framework to think through the relative importance of expected returns and dividend growth rates. With this framework, we can explain the puzzling fact that expected returns became much more important after 1945, and can shed light on the cross-sectional variation that exists in the relative importance of expected returns and dividend growth rates (Maio and Santa-Clara 2015).

Our paper is related to other work that tries to explain variation in the relative predictability of returns and growth rates. Menzley, Santos and Veronesi (2004) and Lettau and Ludwigson (2005) note that, if shocks to expected returns and dividend growth rates are positively correlated, the dividend-to-price ratio might fail to predict either returns or growth rates.[5] Binsbergen and Koijen (2010) emphasize the importance of the persistence of shocks for the variance decomposition. In our work, we keep the correlation and persistence of shocks constant, but vary the duration of cash flows. We show that the dividend-to-price ratio predicts returns in both high- and low-duration environments, whereas growth rates are only predictable when duration is low.

Chen, Da, and Priestley (2012) argue that the limited contribution of expected dividend growth rates in the recent (post-1945) period can be explained by excessive dividend smoothing. Dividend smoothing is complementary to our framework. In fact, the lower the payout ratio, the easier it will be for firms to smooth dividends over time. Nevertheless, while dividend smoothing might be able to explain the patterns in the time series, it cannot explain our findings for dividend strips. Since strips are claims on dividends paid out by the market, they are sensitive to smoothing in exactly the same way as the market itself. Moreover, in the cross-section we find that dividend smoothing is relatively constant in our duration-sorted portfolios, or at least does not vary in a way that could explain our results.

Another strand in the literature tries to reconcile the puzzling predictability facts by introducing subjective beliefs inferred from surveys and analysts' forecasts (Chen, Da, and Zhao 2013, Greenwood and Shleifer 2014). De la O and Meyers (2019) provide evidence that the

[5] Binsbergen, Hueskes, Koijen, and Vrugt (2013) and Li and Wang (2019) show that dividend growth is predictable by a combination of equity yields with different durations.

dividend-to-price ratio is correlated with subjective dividend growth expectations, but not with subjective expected returns.[6] In comparison, we remain in the framework of rational expectations and show how equity duration helps us understand the data without having to introduce a wedge between statistically inferred and subjective beliefs.

The rest of this paper is organized as follows. In Section 2 we lay out a simple model to illustrate the relation between duration and the relative contributions of expected returns and dividends. Section 3 discusses the underlying data. In Sections 4.1 through 4.3, we analyze evidence from dividend strips, the time series, and the cross-section of stocks, respectively. In Section 5 we calibrate our simple model to illustrate to what extent our framework can quantitatively explain differences in the relative contributions. In Section 6 we discuss the role of dividend smoothing and share repurchases. Section 7 concludes.

2 Duration in a present value model

In this section, we illustrate the importance of duration for the sensitivity of stock prices to expected returns and dividend growth rates. We first discuss a simple model for dividend strips. We then write down a richer model for an asset that pays out dividends in each period. This model provides the basis of the calibration exercise in Section 5.

2.1 Motivating example: dividend strips

There is an asset (dividend strip) that pays out a dividend in n periods: D_{t+n}. We can think of n as the duration of the dividend strip. Current dividends are given by D_t. We assume that

[6] While data on *subjective* expected returns goes back to 1963, the data on *subjective* dividend growth expectations only spans the period 2003-2015, when, incidentally, the correlation between the dividend-to-price ration and *realized* dividend growth rates was uncommonly high.

expected returns μ_t and dividend growth rates g_t between t and $t+n$ are given by AR(1) processes (Binsbergen and Koijen 2010)

$$\begin{aligned} \mu_{t+1} &= \delta_0 + \delta_1(\mu_t - \delta_0) + \varepsilon_{t+1}^{\mu} \\ g_{t+1} &= \gamma_0 + \gamma_1(g_t - \gamma_0) + \varepsilon_{t+1}^{g} \end{aligned} \tag{1}$$

Parameters δ_1 and γ_1 capture the persistence of shocks. Motivated by the extant evidence that expected returns are more persistent than growth rates, we assume that $\delta_1 > \gamma_1$.[7] For simplicity, we assume that ε_{t+1}^{μ} and ε_{t+1}^{g} are uncorrelated.

The log-return on a dividend strip that pays after *n* periods is given by

$$\begin{aligned} r_{t,n} &= \log\left(\frac{D_{t+n}}{P_t}\right) = \log\left(\frac{D_{t+n}}{D_t}\frac{D_t}{P_t}\right) \\ &= \Delta d_{t,n} + dp_t, \end{aligned} \tag{2}$$

where dp_t is the current dividend-to-price ratio and $\Delta d_{t,n}$ is the growth rate of dividends between *t* and *t*+*n*. After taking expectations on both sides of the equation, we arrive at

$$dp_t = \mu_{t,n} - g_{t,n} \ . \tag{3}$$

Combining equations (1) and (3), we can write the dividend-to-price ratio as

$$dp_t = n(\delta_0 - \gamma_0) + \frac{1-\delta_1^{\,n}}{1-\delta_1}(\mu_t - \delta_0) + \frac{1-\gamma_1^{\,n}}{1-\gamma_1}(g_t - \gamma_0). \tag{4}$$

Thus, the dividend-to-price ratio for a dividend strip that pays dividends in *n* periods depends on the long-run average return and dividend growth rate (δ_0 and γ_0) plus the current levels of μ_t and g_t in excess of the long-run average, scaled by their persistence parameters δ_1 and γ_1 and

[7] Fama and French (1989), Binsbergen and Koijen (2010), Koijen and Van Nieuwerburgh (2011), Golez (2014), Piatti and Troiani (2017).

duration *n*. Similarly, the variance of the dividend-to-price ratio depends on the variances of μ_t and g_t, scaled by their persistence parameters δ_1 and γ_1, and duration *n*. The longer the duration, the more important the more persistent process.

As an illustration, consider two extremes. First, suppose that $n=1$. In that case

$$\operatorname{var}(dp_t) = \operatorname{var}(\mu_t) + \operatorname{var}(g_t)$$

Denote by ER and EDG the fraction of the variance of the dividend-to-price ratio that is explained by expected returns and expected growth rates:

$$ER = \frac{\operatorname{var}(\mu_t)}{\operatorname{var}(dp_t)}; \quad EDG = \frac{\operatorname{var}(g_t)}{\operatorname{var}(dp_t)}$$

$$\frac{ER}{EDG} = \frac{\operatorname{var}(\mu_t)}{\operatorname{var}(g_t)}. \tag{5}$$

The ratio of *ER* to *EDG* shows that, in this case, persistence is irrelevant for the relative importance of expected returns and growth rates.

Next, suppose that *n* equals infinity. In that case, we get that

$$\operatorname{var}(dp_t) = \frac{\operatorname{var}(\mu_t)}{(1-\delta_1)^2} + \frac{\operatorname{var}(g_t)}{(1-\gamma_1)^2}$$

and therefore

$$ER = \frac{\operatorname{var}(\mu_t)}{(1-\delta_1)^2 \operatorname{var}(dp_t)}; \quad EDG = \frac{\operatorname{var}(g_t)}{(1-\gamma_1)^2 \operatorname{var}(dp_t)}$$

$$\frac{ER}{EDG} = \frac{(1-\gamma_1)^2}{(1-\delta_1)^2} \frac{\operatorname{var}(\mu_t)}{\operatorname{var}(g_t)}, \tag{6}$$

and the most persistent process, in this case μ_t, will contribute disproportionally more to the variance of dp_t.

2.2 Full model

Next, we extend this intuition to an infinitely lived asset that pays a dividend in each period. The processes for expected returns and dividend growth rates, μ_t and g_t, are the same as before and given by Eqn. (1). In this section, we retain the assumption that shocks ε_{t+1}^{μ} and ε_{t+1}^{g} are uncorrelated; in the calibration exercise in Section 5 we relax this assumption.

