Does Firm Value Move Too Much to be Justified by Subsequent Changes in Cash Flow?*

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Abstract

The appropriate measure of cash flow for valuing corporate assets is net payout, which is the sum of dividends, interest, and net repurchases of equity and debt. Variation in net payout yield, the ratio of net payout to asset value, is mostly driven by movements in expected cash flow growth, rather than by movements in discount rates. Net payout yield is less persistent than the dividend yield and implies much smaller variation in long-horizon discount rates. Therefore, movements in the value of corporate assets can be justified by changes in expected future cash flow.

JEL classification: G12; G32; G35

Keywords: Asset valuation; Excess volatility; Payout policy

First draft: March 18, 2004

This draft: June 28, 2006

*For comments and discussions, we thank Andrew Abel, Tobias Adrian, Malcolm Baker, John Campbell, Jonathan Lewellen, Craig MacKinlay, Michael Roberts, Robert Stambaugh, and seminar participants at Dartmouth, FRB of Boston, Federal Reserve Board, Harvard, MIT, Singapore Management University, Wharton, NBER Asset Pricing Meeting 2005, and WFA Annual Meeting 2006. Maria Giduskova provided excellent research assistance. The views expressed in this paper are solely those of the authors and do not reflect official positions of the Federal Reserve Bank of Boston or the Federal Reserve System.

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Movements in stock prices cannot be explained by changes in expected future dividends (LeRoy and Porter 1981, Shiller 1981). Panel A of Figure 1 shows the log real value of a stock price index together with expected future dividends discounted at a constant rate.[1] The wedge between the two time series represents variation in discount rates implied by a forecast of stock returns by the dividend yield, the ratio of dividends to stock price. The stock price index wanders far away from expected future dividends. At the end of 2000, for example, the stock price index was approximately 100 percent higher than expected future dividends discounted at a constant rate.

In contrast, we find that movements in the value of corporate assets (equity plus liabilities) can be explained by changes in expected future cash flow. The total cash outflow from the corporate sector is *net payout*, which is the sum of dividends, interest, equity repurchase net of issuance, and debt repurchase net of issuance. Panel B of Figure 1 shows the log real asset value of U.S. nonfinancial corporations together with expected future net payout discounted at a constant rate. The wedge between the two time series represents variation in discount rates implied by a forecast of asset returns by *net payout yield*, the ratio of net payout to asset value. Asset value moves in lockstep with expected future net payout.

The stark contrast between the two panels of Figure 1 ultimately boils down to two different models of expected returns. A model of expected returns based on the dividend yield implies excessive volatility of long-horizon discount rates. A variance decomposition of the dividend yield shows that 83 percent of its variation is explained by stock returns, while 17 percent is explained by dividend growth. Moreover, the dividend yield is highly persistent with an autoregressive coefficient of 0.93. These empirical properties imply that the standard deviation of long-horizon discount rates (i.e., the wedge in Panel A) is 35 percent, which is barely within two standard errors of zero.

A model of of expected returns based on net payout yield implies much smaller variation

[1] The figure replicates Campbell, Lo and MacKinlay (1997, Figure 7.2) with the Center for Research in Security Prices (CRSP) value-weighted index for the period 1926–2004. Appendix C contains a complete description of the estimation.

in long-horizon discount rates. A variance decomposition of net payout yield shows that 12 percent of its variation is explained by asset returns, while 88 percent is explained by net payout growth. Moreover, net payout yield is much less persistent than the dividend yield with an autoregressive coefficient of 0.78. These empirical properties imply that the standard deviation of long-horizon discount rates (i.e., the wedge in Panel B) is only 8 percent, which is within one standard error of zero.

This paper does not to claim that returns are unpredictable or that discount rates are constant. Instead, our goal here is to simply document the magnitude of variation in long-horizon discount rates implied by alternative valuation models. Our work is partly motivated by a recent literature that has shown the shortcomings of the dividend yield in pinning down the magnitude of variation in discount rates. The dividend yield is highly persistent (or even non-stationarity), leading to fairly uninformative inference on the exact magnitude of return predictability.[2] In addition, the forecasting relationship between stock returns and the dividend yield appears to suffer from structural instability.[3] Partly in response to these problems, Boudoukh, Michaely, Richardson and Roberts (2004) and Robertson and Wright (2006) examine the evidence for return predictability using valuation ratios that include equity repurchase in addition to dividends.

Our focus on net payout, rather than dividends, is motivated by two considerations. First, a recent literature on corporate payout policy has broadened the scope of payout beyond ordinary dividends (see Allen and Michaely (2003) for a survey). Because firms jointly determine all components of net payout, rather than dividends in isolation, a comprehensive measure of cash flow is necessary for understanding asset valuation (Modigliani and Miller 1958). Firms tend to use dividends to distribute the permanent component of earnings because dividend policy requires financial commitment (Lintner 1956). Consequently, dividends change slowly and remain mostly independent of asset value. In contrast, firms tend to use repurchases

[2]See Campbell and Yogo (2006), Lewellen (2004), Stambaugh (1999), and Torous, Valkanov and Yan (2004).

[3]See Goyal and Welch (2003), Lettau, Ludvigson and Wachter (2006), Lettau and Van Nieuwerburgh (2006), and Viceira (1996).

to distribute the transitory component of earnings because repurchase and issuance policy retains financial discretion. Consequently, repurchases and issuances of both equity and debt are cyclical and move together with asset value (Hall 2001b).[4]

A second motivation for focusing on net payout is the difference between the "portfolio view" and the "macro view" of investment. Dividends are the appropriate measure of cash flow for an "individual investor" who owns one share of a value-weighted portfolio (e.g., the CRSP value-weighted index). The investor essentially follows a portfolio strategy in which dividends are received and net repurchases of equity are reinvested. In contrast, net payout is the appropriate measure of cash flow for a "representative investor" who owns the entire corporate sector. From a macro view, net repurchase of equity and debt is a cash outflow from the corporate sector that (by definition) cannot be reinvested. The value of corporate assets, rather than the stock price index, is related to the underlying quantity of capital and ultimately enters the representative household's intertemporal budget constraint (Abel, Mankiw, Summers and Zeckhauser 1989, Hall 2001a).