In the model, firms face a trade-off between paying out dividends today and reinvesting earnings to generate a higher dividend growth rate. Consistent with Modigliani and Miller (1961) we assume that the payout policy does not affect firm value: the long-run average earnings-to-price ratio $\overline{NP}$ is the same regardless of the exact payout/reinvestment choice. We assume that firms pay out a fixed fraction π of their earnings. Denote $R = \exp\{\delta_0\}$ and $G = \exp\{\gamma_0\}$ the long run average expected returns and dividend growth rates. Under the previous assumptions, $\overline{NP}$, π, G, and R are linked through the following (long run) present value relation:

$$\overline{NP} = \frac{R-G}{\pi R}. \tag{7}$$

From here, we can express the average expected dividend growth rate γ_0 as a function of the payout ratio π:

$$\gamma_0 = \delta_0 + \log(1-\pi\overline{NP}) \simeq \delta_0 - \pi\overline{NP}. \tag{8}$$

Holding δ_0 constant, a higher π implies a lower average growth rate γ_0. As such, π is an (inverse) measure of duration: a lower payout ratio means that payments to investors are pushed into the future. A lower π also implies a lower dividend-to-price ratio:

$$\overline{dp} = \log\pi + \overline{np}, \tag{9}$$

which implies that the average $\overline{dp}$ is inversely related to duration. This is similar to the static Gordon growth model, in which the inverse of the dividend-to-price ratio is often used as a measure of equity duration.

Following Campbell and Shiller (1988a), we log-linearize returns to arrive at an (approximate) expression for the dividend-to-price ratio:

$$dp_t \simeq -\frac{\kappa}{1-\rho} + E_t \sum_{j=0}^{\infty} \rho^j (r_{t+j}) - E_t \sum_{j=0}^{\infty} \rho^j (\Delta d_{t+j}) \tag{10}$$

with

$$\begin{aligned} \rho &= \frac{\exp\{-\overline{dp}\}}{1+\exp\{-\overline{dp}\}} \\ \kappa &= \log(1+\exp\{-\overline{dp}\}) + \rho \overline{dp} \end{aligned} \tag{11}$$

We combine Eqns. (1) and (10) to arrive at the following expression for dp_t:

$$dp_t \simeq -\frac{\kappa}{1-\rho} - \frac{\gamma_0 - \delta_0}{1-\rho} + \left(\frac{1}{1-\rho\delta_1}\right)(\mu_t - \delta_0) - \left(\frac{1}{1-\rho\gamma_1}\right)(g_t - \gamma_0) \tag{12}$$

The impact of expected returns and dividend growth rates on the dividend-to-price ratio is pinned down by persistence parameters δ_1 and γ_1, and ρ. Eqns. (9) and (11) show that, holding $\overline{NP}$ constant, changes in ρ are driven by the payout ratio π, and that $\partial\rho / \partial\pi < 0$. Since π is inversely related to duration, a higher ρ implies longer duration.

Under the assumption that shocks are uncorrelated, the variance of the dividend-to-price ratio is given by

$$\mathrm{var}(dp_t) = \left(\frac{1}{1-\rho\delta_1}\right)^2 \mathrm{var}(\mu_t) + \left(\frac{1}{1-\rho\gamma_1}\right)^2 \mathrm{var}(g_t). \tag{13}$$

The fraction of the variance that can be explained by expected returns *ER* is defined as

$$ER = \frac{\left(\frac{1}{1-\rho\delta_1}\right)^2 \operatorname{var}(\mu_t)}{\operatorname{var}(dp_t)} = \frac{1}{1+\chi}, \tag{14}$$

where

$$\chi = \left(\frac{1-\rho\delta_1}{1-\rho\gamma_1}\right)^2 \frac{\operatorname{var}(g_t)}{\operatorname{var}(\mu_t)}. \tag{15}$$

Similarly, the fraction explained by expected dividend growth rates *EDG* is given by

$$EDG = \frac{\left(\frac{1}{1-\rho\gamma_1}\right)^2 \operatorname{var}(g_t)}{\operatorname{var}(dp_t)} = \frac{\chi}{1+\chi}. \tag{16}$$

Thus, the ratio of the relative importance of expected returns and growth rates is:

$$\frac{ER}{EDG} = \frac{1}{\chi} \tag{17}$$

The ratio increases with ρ, $\partial\left(ER/EDG\right)/\partial\rho > 0$, as long as $\delta_1 > \gamma_1$. In words, as long as μ_t is more persistent than g_t, expected returns become relatively more important when duration increases.

3 Data

In this section, we discuss the main data sources for our three empirical exercises. Details are in Online Appendix A. We follow much of predictability literature (Campbell and Shiller 1988a, Cochrane 1992, Binsbergen and Koijen 2010, Jagannathan and Liu 2019) and take the perspective of an investor that holds the stock and does not participate in share repurchases and equity issuances. This means that the only payout to investors we consider are cash dividends.[8]

[8] It is questionable whether repurchases should be counted as payout to investors at all. Share buybacks often arise from employee stock compensation or are used to finance mergers and acquisitions. Fama and French (2001) estimate that only half of all repurchases are actual payouts to investors. Furthermore, Hong and Wang (2008) provide evidence

3.1 Strips, 1996-2017

For dividend strips, we follow the approach of Binsbergen, Brandt, and Koijen (2012, henceforth BBK). In particular, for the time period January 1996 to October 2009, we obtain the data from their webpage. Dividend strip prices are estimated from put-call parity using intra-daily data for S&P 500 options. The monthly return on the dividend strategy consists of monthly dividends plus the change in price of the dividend strip. Maturities of dividend strips range from 1.3 to 1.9 years, with rebalancing occurring every January and July. Details are provided in BBK's Online Appendix. To match the approximate maturity of the return strategy, we use the dividend-to-price ratio for the dividend strip based on 18-month constant maturity dividend strip prices (defined as 12-month trailing sum of dividends for the S&P 500 index over the price of the dividend strip with maturity of 18 months). We carefully follow BBK's approach to extend the data until December 2017. Details are provided in Online Appendix A. For the matching time period, we also calculate the dividend-to-price ratio for the market, returns on the market, and the dividend growth.

3.2 Time series, 1629 – 2017

For the time series between 1629 and 2015 we use stock prices, dividends and earnings from Golez and Koudijs (2018, hereafter GK). We extend their time series until the end of 2017.

Stock prices and dividends between 1629 and 1812 come from the combined Amsterdam and London stock markets, the most developed markets at the time. GK reconstruct this data from primary sources; their appendix has more details. For the years between 1813 and 1870, the data come from London, which became the global financial center after the Napoleonic Wars. GK

that companies engage in stock buybacks to provide liquidity in times of distress, while Almeida, Fos, and Kronlund (2016) show that companies use repurchases strategically to meet analyst EPS forecasts. Larrain and Yogo (2008) consider net payout which includes both repurchases and equity issuances.

reconstruct the data between 1813 and 1825 from primary sources and rely on Acheson, Hickson, Turner and Ye (2009) for the remainder of the period. For the years after 1870, stock prices and dividends are for the U.S. stock market, downloaded from Amit Goyal's webpage; for the period 1871 to 1925, the underlying source is Cowles (1939), for 1925 to 2015, the data are for the S&P 500.[9]

Earnings are only available for 1651-1812 and 1871-2017. For the first period, GK rely on primary sources; details are in their appendix. For the second period, the data come from Amit Goyal's webpage. Before 1926, earnings data come from Cowles (1939). For 1926 onwards, earnings data are from the S&P.

The data on earnings allow us to calculate the payout ratio (dividends/earnings) of the aggregate market, which we take as an inverse measure of stock market duration. First, we calculate average dividends to earnings over 10-year trailing windows. This is the same window Campbell and Shiller (1988b, 2005) use to calculate the cyclically adjusted price-to-earnings (CAPE) ratio. Then, to characterize the payout policy over a particular period, we simply take the mean of this trailing variable.[10]

For comparability across time, we report all variables in real, inflation adjusted terms. Inflation figures come from a number of secondary sources standard in the literature, details are in the appendix to GK.

[9] For 1926-1957, the S&P index covered only 90 rather than 500 stocks.

[10] This approach strikes a balance between two extremes. One is to calculate total dividends and earnings over a given period and simply take the ratio. This approach would give disproportionate weight to years in which the dollar amount of earnings and dividends was the highest and might not be representative. The other is to calculate the payout ratio for each individual year and take the mean over all years. Due to short term fluctuations in earnings, such an annual series is highly volatile and can even be negative in some years, leading to bias.