The rest of the paper is organized as follows. Section 1 sets the stage for our main results by explaining the role of equity repurchase and issuance in the valuation of total market equity. Section 2 provides an analytical and empirical description of net payout yield in the context of the firm's intertemporal budget constraint. Section 3 contains our main empirical findings on the present-value relationship between net payout and asset value. Section 4 uses the present-value model to decompose the variation in asset returns. Section 5 concludes. The appendices contain further details on the data and our empirical methodology.

1 Valuation of Market Equity

This section explains the role of equity repurchase and issuance in the valuation of total market equity. The appropriate measure of cash flow for valuing market equity is *equity*

[4]See Dittmar and Dittmar (2004), Guay and Harford (2000), and Jagannathan, Stephens and Weisbach (2000) for related evidence on equity repurchase.

payout, which is the sum of dividends and equity repurchase net of issuance. We initially focus on cash flows to equity holders in isolation of cash flows to debt holders for two reasons. First, most of the literature on excess volatility since Shiller (1981) is about stock returns in relation to cash flows to equity holders. Second, an empirical understanding of equity payout will be useful in highlighting the unique role that debt payout plays in explaining the variation in asset value.

1.1 Dividend Yield versus Equity Payout Yield

Let P and D denote the price and dividend per share of equity. The return on equity for the holding period t to $t+1$ is

$$R_{t+1} = \frac{P_{t+1} + D_{t+1}}{P_t}. \tag{1}$$

Let $[\cdot]^+$ be an operator that takes the positive part of the expression inside the brackets (and takes the value zero if the expression is negative). Multiplying the numerator and the denominator of equation (1) by the number of shares outstanding in period t,

$$R_{t+1} = \frac{\mathrm{ME}_{t+1} + \mathrm{DIV}_{t+1} + \mathrm{REP}_{t+1} - \mathrm{ISS}_{t+1}}{\mathrm{ME}_t}, \tag{2}$$

where

$$\begin{aligned}
\mathrm{ME}_t &= P_t \times \mathrm{Shares}_t, \\
\mathrm{DIV}_{t+1} &= D_{t+1} \times \mathrm{Shares}_t, \\
\mathrm{REP}_{t+1} &= P_{t+1}[\mathrm{Shares}_t - \mathrm{Shares}_{t+1}]^+, \\
\mathrm{ISS}_{t+1} &= P_{t+1}[\mathrm{Shares}_{t+1} - \mathrm{Shares}_t]^+.
\end{aligned}$$

Equation (1) is the return on one share of equity, and equation (2) is the return on all outstanding shares of equity. Equity return is the *same* in both cases, but they have different implications for cash flow. An investor who owns one share receives dividends as the cash outflow from the firm. An investor who owns all outstanding shares receives dividends and equity repurchase as the cash outflow from the firm, but in addition, invests equity issuance as the cash inflow to the firm. We refer to the ratio D_t/P_t as dividend yield, and the ratio $(\mathrm{DIV}_t + \mathrm{REP}_t - \mathrm{ISS}_t)/\mathrm{ME}_t$ as *equity payout yield*. The two valuation ratios coincide only in a world where the number of shares outstanding remains constant over time.

The dividend yield and equity payout yield represent a subtle but important difference between a microeconomic and a macroeconomic view of investment. This conceptual difference can be understood in terms of portfolio strategies. The dividend yield is the appropriate valuation ratio for an investor who owns one share of equity; this investor receives dividends, reinvests repurchases, and never invests additional capital. Equity payout yield is the appropriate valuation ratio for an investor who owns all outstanding shares of equity; this investor receives dividends, receives repurchases, and invests issuances as additional capital. At the macroeconomic level, net repurchase of equity is an outflow from the corporate sector that cannot be reinvested (except through net issuance of debt). Therefore, the portfolio strategy implicit in dividend yield is feasible only at the microeconomic level, while the portfolio strategy implicit in equity payout yield is also feasible at the macroeconomic level.

Figure 2 shows the time series of dividend yield and equity payout yield for all NYSE, AMEX, and NASDAQ stocks for the period 1926–2004. As in Boudoukh et al. (2004), we construct equity payout yield for a monthly rebalanced value-weighted portfolio using the CRSP Monthly Stock Database. We keep track of all cash flows in equation (2) for individual stocks, including potentially important terminal cash distributions through CRSP's delisting data. We then aggregate returns and cash flows across all stocks in the portfolio.

Dividend yield is less volatile and more persistent than equity payout yield. The high persistence of dividend yield has led Boudoukh et al. (2004) to question its stationarity, finding evidence for a structural break in 1984. Dividend yield is above equity payout yield for most of the sample period, indicating a net capital inflow to the market equity of U.S. corporations. Equity payout can be negative whenever issuance exceeds dividends plus repurchase. The two striking troughs in equity payout yield at the end of 1929 and 2000 are such episodes, which are interestingly at the end of stock market booms.

1.2 Variance Decomposition of Dividend Yield

In Panel A of Table 1, we estimate the joint dynamics of equity return, dividend growth, and dividend yield through a vector autoregression (VAR). Appendix C contains a complete description of the estimation. As shown in the first column, past equity return and dividend growth have little forecasting power for equity return; the coefficients are not significantly different from zero. However, high dividend yield predicts high equity returns with a *t*-statistic of almost two (Campbell and Shiller 1988, Fama and French 1988). As shown in the second column, neither past equity return, dividend growth, nor dividend yield have forecasting power for dividend growth. As shown in the last column, dividend yield is essentially an autoregression with coefficient of 0.93.

Using the VAR model, we examine the valuation of the stock price index in relation to dividends. The particular framework that we adopt is the log-linear present-value model of Campbell and Shiller (1988), which can be interpreted as a dynamic version of the Gordon growth model that allows for time variation in discount rates and expected cash flow growth. We decompose the variance of dividend yield into its covariance with future equity returns, future dividend growth, and future dividend yield (Cochrane 1992). Section 3 contains a complete description of the variance decomposition. We report the results in Panel A of Table 2.