3.3 Cross-section of stocks, 1945-2017

For the cross-section of stocks between 1945 and 2017, we calculate annual dividends and returns for individual securities from the monthly CRSP tapes. As is typical in the literature, we only retain common stocks (share codes 10 and 11). We then merge these data with the earnings data from the annual COMPUSTAT tapes (income before special items). For before 1950, when COMPUSTAT earnings data are not available, we calculate earnings using the "clean surplus" approach as

$$E_t = BE_t - BE_{t-1} + RP_t - SI_t + D_t, \tag{18}$$

where BE is book equity, RP are repurchases, SI are stock issuances, and D are dividends. Following Chen, Da, and Priestly (2012), we calculate repurchases and issuances from the CRSP monthly tapes.[11] For book equity, we use the data used in Davis et al. (2000), downloaded from Kenneth French's website.

4 Empirical evidence

In this section, we explore the role of duration for the relative importance of expected returns and dividend growth rates in three different settings: (1) dividend strips, (2) the time series between 1871 and 2017, and (3) the cross-section of stocks. As is standard in the literature, we do this through predictive regressions (Campbell and Shiller 1988a, Cochrane 1992). That is, we use the dividend-to-price ratio to predict future returns, dividend growth rates and the dividend-to-price ratio itself:

$$\begin{bmatrix} ret_{t+1} \\ dg_{t+1} \\ dp_{t+1} \end{bmatrix} = \begin{bmatrix} \beta_{ret} \\ \beta_{dg} \\ \beta_{dp} \end{bmatrix} dp_t + \begin{bmatrix} \varepsilon_{t+1}^{ret} \\ \varepsilon_{t+1}^{dg} \\ \varepsilon_{t+1}^{dp} \end{bmatrix} \tag{19}$$

[11] We thank Zhi Da for sharing the code.

By approximation, $\beta_{ret} - \beta_{dg} + \rho\beta_{dp} \simeq 1$, where ρ is defined in Eqn. (11). Using these coefficients, we can calculate the fraction of the variation in the dividend-to-price ratio coming from changes in expected returns:

$$ER = \frac{\beta_{ret}}{(1-\rho\beta_{dp})} \tag{20}$$

The fraction coming from expected dividend growth rates is calculated analogously

$$EDG = \frac{\beta_{dg}}{(1-\rho\beta_{dp})}.$$

When considering dividend strips, Eqn. (19) simplifies to

$$\begin{bmatrix} ret_{t+1} \\ dg_{t+1} \end{bmatrix} = \begin{bmatrix} \beta_{ret} \\ \beta_{dg} \end{bmatrix} dp_t + \begin{bmatrix} \varepsilon_{t+1}^{ret} \\ \varepsilon_{t+1}^{dg} \end{bmatrix} \tag{21}$$

as payouts end after maturity (and the future dividend-to-price ratio is not defined). The relative contributions of expected returns and dividend growth rates are simply given by $ER = \beta_{ret}$ and $EDG = \beta_{dg}$, respectively.

The ratio between the fractions for both the aggregate market and dividend strips depends merely on the estimated coefficients in the return and dividend growth regressions:

$$\frac{ER}{EDG} = \frac{\beta_{ret}}{\beta_{dg}}$$

Because $ER - EDG \simeq 1$, we can also calculate implied fractions as one minus the other fraction.

4.1 Dividend strips, 1996-2017

We start by testing whether the dividend-to-price ratio for dividend strips and the dividend-to-price ratio for the stock market predict returns and dividend growth rates. Since dividend strip data is only available from 1996 onward, we restrict the analysis to 1996-2017.

Both dividend-to-price ratios are based on the same underlying asset, the S&P 500 index. The only difference is that dividend strips entitle the owner to dividends over a fixed period, whereas the aggregate market entitles the owner to the whole stream of dividends until infinity. Thus, dividend strips and the aggregate market represent short and long duration assets, respectively.

Table 1 reports summary statistics. Everything is in real (inflation adjusted) terms. Consistent with BBK, returns on dividend strips are higher than those on the aggregate market, and the dividend-to-price ratio for dividend strips is much higher. In a simple Gordon growth model, duration is the inverse of the dividend-to-price ratio. For dividend strips, the inverse is 1.47, which is only slightly lower than their maturity. For the aggregate market, the inverse is 54, which implies that the duration of the aggregate market is approximately 50 years in this period.

In Table 2, we present the main predictability results. In this analysis, we run regressions at the monthly frequency. That is, we regress 12-month returns, 12-month growth rates, and the current dividend-to-price ratio on the 12-times lagged dividend-to-price ratio. We report Newey and West (1987) t-statistics with 12 lags. Additionally, we report t-statistics based on non-overlapping observations, which we calculate as the mean across the t-statistics based on 12 non-overlapping samples.

For the market, we obtain the standard result that the dividend-to-price ratio predicts returns, but not dividend growth rates. The coefficients suggests that changes in expected returns explain close to 100% of the variation in the dividend-to-price ratio. In comparison, the dividend-to-price ratio for dividend strips predicts both returns on the dividend strips and aggregate dividend growth. Results are highly significant, and the associated R^2 are relatively high. The coefficients suggest that around 60-70% of the variation in dividend strips is due to changes in expected returns, and the rest is due to changes in expected growth rates.[12]

Put differently, for the aggregate stock market, changes in expected returns are 30 times as important as changes in expected growth rates. For dividend strips prices, expected returns are only twice as important as changes in expected growth rates.[13] This confirms that longer duration assets are relatively more sensitive to expected returns.

4.2 Time series, 1629 – 2017

Next, we explore the historical time series relation between the importance of expected returns and stock market duration.

Table 3 reports summary statistics for real (inflation adjusted) variables. Three things stand out. First, the payout ratio was much higher before 1945 than afterwards. Whereas before firms paid out more than 95% of earnings in the form of dividends, afterwards this dropped to less than 50%.[14] To illustrate more recent developments, Figure 1 presents the payout ratio of the U.S. stock market since 1870 where we calculate average dividends over earnings for 10-year trailing windows. Before 1945, the payout ratio fluctuated around 70%, and was as high as 86% right before WWII, after which it steadily declined to approximately 40% today.[15] Second, DY/RET,

[12] The coefficients do not sum up to 1 exactly. In part, this is because the return strategy relies on actual dividend prices, whereas the dividend-to-price ratio relies on interpolated values. In addition, the return strategy does not match exactly the maturity of 1.5 years as it is rebalanced every 6-months rather than every month.

[13] Most likely, this ratio is upward biased and the true *EDG* is higher than estimated. Since the prices for dividend strips are inferred from derivatives, there is measurement error. This will lead to negative autocorrelation in prices, which manifests itself in more predictability for returns and attenuates the predictability of dividend growth rates.

[14] The estimate for payouts in the early period is based on the data from 1629-1812 and 1871-1945. Even though earnings data is not available between 1813 and 1870, there is suggestive evidence that payout ratios were high then as well. Goetzmann, Ibbotson, and Peng (2001) observe that during the 19th century, stock prices of U.S. firms typically fluctuated around the paid-in (par) value of shares, indicating that firms typically paid out earnings rather than retaining them on balance sheet. Similarly, aggregate data from Acheson, Hickson, Turner and Ye (2009) show that between 1825 and 1870 the average stock price of firms in the U.K. was also close to par.

[15] Fama and French (2001) show that this is both the result of more small and growth oriented firms issuing shares and large, profitable firms cutting payout and increasing investment.

the fraction of returns investors receive in the form of dividends, was much higher before 1945. Whereas before investors received approximately 70% of returns in the form of dividends, afterwards this was approximately 40%. Finally, the dividend-to-price ratio was markedly higher before 1945, falling from approximately 5% to 3.5% more recently.

All three results are consistent with increased duration of the stock market as a whole. As firms reinvest more of their earnings, or simply hold it in cash, investor payout is pushed into the future. As a result, investors receive more of their returns in the form of capital gains rather than dividends, and the dividend-to-price ratio falls. The stock market becomes more growth oriented. Consistent with these developments, the co-movement of growth stocks with the market has increased in recent decades (Campbell and Vuolteenaho 2004).[16] Again, in a simple Gordon growth model, duration equals the inverse of the dividend-to-price ratio. For the whole post-1945 period, this would imply an average duration of 30 years, for the pre-1945, the numbers suggest a duration of 20 years.[17]

In Table 4, we present the predictability results. All regressions are conducted at the annual frequency; t-statistics are based on Newey and West (1987) with one lag. Results shows that the change in firms' payout policies is associated with a growing importance of expected returns. Even though there is strong statistical evidence for return predictability going back as far as 1629, the quantitative importance of expected returns varies considerably over time. The table shows that if one considers the period 1629-1945, changes in expected returns only explain around 35% of the

[16] It is beyond the scope of this paper to explain why firms' payout policies have changed. We conjecture that this driven by a combination of two factors: (1) An increase in the personal tax rate (together with a differential treatment of dividends and capital gains), which makes it more tax efficient for firms to re-invest earnings than for individuals to re-invest dividends. (2) An increase in investor protection, in particular the founding of the SEC in 1934 and improved securities legislation in the 1930s, which may have made shareholders less reluctant to have firms invest their earnings for them.