At a one-year horizon, 10 percent of the variation in dividend yield is explained by future equity returns, none is explained by future dividend growth, and 90 percent is explained by future dividend yield. At longer horizons, the variation in dividend yield is increasingly explained by future equity returns. In the infinite-horizon limit, 83 percent of the variation in dividend yield is explained by future equity returns, while only 17 percent is explained by future dividend growth. The variance decomposition shows that the transitory variation in discount rates is large relative to the transitory variation in expected dividend growth. Roughly speaking, the permanent component of dividend yield is dividends, while any deviation in stock price from dividends is transitory.

Instead of reporting the relative variation, the last row of Panel A of Table 2 reports the actual magnitude of variation in expected returns and expected dividend growth. The standard deviation of infinite-horizon expected returns is 35 percent, while the standard deviation of infinite-horizon expected dividend growth is 8 percent. In relation to Panel A of Figure 1, this 35 percent is the standard deviation of the wedge between the stock price index and expected future dividends discounted at a constant rate. Because the variation in discount rates implied by the dividend yield is large, stock price cannot be explained by changes in expected future dividends.

1.3 Variance Decomposition of Equity Payout Yield

In Panel B of Table 1, we estimate the joint dynamics of equity return, equity payout growth, and equity payout yield through a VAR.[5] As shown in the first column, high equity payout yield predicts high equity returns with a t-statistic of four (Boudoukh et al. 2004, Robertson and Wright 2006). The R^2 of the regression is 8 percent, compared to 4 percent for the dividend yield in Panel A. Equity payout yield leads to stronger evidence for short-run predictability than the dividend yield, in the sense that the implied expected return has greater variation at the one-year horizon. As shown in the second column, high equity payout yield also predicts low equity payout growth with a t-statistic above two and an R^2 of 29 percent. In contrast to dividends, there is strong mean reversion in equity payout. As shown in the last column, equity payout yield is essentially an autoregression with coefficient of 0.81, which is less persistent than the dividend yield.

Panel B of Table 2 reports the variance decomposition of equity payout yield. At a one-year horizon, 4 percent of the variation in equity payout yield is explained by future equity

[5] The fact that equity payout can be negative requires a technical (not conceptual) modification to the definition of equity payout growth, which is explained in Appendix D.

returns, 20 percent is explained by future equity payout growth, and 76 percent is explained by future equity payout yield. At longer horizons, the variation in equity payout yield is increasingly explained by future equity payout growth. In the infinite-horizon limit, only 16 percent of the variation in equity payout yield is explained by future equity returns, while 84 percent is explained by future equity payout growth. The variance decomposition shows that the transitory variation in discount rates is small relative to the transitory variation in expected equity payout growth. Changes in equity repurchase and issuance are highly predictable, while changes in dividends are not.

Figure 3 shows log real market equity of NYSE, AMEX, and NASDAQ stocks together with expected future equity payout discounted at a constant rate. The wedge between the two time series represents variation in discount rates implied by a forecast of stock returns by equity payout yield. The figure shows that movements in market equity cannot entirely be explained by changes in expected future cash flow. At the end of 2000, for example, market equity was approximately 50 percent higher than expected future equity payout. However, the wedge between the two time series in Figure 3 is smaller than the wedge between the two time series in Panel A of Figure 1. Because equity payout yield is less persistent than the dividend yield, it implies smaller variation in long-horizon expected returns. As reported in Panel B of Table 2, the standard deviation of infinite-horizon expected returns implied by equity payout yield is 25 percent, which is smaller than the 35 percent implied by the dividend yield. Ackert and Smith (1993) report similar evidence for the Toronto Stock Exchange.

1.4 The Role of Equity Repurchase and Issuance

A case study of the period 1945–1955 illustrates the role that equity repurchase and issuance play in reducing the implied volatility of long-horizon discount rates. In the postwar period, firms issued equity to finance high investment. Therefore, dividends remained unusually high, while equity payout was much closer to the historical norm (see Figure 2). Based on the unusually high dividend yield, we are forced to conclude that discount rates were high relative to expected dividend growth (Panel A of Figure 1). Based on equity payout yield, we can instead conclude that discount rates were in line with expected equity payout growth (Figure 3).

The VAR models in Table 1 use different sets of conditioning information and consequently represent different models of expected returns. Table 3 explicitly links the two models to clarify the role of equity payout in reducing the magnitude of variation in long-horizon expected returns. We estimate a VAR in equity return, equity payout growth, equity payout-dividend ratio, and dividend yield. Because equity payout yield is the sum of the equity payout-dividend ratio and the dividend yield in logs, Table 3 can be interpreted as an unconstrained version of the VAR in Panel B of Table 1. We loosely refer to log equity payout-dividend ratio as "net equity repurchase" since equity payout minus dividends is equal to net equity repurchase in levels.

On the one hand, high net equity repurchase predicts high equity returns, implying that expected return is low when equity issuance is high (Baker and Wurgler 2000). On the other hand, high net equity repurchase predicts low equity payout growth. Therefore, net equity repurchase captures independent variation in expected returns and expected equity payout growth. High dividend yield predicts, although not significantly, both high equity returns and high equity payout growth. Therefore, the dividend yield captures common variation in expected returns and expected equity payout growth. In the ratio of equity payout to market equity, the persistent variation in discount rates implied by the dividend yield, which is responsible for excess volatility, gets offset to some extent by variation in expected equity payout growth.

1.5 Limitations of Equity Payout

Since the purpose of this paper is to examine the valuation of corporate assets in relation to cash flow, equity payout is an incomplete account of the relevant cash flows for two reasons. First, equity issuance, as measured by changes in shares outstanding, may represent transfer of ownership rather than actual cash flow. Important examples of such transactions are equity-financed mergers and equity issued as part of executive compensation. In 2000, equity issued through mergers (executive compensation) was 4.31 percent (1.23 percent) of the assets of S&P 100 firms (Fama and French 2005, Table 7). This explains why equity payout yield falls to a historical low in 2000 (see Figure 2). Second, equity repurchase and issuance do not represent cash flow if there are offsetting transactions in debt. Since firms tend to offset equity issuance through debt repurchase, equity payout can understate the total cash outflow from the corporate sector during periods of high equity issuance. In order to account for all the cash flows, we now build a present-value model starting with the flow of funds identity for the corporate sector.