[17] The dividend-to-price ratio does not only reflect duration, but also other factors, in particular expected returns. Table 3 shows no evidence that expected returns have decreased since 1945. Therefore, this in itself cannot explain the drop in the dividend-to-price ratio.

variation in the dividend-to-price ratio, while for the more recent period this is 90%. Put differently, before 1945 changes in expected returns were half as important as changes in expected growth rates, after 1945 expected returns were more than seven times as important. In other words, the dominance of expected returns is only a recent phenomenon.

We further explore the relation between duration and expected returns in Figure 2, Panels A and B. In both panels we plot *ER*, the fraction of the variance in the dividend-to-price ratio explained by expected returns. This is based on predictive regressions estimated on 75-year trailing windows. For example, the *ER* for 1945 comes from the period 1871-1945. In Panel A, we include the payout ratio, which we calculate as the mean of the trailing 10-year dividends over earnings over the same 75-year period. The figure shows a strong time-series correlation between payout policies and *ER* – as the payout ratio declines, expected returns become more important. In Panel B we include the mean dividend-to-price ratio over the same 75-year period. Again, there is a strong inverse time series correlation with *ER*.

4.3 Cross-section of stocks, 1945-2017

There is substantial variation in payouts across the firms. Fama and French (2001) show that today a small fraction of companies account for majority of payouts. In this section, we construct portfolios of stocks with different payout ratios to test whether there is cross-sectional evidence that higher duration is associated with a more important role for expected returns.

We start with the CRSP universe of listed stocks that we classify as high or low duration based on their average payouts (dividends/earnings) over the last 10 years. We restrict our sample to the stocks of firms that have non-missing earnings. We also require that firms paid out non-zero dividends in all of the 10 preceding years (excluding the current year). The former restriction ensures we can calculate the past payout ratio. The latter restriction ensures that predictive regression are well defined. Suppose we want to construct a low payout portfolio. If this includes many non-dividend-paying firms, the dividend-to-price ratio would be close to zero and would fluctuate wildly in response to the changing dividend policies of only a few firms. The same holds for the dividend growth rate. It is unlikely that predictive regressions on such a portfolio give meaningful results. We consider dividend payments over the last ten years, rather than current (or future) payments, to avoid look-ahead bias Results are robust to restricting the sample to firms that paid out non-zero dividends in at least five out of the 10 preceding years.

We form portfolios based on stocks' past payout policies (weighted by market capitalization). For each portfolio, we calculate annual returns, dividend growth rates, and the dividend-to-price ratio. We rebalance portfolios annually. We consider five different portfolios. First, we place stocks into three buckets, depending on where they fall in the relative distribution of payouts. For example, in 1946, the first year in our data, we calculate the payout ratio over 1936-1945 for all stocks in the sample. We then determine which stocks fall in the lowest, middle and highest tercile of the payout distribution, designating them as "Low", "Medium", and "High". In 1947, we repeat this procedure, and rebalance our portfolios according to the distribution of payouts over 1937-1946. Second, we divide stocks into low and high duration buckets on an absolute basis – that is, whether a stock, in the preceding 10 years, paid out more or less than half of its earnings. Because the average level of payouts increased during the period, we limit ourselves to two buckets. Having more would lead to portfolios with very few stocks in some years. For each portfolio, we also calculate the payout ratio. As in the time series analysis we calculate annual dividends and earnings for each portfolio and then take the 10 year trailing average.

Table 5 reports the summary statistics. Consistent with the previous results, everything is in real terms. Column (1) has information for a portfolio that includes all firms that pass our initial filter. The payout ratio, returns, dividend growth rates and dividend-to-price ratio are all very similar to the aggregate market (Table 3), indicating that our initial filter yields a representative sample. Columns (2) to (4) have information for the "Low", "Medium", and "High" portfolios. Columns (5) and (6) have the portfolios of stocks that paid out less or more than half their earnings. Average payout ratios range from 32 to 63%. For high payout portfolios, dividend growth rates are lower, the dividend-to-price ratio is higher, and a larger fraction of returns comes from dividends, all in line with the simple model of Section 2.

Table 6 reports the predictability results. All regressions are conducted at the annual frequency, and t-statistics are based on Newey and West (1987) with one lag. For the portfolio of all firms that pass our initial filter, *ER* is 83%, close to the 89% we find for the entire market in Table 4. In line with our theoretical predictions, expected returns are less important for high payout portfolios with shorter duration. On a relative basis, going from the "Low" to "High" portfolio is associated with a drop in *ER* from 0.96 to 0.58. The ratio between *ER* and *EDG* ranges from 10.19 for the low to 1.27 for the high payout portfolio. On an absolute basis, comparing stocks paying out less or more than half of earnings, leads to an equally substantial drop in *ER* from 0.93 to 0.60. *ER/EDG* falls from 7.8 to 1.33.

These results line up well with the time series analysis. Figure 3, panel A, plots the *ER*s from different portfolios or time-periods against their payout ratios. The points from the time series and cross-sectional analyses are closely aligned. The dotted (green) line provides the best linear fit through both sets of points. For each increase in the payout ratio by 10%, *ER* decreases by roughly

0.10. Panel B plots the corresponding *ER/EDG*. Here the relation with the payout ratio has the shape of a power function. Again, points from the time series and cross-section are closely aligned.

In sum, the empirical evidence is consistent with the previous two sections: higher duration is associated with a more important role for expected returns. Quantitatively, the time series and cross-sectional analyses provide similar conclusions about the impact of the payout ratio on *ER* and *EDG*.

5 Simulations

The model of Section 2 is qualitatively consistent with what we find in the data. In this section, we explore to what degree the model can match the patterns quantitatively. We simulate the model under different payout ratios (parameter π) and run predictive regressions on the simulated series of returns and dividend growth rates. The main quantities of interest are the changes in *ER* and *EDG* in response to a change in the payout ratio.

We proceed as follows. First, we normalize the model so that a payout ratio of 1 translates into a long term dividend growth rate (parameter γ_0) of 0. Under this normalization, Eqn. (8) establishes a unique mapping from the long run earnings-to-price ratio ($\overline{NP}$) to the long run average returns (parameter δ_0). We calibrate $\overline{NP}$ in order to match the δ_0 = 0.09 reported in Binsbergen and Koijen (2012), Table VI. From here, we can use Eqn. (8) to calculate the appropriate γ_0 for each π. We take the other parameters directly from Binsbergen and Koijen (2012, Table VI), in particular the persistence parameters for expected returns and dividend growth rates $\delta_1 = 0.927$ and $\gamma_1 = 0.485$, and the covariance matrix of the shocks $\{\varepsilon_{t+1}^{\mu}, \varepsilon_{t+1}^{g}, \varepsilon_{t+1}^{\Delta d}\}$.

We simulate the model a total of 100,000 times. To match the 1945-2017 period, each simulation is 72 years long. We use 200 additional years to initialize the simulation. We first simulate out expected returns and dividend growth rates using Eqn. (1) and a simulated series for ε_{t+1}^{μ} and ε_{t+1}^{g}. From there, we calculate the dividend-to-price ratio using Eqn. (12). We calculate realized dividend growth rates from directly simulating $\varepsilon_{t+1}^{\Delta d}$, and realized returns from the log-linearized return equation:

$$ret_{t+1} = \kappa + dp_t + \Delta d_{t+1} - \rho dp_{t+1} \;, \tag{22}$$

where κ and ρ are given by Eqn. (11).