2 Description of Net Payout Yield

2.1 A Firm's Intertemporal Budget Constraint

In order to develop the firm's intertemporal budget constraint, we first introduce the following quantities.

- Y_t: Earnings net of taxes and depreciation in period t.
- C_t: Net payout, or the net cash outflow from the firm, in period t. It is composed of dividends, equity repurchase net of issuance, interest, and debt repurchase net of issuance.
- I_t: Investment net of depreciation in period t.
- A_t: Market value of assets at the end of period t.
- C_t/A_t: Net payout yield at the end of period t.
- $R_{t+1} = 1 + Y_{t+1}/A_t$: Return on assets in period $t + 1$.

Investment includes both capital expenditures (on property, plant, and equipment) and financial investment. Since we are interested in the market value of assets, the relevant notion of depreciation is economic rather than accounting. Economic depreciation includes capital gains and losses from changes in the market value of assets.

The flow of funds identity states that the sources of funds must equal the uses of funds,

$$Y_t = C_t + I_t. \tag{3}$$

The capital accumulation equation is

$$A_{t+1} = A_t + I_{t+1}. \tag{4}$$

Equations (3) and (4) together imply that

$$A_{t+1} + C_{t+1} = R_{t+1} A_t. \tag{5}$$

This equation can be interpreted as the firm's intertemporal budget constraint. It is analogous to a household's intertemporal budget constraint: C represents consumption, A represents wealth, and R represents the return on wealth. It is also analogous to the formula for equity return (see equations (1) and (2)).

2.2 Data on Payout, Issuance, and Asset Value

We construct net payout and the market value of assets for the nonfarm, nonfinancial corporate sector as described in Appendix A. Our primary data source is the *Flow of Funds Accounts of the United States* (Board of Governors of the Federal Reserve System 2005), which is available at annual frequency since 1946. We extend the sample back to 1926 using hand-collected data from original sources.[6] In constructing the data set, we contribute to the

[6] Although all of the reported results are for the full sample 1926–2004, the results are essentially the same for the postwar sample 1946–2004.

corporate payout literature by documenting the history of payout, issuance, and asset value for the last 79 years. Our data allow us to quantify, from a macroeconomic perspective, the relative importance of historical events such as the tightening of bond markets during the Great Depression, the leveraged buyouts of the 1980s, and the surge of equity repurchase activity in the last twenty years.

Our secondary data source is Compustat. The data are available at annual frequency for the period 1971–2004 (because our construction requires the statement of cash flows). We construct net payout and the market value of assets for publicly traded nonfinancial firms by aggregating firm-level data as described in Appendix B. One advantage of Compustat is that repurchase and issuance are separately observed. Another advantage is that the market value of equity is directly observed, and the market value of long-term debt can be imputed by explicitly accounting for the maturity structure (Brainard, Shoven and Weiss 1980). This procedure leads to an arguably better measure of the market value of assets. The disadvantages of Compustat are the short sample period and the lack of coverage of private corporations. We therefore view the Flow of Funds as our main evidence and Compustat as supporting evidence. In an average year during 1971–2004, firms in Compustat represent 54 percent of the assets in the Flow of Funds.

2.3 Description of Payout, Issuance, and Asset Value

Table 4 reports summary statistics of the main variables. In the Flow of Funds, net payout is 1.7 percent of assets on average with a standard deviation of one percent. Dividends are the largest component of net payout. Net equity and debt repurchases represent a smaller component of net payout on average, but they are as volatile as dividends. The autocorrelation of net payout yield is 0.81, and its components are also persistent. The Compustat sample paints a similar picture. *Net* repurchases of both equity and debt are smaller than dividends. However, equity repurchase and issuance are comparable to dividends on average, while long-term debt repurchase and issuance represent a larger fraction of assets.

Figure 4 shows the time series of net payout yield (Panel A) and its components (Panel B) in the Flow of Funds. Net payout has been positive in every year since 1926, which has been cited as evidence that the U.S. economy is dynamically efficient (Abel et al. 1989). The 1930s and the 1980s are periods of high net payout compared to other decades. These two peaks are driven by different forces. The 1930s is a decade of high dividends and high debt repurchase; this is explained by the difficulty that firms had in issuing new debt during the Great Depression (Hickman 1952). In contrast, the 1980s is a decade of high equity repurchase and low debt repurchase. The high equity repurchase is partly explained by merger activity in the 1980s (see Andrade, Mitchell and Stafford (2001) and Baker and Wurgler (2000)). Allen and Michaely (2003) argue that cash distributions related to merger activity are an important source of payout to shareholders (one that is often neglected by researchers).

Panel B of Figure 4 shows that dividends have fallen relative to asset value throughout the sample period. The downward trend is explained by the fact that earnings have fallen relative to asset value, although dividends have not fallen relative to earnings (DeAngelo, DeAngelo and Skinner 2004, Fama and French 2001). Equity repurchase has increased recently, particularly after the adoption of Securities and Exchange Commission Rule 10b-18 in 1982 (Grullon and Michaely 2002). As reported in Panel A of Table 4, the correlation between dividends and net equity repurchase, both as fractions of assets, is -0.47. In the most recent decade, dividends are clearly low relative to asset value, but net payout is not unusually low when put into historical perspective. Panel B of Figure 4 also shows that periods of high net equity repurchase tend to be periods of low net debt repurchase. As reported in Panel A of Table 4, the correlation between net equity and debt repurchase, both as fractions of assets, is -0.26.

As shown in Panel A of Figure 5, net payout in Compustat is on average a higher fraction of assets than in the Flow of Funds. This can be explained by the fact that firms that go private disappear from Compustat, but remain in the corporate sector as defined by the Flow of Funds. In Compustat, the terminal cash flow (as equity repurchase) from a firm that goes private is recorded as an outflow from the publicly traded sector. The Flow of Funds nets out such transactions between public and private corporations. For example, the leveraged buyouts of the 1980s explain why the net payout yield peaks at 6 percent in Compustat and at only 3 percent in the Flow of Funds during the same period. As reported in Panel B of Table 4, the correlation between equity repurchase and long-term debt issuance, both as fractions of assets, is 0.34 for the Compustat sample. Kaplan (1991) reports that 62 percent of large leveraged buyouts during the period 1979–1986 remained privately owned in 1990.