Next, we calculate summary statistics and run predictive regressions for each of the 100,000 different datasets. We then take the mean. Results are in Table 7. Each column has a different payout ratio, ranging from 30% to 100%, to broadly match what we observe in the data. Panel A has the summary statistics. All variables are in logs. By construction, returns are constant across columns, while dividend growth rates fall as the payout ratio increases. In line with the model, the fraction of returns coming from dividend yield and the dividend-to-price ratio increase with payouts. Panel B has the results from the predictive regressions. The coefficient on dp_t predicting returns is slightly increasing with the payout ratio, but mostly stable. The coefficient on dp_t predicting dividend growth rates is strongly decreasing. As the payout increases, dividend growth rates become much more predictable. As a result, *ER* decreases from 0.94 to 0.72, and ER/EDG decreases from close to 19 to less than 3.

In sum, simulations show that our simple model can generate quantitatively important changes in *ER* and *EDG*, although the effects are somewhat smaller than what we observe in the data. Figure 3 includes the *ER* and *ER/EDG* we get from the simulations. The sensitivity of *ER* with respect to the payout ratio is somewhat lower compared to what we find for the time series and cross-section, especially when the payout is high. This can likely be explained by the fact that the model is highly stylized and depends on parameters that were estimated on post-1945 data only when payouts were low.

6 Discussion

In this section, we discuss to what extent alternative forms of payouts (e.g. share repurchases) and dividend smoothing can explain our findings.

6.1 Share repurchases

As it is standard in the literature, we focus on cash dividends only (see Jagannathan and Liu 2019 for a recent example). Share repurchases are more irregular than cash dividends and typically used to pay out transitory shocks to earnings (De la O 2019). Also, share repurchases are only a relatively recent phenomenon. Before 1982, the SEC enforced strict rules on manipulative trading that seriously reduced firms' scope to repurchase shares. This means that for much of our time series repurchases are not relevant.

Nevertheless, there is a concern that the increase in share repurchases from 1982 onwards can explain the time-series results in the paper. Repurchases may lead to lower payout and dividend-to-price ratios, and make the market appear to have a higher duration than it actually has.[18] Two pieces of empirical evidence suggest this does not drive our results. First, the average payout ratio dropped before repurchases started to become quantitatively important. Figure 1 shows that by 1981 the trailing 10-year average payout ratio had already dropped to 42%. Second, when we run predictive regressions on the 1946-1981 period, we find that the estimated *ER* is more

[18] We thank John Campbell and Xavier Gabaix for pointing this out.

than 1.00.[19] In other words, even absent repurchases, the decrease in the payout ratio after 1945 is associated with a (dramatic) increase in expected returns.

There is a similar concern for the cross-sectional results. If firms substitute dividends for repurchases, then the payout ratio, as we define it, will suggest they have higher duration than they actually have. If all firms do this in roughly the same proportions, this will not affect the relative ordering of high and low duration firms and our results would be largely unaffected. If, however, firms do this in different proportions, the relative ordering would change and our results might be affected. To check this we consider two alternative measures of the payout ratio, one where we add repurchases, and another where we both add repurchases and subtract issuances to arrive at "total payout" (Larrain and Yogo 2008).[20] As argued by Fama and French (2001), at most half of the repurchases are directly meant to substitute for dividends. The other half simply adds noise to our sorting and we would expect our estimates to be less well behaved. Summary statistics and predictability results are in Tables OA.1 and OA.2, respectively, in the Online Appendix. Results are quantitatively similar, suggesting that differences in firms' tendency to substitute dividends for repurchases is not importantly affecting our results. Consistent with the idea that we are adding noise to the sorting, the change in estimated coefficients is not always monotonic as we move across portfolios with high and low duration.

6.2 Dividend smoothing

Depending on how firms smooth dividends, the predictability of dividend growth rates might be attenuated. In a stylized model such as Marsh and Merton (1987), firms pay out a fraction

[19] We estimate $\beta_{ret} = 0.261$ with a t-stat of 3.428, while $\beta_{dg} = 0.043$, with the theoretically wrong sign, and a t-stat of 0.748.

[20] If a firm had negative payout over the last 10 years, we count it as high payout firm and set the payout ratio to the sample maximum.

of lifetime earnings and dividends only respond to permanent shocks. As such, dividends are smoother than earnings. Prices will be highly responsive to changes in lifetime earnings. If prices respond immediately to this news, but dividends only adjust with some lag, the dividend-to-price ratio will still predict future dividend growth, at least in the short run (Cochrane 1994).[21] If, however, firms smooth dividends above and beyond permanent earnings, because they have a particular target in mind, changes in dividends become uninformative about the underlying fundamentals. This will attenuate the predictability of dividend growth rates (Chen, Da, and Priestley 2012).

To what extent can dividend smoothing explain our results? First, note that duration and dividend smoothing are complementary. Sticking to a particular dividend target is easier if the payout ratio is relatively low to begin with. This makes it difficult to disentangle the two effects. Nevertheless, for all our three pieces of empirical evidence, we can assess the degree to which dividend smoothing might play a role.

With respect to dividend strips the issue is straightforward. Dividend smoothing affects the market and dividend strips in exactly the same way and, therefore, cannot explain the empirical results.

For the time series results this is more nuanced. Chen, Da, and Priestley (2012) measure dividend smoothing by taking the ratio of the standard deviations of dividend and earnings growth: $std(dg)/std(eg)$. A lower "smoothing parameter" indicates more smoothing. As Chen, Da, and Priestley observe, this ratio was much lower after 1945 than between 1871 and 1945: 0.22 vs 0.54. Using the full data from 1629 to 1945, however, we find that the smoothing parameter was 0.32

[21] In fact, predictive regressions might be more meaningful if firms pay out permanent earnings than in the hypothetical case where firms simply pay out (a fixed fraction of) current earnings. In that case, transitory shocks to the level of earnings/dividends will mechanically induce predictability even if prices do not respond: a temporarily high (low) dividend-to-price ratio will predict lower (higher) dividend growth next period.

(see the last row of Table 3). This is much closer to the post-1945 period, which suggests that the 1870-1945 period is somewhat of an outlier.[22] Bottom line, while the importance of dividend growth rates before 1945 can be partly driven by dividend smoothing, these numbers suggest that it is unlikely to be the full story.

Finally, our cross-sectional results appear unlikely to be driven by dividend smoothing. We calculate the smoothing parameter for each of the portfolios in Tables 5 and 6. The last row of Table 5 shows that the smoothing parameter is close to 0.4 for all portfolios, except for the low payout portfolio (Column 2) for which it is 0.54. In other words, the portfolio with the smallest role for expected dividend growth rates features *less* smoothing. This is the opposite of what one would expect if smoothing was driving our results.

7 Conclusion

In this paper, we show that there is a strong relation between *equity duration* and the relative importance of expected returns in three different samples: (1) dividend strips, (2) the time series of stock markets going back to 1629, and (3) the cross-section of stocks. This relation can be explained by a simple present value model in which expected returns are more persistent than expected dividend growth rates.

This finding has important implications for how we think about the dominance of expected returns in post-U.S. 1945 data. This phenomenon is not necessarily a sign of increased fluctuations in investors' risk appetite or an increase in "animal spirits", but appears to be closely related to firms' policies to reduce current payout in favor of retaining earnings to generate future payouts.

[22] Earnings data for 1813-1870 is unavailable. However GK (Table 1) show that the volatility of dividend growth rates in this period was very similar to 1629-1812. This suggests that dividend smoothing was not dramatically different between the two periods.

As the market has become much more growth oriented, investors' expected returns have become more important for stock prices than changes in fundamentals.

More broadly, this paper's findings point to the fact that firm decisions can have first order implications for asset pricing, something that is not often emphasized in the literature.

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Data Appendix

A1. Dividend strips

We obtain the SPX minute-by-minute options and index data from the CBOE for the period January 2004-December 2017. We retain only standard SPX options with expirations on the third Friday in a month, and we exclude options with bid or ask prices below $3. As in BBK, we use observations between 10AM and 2PM on the last trading day in a month. For the risk-free rate, we use the Zero-Curve rate from OptionMetrics. We linearly interpolate among the given zero-curve maturities to match the options maturity. Using the bid-ask mid-point, we calculate the price of a dividend strip for all the put-call pairs with the same strike price and maturity. At each end-of-month, we then take the median across all the dividend strip prices for a given maturity.

As in BBK, we estimate prices of dividend strips for constant maturities by linearly interpolating among the prices for dividend strips slightly above and below the given maturity. For the overlapping period January 2004 to October 2009, our estimates for dividend prices are almost identical to those reported by BBK. For 18-month maturity dividends strip, we have a correlation of 0.999 with dividend prices on the same series provided by BBK. The absolute difference in prices is 0.12 on average (0.48% in relative terms). For the final series, running from January 1996 until December 2017, we append our data to BBK's data in October 2009.

The PD ratio of the market is the current level of the S&P 500 index divided by the sum of daily dividends over the past year. Similarly, the PD ratio of the dividend strip is the current price of the 18-month dividend strip divided by the sum of daily dividends over the past year. Finally, we calculate returns on a dividend strategy. As in BBK, we rely on maturities between 1.9 and 1.3 years, with rebalancing in January and July. The only exception is July 2013 to January 2014, during which we let the strategy rely on maturities between 1.5 and 0.9 years, because the appropriate maturity options (expiration in June 2015) were not listed until September 2013. As in

Golez (2014), we calculate daily realized dividends from the Datastream S&P 500 return index and total return index. For the overlapping period January 2004 to October 2009, our estimates for returns have a correlation of 0.98 with returns on the same series provided by BBK.

Table 1: Summary statistics: Market and dividend strips

This table reports summary statistics for 12-month real returns, real growth rates, and dividend-to-price ratios. Lower case letters are logs of corresponding capital letters. The first column reports the statistics for the S&P 500 index; the second column reports the statistics for dividend strips on the S&P 500 index. Observations are at a monthly frequency. The period is from January 1996 to December 2017.

	Market	Dividend strips
	(1)	(2)
ret(%)	5.92	7.34
Std. (%)	17.61	15.73
dg(%)	3.52	
Std. (%)	8.03	
DP(%)	1.84	68.11
Std. (%)	0.39	11.20

Table 2: Return and dividend growth predictability: Market and dividend strips

This table reports OLS estimates of regressing 12-month real returns, dividend growth rates, and the dividend-to-price ratio on the lagged dividend-to-price ratio. Lower case letters are logs of corresponding capital letters. The first column reports results for the S&P 500 index; the second column reports results for dividend strips on the S&P 500 index. Below the estimated coefficients (in parentheses) are Newey-West (1987) *t*-statistics with 12 lags. In brackets are *t*-statistics based on non-overlapping observations, calculated as the mean across 12 alternative non-overlapping samples. For the market, we calculate the fraction of the variation in the dividend-to-price ratio coming from changes in expected returns (*ER*) and expected growth rates (*EDG*) as $\beta_x / (1-\rho\beta_{dp})$, where β_x is the predictive coefficient for expected returns or dividend growth rates, and β_{dp} is the predictive coefficient for the dividend-to-price ratio. For dividend strips, these fractions directly correspond to the estimated coefficients. Implied return and growth fractions are inferred from the corresponding growth and return fractions. The period is from January 1996 to December 2017.

	Market	Dividend strips
	(1)	(2)
Dependent variable: $ret_{t,t+12}$		
dp_t	0.36	0.73
t-stat. (N-W)	(3.12)	(5.29)
t-stat. (Non. Overlap.)	[2.48]	[4.39]
R2	0.19	0.43
Dependent variable: $dg_{t,t+12}$		
dp_t	-0.01	-0.37
t-stat. (N-W)	(-0.08)	(-3.39)
t-stat. (Non. Overlap.)	[0.00]	[-3.77]
R2	0.00	0.42
Dependent variable: dp_{t+12}		
dp_t	0.65	
t-stat. (N-W)	(4.68)	
t-stat. (Non. Overlap.)	[4.01]	
R2	0.43	
ER	0.98	0.73
ER (implied)	0.97	0.63
EDG	0.03	0.37
EDG (implied)	0.02	0.27
ER/EDG	33.36	1.98

Table 3: Summary statistics: Time-series analysis

This table reports summary statistics for annual variables in real terms. Column (1) reports the statistics for the 1629-1945 period based on the combination of the Netherlands/U.K. (1629-1812), U.K. (1813-1870) and the early U.S. data (1871-1945). Annual dividend growth rates and the dividend-to-price ratio before 1700 are based on a 10-year trailing averages of real or nominal dividends. Column (2) reports the same statistics for the post-1945 period based on U.S. data. Column (3) reports the statistics based on the full sample. Lower case letters are logs of corresponding capital letters. Payout is the mean of 10-year trailing dividends over earnings. The smoothing parameter is the ratio of the standard deviations of log dividend and log earnings growth. To calculate this, we drop years with negative earnings. The † indicates that the data for the payout ratio and the smoothing parameter is not complete because earnings data are not available for the 1812-1870 period. DY/RET is the ratio of the dividend yield (D_t/P_{t-1}) to total returns.

	1629-1945	1945-2017	1629-2017
	(1)	(2)	(3)
Payout (%)	98.41†	47.75	86.91†
ret (%)	5.86	6.65	6.01
Std. (%)	14.12	16.76	14.63
DY/RET	0.69	0.42	0.63
dg (%)	0.81	2.36	1.10
Std. (%)	13.29	6.82	12.35
DP (%)	4.86	3.35	4.58
Std. (%)	1.27	1.41	1.43
AR(1)	0.69	0.90	0.78
Smoothing	0.32†	0.22	0.31†

Table 4: Return and dividend growth predictability: Time-series analysis

This table reports OLS estimates of regressing annual real returns and dividend growth rates on the lagged dividend-to-price ratio. Lower case letters are logs of corresponding capital letters. All regressions include a constant (not reported). Below the estimated coefficients (in parentheses) are Newey-West (1987) *t*-statistics with one lag. In brackets are the *t*-statistics for the difference of the estimated coefficient from the rest of the sample (based on a full-period regression with an interaction term). *ER* and *EDG* are defined in Table 2.

	1629-1945	1945-2017	1629-2017
	(1)	(2)	(3)
Dependent variable: ret_{t+1}			
dp_t	0.11	0.09	0.07
t-stat.	(3.22)	(1.94)	(2.70)
Diff. (t-stat.)		[-0.41]	
R2	0.04	0.05	0.03
Dependent variable: dg_{t+1}			
dp_t	-0.20	-0.01	-0.10
t-stat.	(-5.30)	(-0.43)	(-4.14)
Diff. (t-stat.)		[4.13]	
R2	0.14	0.01	0.07
Dependent variable: dp_{t+1}			
dp_t	0.72	0.93	0.86
t-stat.	(15.75)	(20.81)	(25.87)
Diff. (t-stat.)		[3.38]	
R2	0.52	0.85	0.73
ER	0.34	0.89	0.40
ER (implied)	0.37	0.89	0.44
EDG	0.63	0.11	0.56
EDG (implied)	0.66	0.11	0.60
ER/EDG	0.55	7.76	0.71

Table 5: Summary statistics: Cross-sectional analysis

This table reports summary statistics for annual variables in real terms for different stock portfolios. Period: 1946-2017. Column (1) includes all stocks in CRSP that, over the last 10 years, had non-missing earnings and paid out non-zero dividends. In Columns (2) to (4) we create three portfolio's where we rebalance after each calendar year. Stocks for which the payout ratio over the last 10 years was in the bottom tercile fall in the "Low" category, the second tercile in "Medium", and the top tercile in "High". In Columns (5) and (6) we construct portfolios with stocks for which the payout ratio over the last 10 years was more or less than 0.5, again rebalancing after each calendar year. The reported payouts are calculated as the mean of 10-year trailing dividends over earnings at the portfolio level. The smoothing parameter is the ratio of the standard deviations of log dividend and log earnings growth. If for a portfolio, earnings in a given year are negative, this year is eliminated from the calculation of the smoothing parameter for all portfolios.

	All	Low	Medium	High	<=0.5	>0.5
	(1)	(2)	(3)	(4)	(5)	(6)
No. stocks in a portfolio						
Average	683	227	228	228	438	245
Min	190	63	64	63	21	102
Max	1231	410	411	410	973	390
Payout (%)	48.73	32.06	46.98	63.34	40.28	63.21
ret (%)	6.96	7.39	7.02	6.25	7.49	6.62
Std. (%)	15.75	18.08	15.68	15.08	17.19	14.64
DY/RET	0.46	0.30	0.44	0.64	0.37	0.61
dg (%)	2.60	3.90	2.75	1.30	3.52	1.71
Std. (%)	6.45	10.07	7.12	8.92	7.39	8.48
DP (%)	3.54	2.46	3.40	4.47	3.03	4.46
Std. (%)	1.27	1.29	1.14	1.38	1.27	1.51
AR(1)	0.88	0.90	0.85	0.84	0.87	0.87
Smoothing	0.35	0.54	0.41	0.41	0.41	0.39

Table 6: Return and dividend growth predictability: Cross-sectional analysis

This table reports OLS estimates of regressing annual real returns and dividend growth rates on the lagged dividend-to-price ratio for the portfolios defined in Table 5. Lower case letters are logs of corresponding capital letters. All regressions include a constant (not reported). Below the estimated coefficients (in parentheses) are Newey-West (1987) *t*-statistics with one lag. *ER* and *EDG* are defined in Table 2.