Panel B of Figure 5 identifies "hot markets" for equity issuance during the period 1971–2004. Equity issuance, as a fraction of assets, peaked in 1983. Equity issuance again peaked in 2000, but not at the unusually high level suggested by the rise in shares outstanding (see Figure 2). As discussed in Section 1, much of equity issuance in this period was due to equity-financed mergers and executive compensation, which are not part of cash transactions recorded in Compustat. As shown in Panel C, the market for long-term debt was particularly depressed in 1983, interestingly coinciding with the hot equity market. Debt issuance rose throughout the rest of the 1980s and peaked in 1992.

Table 5 performs a simple accounting decomposition that summarizes the sources of time variation in net payout yield. By definition, the variance of net payout yield is equal to the sum of the covariances of net payout yield with its components. The covariances, scaled by the variance of net payout yield, represent the fraction of the time variation in net payout yield explained by each component. In the Flow of Funds sample, each of the four components (dividends, interest, net equity repurchase, and net debt repurchase) accounts for a similar fraction of the variation in net payout yield, between 20 and 30 percent. In the Compustat sample, net equity repurchase plays a more prominent role, accounting for 45 percent of the variation in net payout yield, while net debt repurchase accounts for only 5 percent of the variation. Most of the variation in the net equity flow is explained by repurchase (47 percent) rather than issuance (−2 percent).

2.4 Description of Asset Return

Panel A of Figure 6 shows the time series of real asset returns, together with real equity returns, for the period 1926–2004. The correlation between asset returns and equity returns is 0.97. Asset return has mean of 5.4 percent and standard deviation of 12.2 percent (see Table 4 and also Fama and French (1999, Table V)). Panel B shows the time series of real net payout growth, together with real dividend growth, for the period 1926–2004. The correlation between net payout growth and dividend growth is 0.01. Net payout growth has mean of 3.8 percent and standard deviation of 38.4 percent (see Table 4), which is much more volatile than dividend growth.

A key empirical finding of this paper, documented in the next section, is that the variation in net payout yield is mostly explained by future net payout growth, rather than by future asset returns. Figure 6 provides a simple intuition for our finding. Net payout growth is more volatile than asset returns in the short run. If net payout yield is stationary, the volatility of net payout growth must fall, through mean reversion, to that of asset returns in the long run. In contrast, equity returns are more volatile than dividend growth in the short run. If the dividend yield is stationary, the volatility of equity returns must fall, through mean reversion, to that of dividend growth in the long run.

3 Valuation of Corporate Assets

3.1 Present-Value Relationship between Net Payout and Asset Value

Under the assumption that net payout yield is stationary, the market value of assets can be approximated through a log-linear present-value formula (Campbell and Shiller 1988). Let lowercase letters denote the log of the corresponding uppercase variables, and let Δ denote the first-difference operator. Let $v_t = \log(C_t/A_t)$ denote the log of net payout yield.

Log-linear approximation of equation (5) leads to a difference equation for net payout yield

$$v_t \approx r_{t+1} - \Delta c_{t+1} + \rho v_{t+1}, \tag{6}$$

where $\rho = 1/(1+\exp\{\mathbf{E}[v_t]\})$. The constant in the approximation is suppressed (equivalently, all the variables are assumed to be de-meaned) to simplify notation here and throughout the paper.

Solving equation (6) forward H periods,

$$v_t = r_t(H) - \Delta c_t(H) + v_t(H), \tag{7}$$

where

$$\begin{aligned} r_t(H) &= \sum_{s=1}^{H} \rho^{s-1} r_{t+s}, \\ \Delta c_t(H) &= \sum_{s=1}^{H} \rho^{s-1} \Delta c_{t+s}, \\ v_t(H) &= \rho^H v_{t+H}. \end{aligned}$$

In the infinite-horizon limit, equation (7) becomes

$$v_t = \sum_{s=1}^{\infty} \rho^{s-1}(r_{t+s} - \Delta c_{t+s}), \tag{8}$$

where convergence of the sum is assured by the stationarity of net payout yield.

Equation (8) also holds ex ante as a present-value formula

$$v_t = \mathbf{E}_t \sum_{s=1}^{\infty} \rho^{s-1}(r_{t+s} - \Delta c_{t+s}). \tag{9}$$

Net payout yield summarizes a firm's expectations about future changes in asset value and cash flow, just as the consumption-wealth ratio summarizes a household's expectations about future changes in wealth and consumption (Campbell and Mankiw 1989). Equation (9) says that net payout yield is high when expected asset returns are high or expected net payout growth is low. If movements in discount rates were perfectly offset by movements in expected cash flow growth, net payout yield would be constant. Therefore, net payout yield must forecast independent (as opposed to common) variation in asset returns or net payout growth.

Rearranging equation (9),

$$a_t = c_t + \mathbf{E}_t \sum_{s=1}^{\infty} \rho^{s-1} \Delta c_{t+s} - \mathbf{E}_t \sum_{s=1}^{\infty} \rho^{s-1} r_{t+s}. \tag{10}$$

The first two terms on the right side of this equation can be interpreted as expected net payout under a constant discount rate. The last term on the right side can be interpreted as deviation from the constant discount rate present-value model. We use equation (10) to assess whether changes in expected future cash flow justify movements in asset value.

3.2 Variance Decomposition of Net Payout Yield

In Table 6, we estimate the joint dynamics of asset return, net payout growth, and net payout yield through a VAR. Panel A reports results for the Flow of Funds, and Panel B reports results for Compustat. As shown in the first column, past asset return and past net payout growth have little forecasting power for asset returns; the coefficients are not significantly different from zero. However, net payout yield is a better predictor of asset returns. The evidence for predictability is stronger in Compustat with a t-statistic of two and an R^2 of 9 percent. As shown in the second column, past asset return and past net payout growth have little forecasting power for net payout growth. However, high net payout yield strongly predicts low net payout growth. The evidence for predictability is stronger in the Flow of Funds with a t-statistic of three and an R^2 of 15 percent. Simply put, there is strong mean reversion in net payout. As shown in the last column, net payout yield is essentially an autoregression with coefficient of 0.78 in the Flow of Funds. Net payout yield is less persistent than both the dividend yield and equity payout yield.

The intertemporal budget constraint (7) implies a variance decomposition of net payout yield

$$\mathrm{Var}(v_t) = \mathrm{Cov}(r_t(H), v_t) + \mathrm{Cov}(-\Delta c_t(H), v_t) + \mathrm{Cov}(v_t(H), v_t). \tag{11}$$

Panel A of Table 7 reports this variance decomposition for the Flow of Funds, which is estimated through the VAR model in Table 6. At a one-year horizon, two percent of the variation in net payout yield is explained by future asset returns, 21 percent is explained by future net payout growth, and 76 percent is explained by future net payout yield. At longer horizons, the variation in net payout yield is increasingly explained by future net payout growth. In the infinite-horizon limit, 12 percent of the variation is explained by future asset returns, while 88 percent is explained by future net payout growth. The hypothesis that none of the variation in net payout yield is explained by future asset returns cannot be rejected. The results are similar for Compustat as shown in Panel B of Table 7, although the shorter sample leads to somewhat larger standard errors.

We can summarize the variance decomposition in Table 7 in the language of cointegration. Net payout, the cash outflow from the corporate sector, and the value of corporate assets are cointegrated. When net payout yield deviates from its long-run mean, either net payout or asset value must revert to the common trend to restore the long-run equilibrium. Asset value is the permanent component of net payout yield, while any deviation in net payout from asset value is transitory. Therefore, net payout yield mostly predicts net payout growth rather than asset returns, especially over long horizons.

The dynamics of net payout yield, revealed by the variance decomposition, has important implications for the present-value relationship between net payout and asset value. The solid line in Panel B of Figure 1 is the log real asset value of nonfinancial corporations in the Flow of Funds. The dashed line is expected future net payout discounted at a constant rate, which corresponds to the sample analog of the first two terms in equation (10). As reported in

Table 7, the standard deviation of infinite-horizon expected returns, which corresponds to the last term in equation (10), is only 8 percent and within one standard error of zero. Net payout yield implies considerably smaller variation in long-horizon expected returns than the dividend yield.

3.3 The Role of Debt Payout

A case study of the period 1990–2000 illustrates the role that debt payout plays in reducing the implied volatility of long-horizon discount rates. In this recent period, firms repurchased debt to offset equity issuance. Therefore, equity payout remained unusually low, while net payout was much closer to the historical norm (see Figure 4). Based on the unusually low equity payout yield, we are forced to conclude that discount rates were low relative to expected equity payout growth (Figure 3). Based on net payout yield, we can instead conclude that discount rates were in line with expected net payout growth (Panel B of Figure 1).

This counterbalancing effect of debt is the key to understanding why net payout yield implies smaller variation in expected returns than equity payout yield. In order to make this point more generally, Table 8 estimates a VAR in asset return, net payout growth, net payout-equity payout ratio, and equity payout-assets ratio. Because net payout yield is the sum of the net payout-equity payout ratio and the equity payout-assets ratio in logs, Table 8 can be interpreted as an unconstrained version of the VAR in Table 6. We loosely refer to log net payout-equity payout ratio as "debt payout" (i.e., interest plus net debt repurchase) since net payout minus equity payout is equal to debt payout in levels.

High equity payout-assets ratio predicts high asset returns, which implies that expected returns are low when net equity issuance is high. This is consistent with our findings in Panel B of Table 1, given that asset returns and equity returns are highly correlated (see Panel A of Figure 6). At the same time, high debt payout predicts low asset returns, which implies that expected returns are low when net debt repurchase is high. However, the combination of high equity issuance and high debt repurchase, which tend coincide empirically, implies smaller variation in expected returns than that implied by the equity payout-assets ratio alone. In the asset return regression of Table 8, the coefficient on debt payout is smaller than the coefficient on the equity payout-assets ratio. Therefore, the average of the two coefficients, which loosely is the coefficient for net payout yield, implies smaller variation in expected returns than the equity payout-assets ratio.

4 Explaining Asset Returns through the Present-Value Model

4.1 Empirical Framework

This section explains the variation in *unexpected* asset returns through the present-value relationship between net payout and asset value. Our empirical framework is based on the firm's intertemporal budget constraint (Campbell 1991). Subtracting the expectation of equation (8) at time t from its expectation at time $t+1$,

$$r_{t+1} - \mathbf{E}_t r_{t+1} = -(\mathbf{E}_{t+1} - \mathbf{E}_t) \sum_{s=2}^{\infty} \rho^{s-1} r_{t+s} + (\mathbf{E}_{t+1} - \mathbf{E}_t) \sum_{s=1}^{\infty} \rho^{s-1} \Delta c_{t+s}. \tag{12}$$

This equation takes the view of an investor who rationalizes realized asset returns through changes in discount rates and changes in expected cash flow growth. Asset return is unexpectedly high when discount rates fall or expected cash flow growth rises. An analogous decomposition applies for equity returns.

4.2 Variance Decomposition of Equity Return

Panel A of Table 9 reports a variance decomposition of unexpected equity returns for an investor who owns one share of equity and receives dividends as the cash flow. By equation

(12), the variance of unexpected equity returns must equal the variance of changes in discount rates, plus the variance of changes in expected dividend growth, minus twice the covariance between the two changes. Appendix C contains a complete description of the estimation. Holding constant discount rates, only 38 percent of the variation in equity returns is explained by dividends.

Panel B reports a variance decomposition of equity returns for an investor who owns all outstanding shares of equity and receives equity payout as the cash flow. The first estimate is based on the VAR in Table 1, in which the main predictor variable is equity payout yield. The second estimate is based on the VAR in Table 3, in which the main predictor variables are the equity payout-dividend ratio and the dividend yield. Holding constant discount rates, at most 61 percent of the variation in equity returns can be explained by equity payout. The rest must be explained by variation in discount rates, implying excess volatility of equity returns.

The covariance between changes in expected returns and expected equity payout growth is positive, while the same covariance is negative in the case of dividend growth. That is, news about rising discount rates are related to news about rising expected equity payout growth. This is consistent with our finding in Table 3, that there is common variation in expected returns and expected equity payout growth.