	All	Low	Medium	High	<=0.5	>0.5
	(1)	(2)	(3)	(4)	(5)	(6)
Dependent variable: ret_{t+1}						
dp_t	0.10	0.10	0.11	0.10	0.12	0.09
t-stat.	(2.38)	(2.34)	(2.32)	(2.11)	(2.56)	(1.78)
R2	0.06	0.07	0.05	0.04	0.08	0.04
Dependent variable: dg_{t+1}						
dp_t	-0.03	-0.01	-0.04	-0.08	-0.02	-0.07
t-stat.	(-1.09)	(-0.37)	(-1.57)	(-2.11)	(-0.77)	(-2.06)
R2	0.02	0.00	0.03	0.08	0.01	0.07
Dependent variable: dp_{t+1}						
dp_t	0.90	0.92	0.89	0.86	0.89	0.89
t-stat.	(19.11)	(21.09)	(17.31)	(13.99)	(19.14)	(17.15)
R2	0.81	0.85	0.77	0.73	0.79	0.78
ER	0.83	0.96	0.77	0.58	0.93	0.60
ER (implied)	0.79	0.91	0.73	0.54	0.88	0.55
EDG	0.21	0.09	0.27	0.46	0.12	0.45
EDG (implied)	0.17	0.04	0.23	0.42	0.07	0.40
ER/EDG	4.03	10.19	2.90	1.27	7.80	1.33

Table 7: Simulations

This table reports simulation results for the present value model described in Section 2, where we vary payouts between 30% and 100%. The length of the time period matches the post 1945 period. We run simulations for each portfolio 100,000 times and then report the average values. The earning-to-price ratio is set to match the empirical long run average return. The rest of the parameters are taken from Binsbergen and Koijen (2012, Table VI). Panel A reports the summary statistics and Panel B reports the results from the predictive regressions, analogous to Table 1 through 6. *ER* and *EDG* are defined in Table 2.

Payout (%)	30	40	50	60	70	80	90	100
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Panel A: Summary statistics								
ret (%)	8.87	8.86	8.87	8.87	8.87	8.87	8.86	8.87
Std. (%)	11.67	10.89	10.24	9.71	9.25	8.87	8.54	8.25
DY/RET	0.30	0.40	0.50	0.61	0.71	0.81	0.92	1.02
dg (%)	6.29	5.41	4.53	3.65	2.74	1.84	0.93	0.00
Std. (%)	5.20	5.18	5.17	5.16	5.15	5.15	5.14	5.14
DP (%)	2.81	3.75	4.70	5.67	6.65	7.64	8.65	9.70
Std. (%)	0.79	0.98	1.15	1.31	1.45	1.58	1.71	1.83
Panel B: Predictive regressions								
Dependent variable: ret_{t+1}								
dp_t	0.14	0.14	0.15	0.15	0.15	0.16	0.16	0.16
Dependent variable: dg_{t+1}								
dp_t	-0.01	-0.02	-0.03	-0.03	-0.04	-0.05	-0.06	-0.07
Dependent variable: dp_{t+1}								
dp_t	0.87	0.87	0.86	0.86	0.85	0.85	0.84	0.84
ER	0.94	0.91	0.87	0.84	0.80	0.77	0.74	0.72
ER (implied)	0.95	0.91	0.88	0.85	0.82	0.79	0.77	0.75
EDG	0.05	0.09	0.12	0.15	0.18	0.21	0.23	0.25
EDG (implied)	0.06	0.09	0.13	0.16	0.20	0.23	0.26	0.28
ER/EDG	18.63	10.50	7.23	5.57	4.42	3.74	3.22	2.84

Figure 1: Total payout

This figure plots the trailing ratio of 10-year dividends over 10-year earnings for the aggregate market. The period is 1871 to 2017, which yields (trailing) estimates for 1881 to 2017.

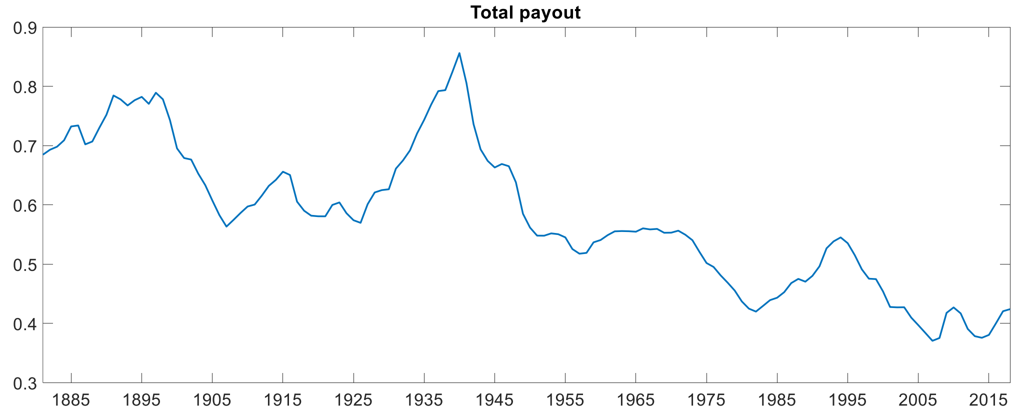
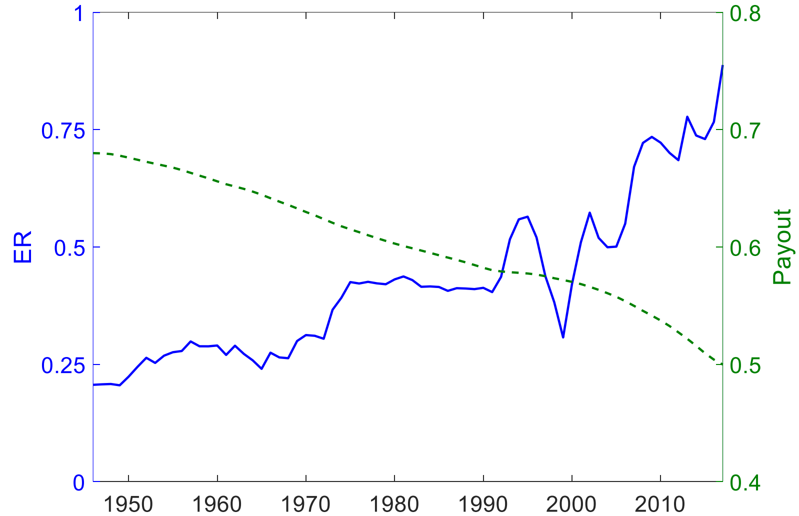


Figure 2: Fraction of expected return variation versus the payout

This figure plots trailing-window estimates of the fraction of the variation in the dividend-to-price ratio coming from expected returns (*ER*) and either average payouts (Panel A) or the average dividend to price ratio (Panel B). Fraction *ER* is defined in Table 2. Payout is defined as mean of 10 year trailing average dividends over earnings. At each point in time, we calculate the estimates over the matching (trailing) 75-year window. The period is 1871 to 2017, which yields (trailing) estimates for 1946 to 2017.