4.3 Variance Decomposition of Asset Return

Table 10 reports a variance decomposition of unexpected asset returns. Panel A reports results for the Flow of Funds, and Panel B reports results for Compustat. In each panel, the first estimate is based on the VAR in Table 6, in which the main predictor variable is net payout yield. The second estimate is based on the VAR in Table 8, in which the main predictor variables are the net payout-equity payout ratio and the equity payout-assets ratio. Since the results are similar, we focus our discussion on the first estimate in Panel A.

Holding constant discount rates, 124 percent of the variation in asset returns is explained by net payout. The covariance between changes in expected returns and expected net payout growth accounts for 38 percent of the variation in asset returns. That is, news about rising discount rates are related to news about rising expected cash flow growth. This offsetting effect between expected returns and cash flow growth explains why unexpected asset returns are 24 percent less volatile than changes in expected cash flow growth.

In contrast to unexpected equity returns, unexpected asset returns are less volatile for two reasons. First, asset returns are less volatile than equity returns (see Panel A of Figure 6), so there is less volatility to explain. Second, and more importantly, changes in expected cash flow growth are larger when debt payout is included. Our findings are broadly consistent with previous empirical evidence. Campbell and Ammer (1993) find that bond returns are mostly driven by inflation expectations, rather than discount rates. Since nominal payments are fixed for pure-discount bonds, a change in expected inflation is effectively a change in real cash flows. Since net payout includes cash flows to debt holders, changes in expected cash flows become a relatively more important source of variation in asset returns.

5 Conclusion

There is now a volume of research showing that stock returns are predictable, and financial economists (including ourselves) are in general agreement that discount rates are time varying. This fact should be of primary importance in the valuation of firms and projects, but classroom and business practice seems to suggest otherwise. In introductory finance classes, we teach students to discount expected future cash flow at a constant discount rate. In corporations, managers spend much effort in projecting future cash flow, but relatively little effort in justifying discount rates. One interpretation is that classroom and business practice lags academic research, partly because present-value calculations are much more difficult with time-varying discount rates (see Ang and Liu (2004)). A second interpretation is that the value of firms and projects is mostly driven by changes in expected future cash flow, rather than by changes in discount rates. This paper favors the second interpretation.

Because true discount rates are ultimately unobservable, we can only infer their movements based on variables that forecast returns. Valuation ratios are natural predictor variables because they must forecast returns or cash flow growth, provided that they are stationary. Panel B of Figure 4 shows that dividends have fallen ruthlessly relative to asset value throughout U.S. history. The non-stationary behavior of the dividend yield forces us to conclude that there is huge variation in long-horizon discount rates, deeming the constant discount rate present-value model useless. In contrast, Panel A of Figure 4 shows that the total cash outflow from the corporate sector has a much more stable relationship with asset value. The behavior of net payout yield allows us to conclude that the variation in long-horizon discount rates is much smaller, implying that the constant discount rate present-value model is a useful approximation for valuing corporate assets.

Appendix A Flow of Funds Data

For the period 1946–2004, our primary data source is the Board of Governors of the Federal Reserve System (2005). We obtain the book value of liabilities and net worth from Table B.102 (Balance Sheet of Nonfarm Nonfinancial Corporate Business). We obtain net dividends, net new equity issues, net increase in commercial paper, and net increase in corporate bonds from Table F.102 (Nonfarm Nonfinancial Corporate Business). We obtain net interest payments from National Income and Product Accounts (NIPA) Table 1.14 (Gross Value Added of Nonfinancial Domestic Corporate Business).

For the period 1926–1945, we collect data from original sources, following the Federal Reserve Board's basic methodology. We refer to Wright (2004) for a related construction that focuses on equity. We obtain the book value of liabilities and net worth from various volumes of the U.S. Treasury Department (1950, Table 4). Liabilities are the sum of accounts payable; bonds, notes, and mortgages payable; and other liabilities. Net worth is the difference between assets and liabilities. From the total for all industrial groups, we subtract the liabilities and net worth for "agriculture, forestry, and fishery" and "finance, insurance, real estate, and lessors of real property." We obtain net issues of equity and corporate bonds from Goldsmith (1955, Table V-14). Net issues of equity are the sum of net issues of common stock (Table V-19) and preferred stock (Tables V-17 and V-18). We aggregate net issues over industrials, utilities, railroads, the Bell system, and new incorporations. For the period 1926–1928, we obtain dividends and interest payments, excluding the agriculture and finance sectors, from Kuznets (1941, Tables 54 and 55). For the period 1929–1945, these data are from NIPA Table 1.14.

In order to compute the market value of net worth, we first compute the book-to-market equity ratio for all NYSE, AMEX, and NASDAQ stocks. Following Davis, Fama and French (2000), we compute book equity for Compustat firms and merge it with historical data from Moody's Manuals, available through Kenneth French's webpage. We then merge the book equity data with the CRSP Monthly Stock Database to compute the aggregate book-to-market ratio at the end of each calendar year. We exclude the SIC codes 100–979 and 6000–6799 to focus on nonfarm nonfinancial firms. The market value of net worth is the book value of net worth divided by the aggregate book-to-market ratio.

Net payout is the sum of dividends and interest payments minus the sum of net equity and corporate debt issues. The market value of assets is the sum of book value of liabilities and the market value of net worth. The return on assets is computed from the market value of assets and net payout through equation (5). All nominal quantities are deflated by the December value of the Consumer Price Index (CPI) from the Bureau of Labor Statistics.

Appendix B Compustat Data

We construct our data set by merging the Compustat Annual Industrial Database with the CRSP Monthly Stock Database. We exclude the SIC codes 6000–6799 to focus on nonfinancial firms. Table 11 lists the relevant variables from Compustat.