Panel A: Fraction of expected return variation and total payout



Panel B: Fraction of expected return variation and average dividend-to-price ratio

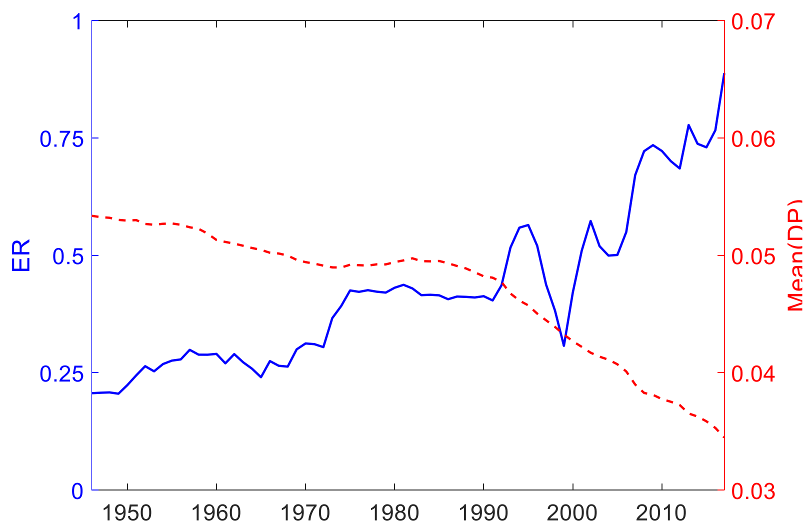
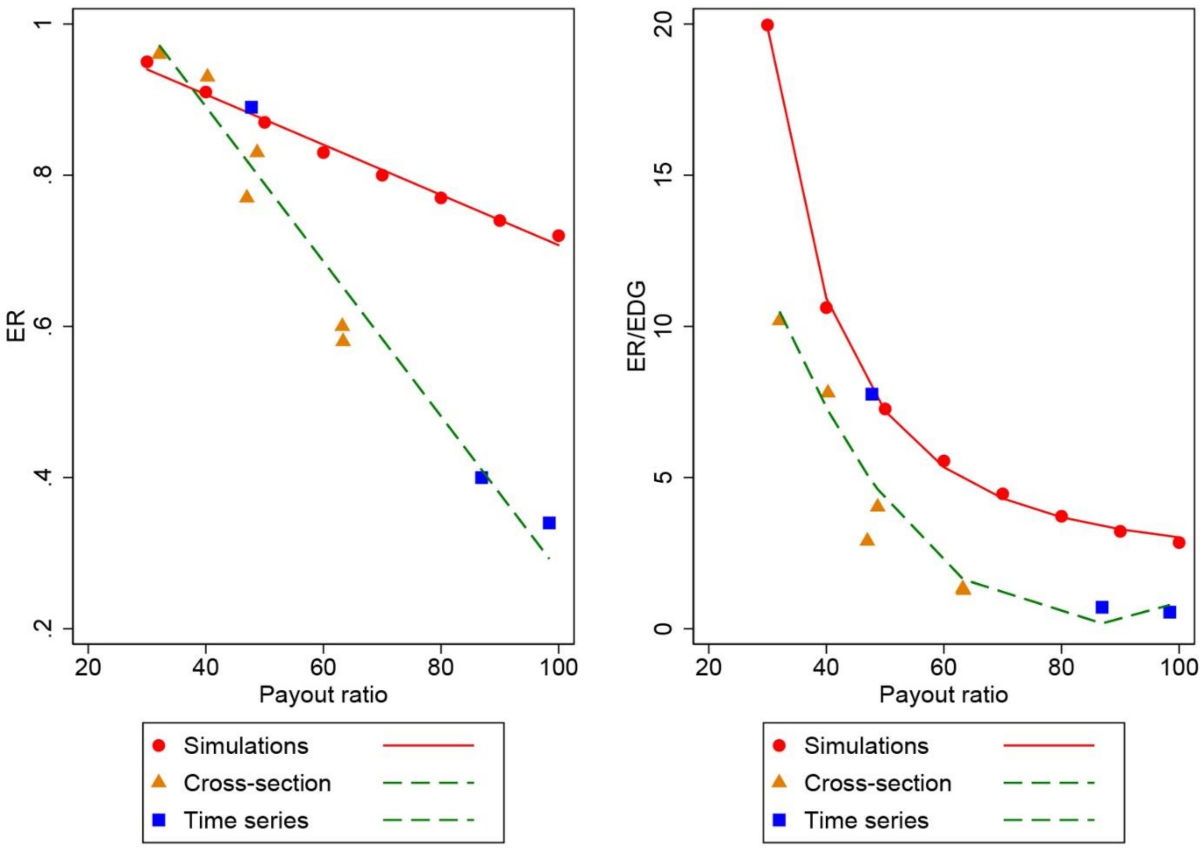


Figure 3: Fraction of expected return variation versus the payout ratio

This figure summarizes our main results. It plots the fraction of the variation in the dividend-to-price ratio coming from expected returns (*ER*, left panel) and the ratio of expected return variation over expected dividend growth variation (*ER/*EDG, right panel) for different levels of payouts. The solid line presents the fitted line for simulations. The dashed line presents the fitted line for the time-series samples and cross-sectional portfolios. In the left panel, we plot a simple linear line; in the right panel we plot a polynomial. *ER* and *EDG* are defined in Table 2.



Online Appendix

Table OA.1: Summary statistics for the cross-sectional analysis: Alternative definitions of payouts

This table reports summary statistics for annual variables in real terms for different stock portfolios. Period: 1946-2017. Column (1) includes all stocks in CRSP that, over the last 10 years, had non-missing earnings and paid out non-zero dividends. In the rest of the columns, we create portfolios where we rebalance after each calendar year. Stocks for which the payout ratio over the last 10 years was in the bottom tercile fall in the "Low" category, the second tercile in "Medium", and the top tercile in "High". Payouts are either defined as dividends and repurchases (Columns (2) to (4) or dividends, repurchases, and issuances (Column (5) to (7)). If a firm had negative payout over the last 10 years, we count it as high payout firm and set the payout ratio to the sample maximum.

	All	Payouts include repurchases			Payouts include repurchases and issuances		
		Low	Medium	High	Low	Medium	High
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
No. stocks in a portfolio							
Average	683	227	228	228	227	227	229
Min	190	63	64	63	63	64	63
Max	1231	410	411	410	410	411	410
ret (%)	6.96	7.27	6.68	7.07	7.15	7.18	6.45
Std. (%)	15.75	17.97	15.78	15.19	15.93	15.15	17.72
DY/RET	0.46	0.32	0.47	0.55	0.43	0.47	0.47
dg (%)	2.60	3.67	2.41	2.07	3.10	2.76	1.90
Std. (%)	6.45	9.06	7.94	8.59	8.11	6.69	12.34
DP (%)	3.54	2.62	3.52	4.23	3.36	3.69	3.51
Std. (%)	1.27	1.28	1.14	1.48	1.26	1.19	1.48
AR(1)	0.88	0.90	0.84	0.88	0.88	0.85	0.85

Table OA.2: Return and dividend growth predictability in the cross-section: Alternative definitions of payouts

This table reports OLS estimates of regressing annual real returns and dividend growth rates on the lagged dividend-to-price ratio for the portfolios defined in Table OA.1. Lower case letters are logs of corresponding capital letters. All regressions include a constant (not reported). Below the estimated coefficients (in parentheses) are Newey-West (1987) *t*-statistics with one lag. *ER* and *EDG* are defined in Table 2.

	All	Payouts include repurchases			Payouts include repurchases and issuances		
		Low	Medium	High	Low	Medium	High
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Dependent variable: ret							
dp	0.10	0.12	0.14	0.07	0.11	0.11	0.08
t-stat.	(2.38)	(2.53)	(2.92)	(1.52)	(2.36)	(2.27)	(1.94)
R2	0.06	0.09	0.08	0.02	0.07	0.05	0.03
Dependent variable: dg							
dp	-0.03	-0.01	-0.03	-0.06	-0.02	-0.05	-0.08
t-stat.	(-1.09)	(-0.20)	(-1.04)	(-2.43)	(-0.62)	(-2.06)	(-2.09)
R2	0.02	0.00	0.01	0.06	0.01	0.05	0.08
Dependent variable: dp							
dp	0.90	0.90	0.87	0.91	0.91	0.88	0.87
t-stat.	(19.11)	(18.43)	(16.19)	(20.02)	(19.67)	(16.74)	(16.27)
R2	0.81	0.82	0.74	0.82	0.82	0.76	0.75
ER	0.83	1.00	0.85	0.56	0.90	0.72	0.50
ER (implied)	0.79	0.95	0.81	0.51	0.87	0.69	0.47
EDG	0.21	0.05	0.19	0.49	0.13	0.31	0.53
EDG (implied)	0.17	0.00	0.15	0.44	0.10	0.28	0.50
ER/EDG	4.03	18.98	4.48	1.14	6.90	2.34	0.94