We construct payout and securities issuance from the statement of cash flows as

$$\begin{aligned} D &= \mathrm{DIV} + \mathrm{EQ\_REP} + \mathrm{INT} + \mathrm{LTD\_REP} + [-\mathrm{DEBT\_NET}]^{+}, \\ E &= \mathrm{EQ\_ISS} + \mathrm{LTD\_ISS} + [\mathrm{DEBT\_NET}]^{+}, \end{aligned}$$

where $[\cdot]^{+}$ is an operator that takes the positive part of the expression inside the brackets (and takes the value zero if the expression is negative). See Richardson and Sloan (2003) for a similar construction. In order to account for equity repurchases that occur during mergers, acquisitions, and liquidations, we use CRSP's delisting data. The terminal cash outflow D from the firm is the delisting amount times the number of shares outstanding (both from CRSP) whenever the delisting code is 233, 261, 262, 333, 361, 362, or 450.

We construct the market value of each firm as the sum of the market value of its common stock, preferred stock, long-term debt, and other liabilities. We follow the conventional procedure in the literature except in the treatment of other liabilities, to be consistent with the definition of assets for our application (see Bernanke and Campbell (1988), Brainard et al. (1980), and Hall, Cummins, Laderman and Mundy (1988)). The market value of common stock is the price of common stock times the number of shares outstanding at the end of calendar year. The market value of preferred stock is DIV_PREF divided by Moody's medium-grade preferred dividend yield at the end of calendar year. Other liabilities consists of LIAB_CUR, and if available, LIAB_OTH, TAX, and MINORITY.

The market value of long-term debt is computed by first imputing the maturity structure of bonds for each firm. All long-term bonds are assumed to be issued at par at the end of a calender year, with semiannual coupons payments, and with maturity of 20 years. For a firm that exists in Compustat in 1958, its initial maturity structure is given by Hall et al. (1988, Table 2.3). For a firm that enters Compustat in subsequent years, its initial maturity structure is given by the global maturity structure for existing Compustat firms in that year. For a given firm, let LTD_t^i be the book value of bonds with i years to maturity at the end of year t. For each maturity $i = 1, \ldots, 19$, the book value of bonds is updated from year t to $t+1$ through the formula

$$\mathrm{LTD}_{t+1}^i = \begin{cases} \mathrm{LTD}_t^{i+1} & \text{if } \mathrm{LTD}_{t+1} - \mathrm{LTD}_t + \mathrm{LTD}_t^1 > 0 \\ \mathrm{LTD}_t^{i+1} \frac{\mathrm{LTD}_{t+1}}{\mathrm{LTD}_t - \mathrm{LTD}_t^1} & \text{otherwise} \end{cases} .$$

New issues of 20-year bonds are given by the formula

$$\mathrm{LTD}_{t+1}^{20} = [\mathrm{LTD}_{t+1} - \mathrm{LTD}_t + \mathrm{LTD}_t^1]^+ .$$

The market value of long-term debt is the book value of bonds multiplied by the respective price, summed across all maturities. The price of bonds at each maturity is computed from Moody's seasoned Baa corporate bond yield, assuming a flat term structure.

Appendix C VAR Estimation and Variance Decompositions

Let $x_t = (r_t, \Delta c_t, v_t)'$ be a column vector consisting of asset return, net payout growth, and net payout yield. To simply notation, assume that the variables are de-meaned so that $\mathbf{E}[x_t] = 0$. Following Campbell and Shiller (1988), the joint dynamics of the variables are modeled by the VAR

$$x_{t+1} = \Phi x_t + \epsilon_{t+1}, \tag{13}$$

where $\mathbf{E}[\epsilon_t] = 0$ and $\mathbf{E}[\epsilon_t \epsilon_t'] = \Sigma$. The first two rows of model (13) have the interpretation of a vector error correction model under the maintained assumption that net payout yield is stationary (i.e., net payout and asset value are cointegrated). The model is identified by the moment restriction

$$\mathbf{E}[(x_{t+1} - \Phi x_t) \otimes x_t] = 0. \tag{14}$$

Let I denote an identity matrix of dimension three, and let e_i denote the ith column of the identity matrix. The present-value model, that is the expectation of equation (6) in period t, requires that the coefficients satisfy the linear restrictions

$$(e_1' - e_2' + \rho e_3')\Phi = e_3'. \tag{15}$$

Therefore, the VAR model (14) is overidentified. The model is estimated by constrained maximum likelihood (i.e., continuous updating generalized method of moments).

The VAR model implies that the present-value formula (10) can be written as

$$a_t = c_t + e_2'\Phi(I - \rho\Phi)^{-1}x_t - e_1'\Phi(I - \rho\Phi)^{-1}x_t. \tag{16}$$

In Figure 1, expected net payout under a constant discount rate is the sample analog of the first two terms on the right side. Let

$$\Gamma = \mathbf{E}[x_t x_t'] = \text{vec}^{-1}[(I - \Phi \otimes \Phi)^{-1}\text{vec}(\Sigma)].$$

Then the variance of infinite-horizon expected net payout growth and expected asset returns are

$$\text{Var}\left(\mathbf{E}_t \sum_{s=1}^{\infty} \rho^{s-1} \Delta c_{t+s}\right) = e_2' \Phi (I - \rho\Phi)^{-1} \Gamma (I - \rho\Phi)^{-1\prime} \Phi' e_2, \quad (17)$$

$$\text{Var}\left(\mathbf{E}_t \sum_{s=1}^{\infty} \rho^{s-1} r_{t+s}\right) = e_1' \Phi (I - \rho\Phi)^{-1} \Gamma (I - \rho\Phi)^{-1\prime} \Phi' e_1. \quad (18)$$

The variance decomposition (11) requires estimates of long-horizon covariances. As well documented in the literature, long-horizon regressions have poor finite-sample properties (see Boudoukh, Richardson and Whitelaw (2005), Hodrick (1992), and Valkanov (2003)). We therefore estimate long-horizon covariances from the VAR model (see Ang (2002) for a similar approach). The VAR model implies that

$$\text{Var}(v_t) = e_3' \Gamma e_3, \quad (19)$$

$$\text{Cov}(r_t(H), v_t) = e_1' \Phi [I - (\rho\Phi)^H] (I - \rho\Phi)^{-1} \Gamma e_3 \rightarrow e_1' \Phi (I - \rho\Phi)^{-1} \Gamma e_3, \quad (20)$$

$$\text{Cov}(-\Delta c_t(H), v_t) = -e_2' \Phi [I - (\rho\Phi)^H] (I - \rho\Phi)^{-1} \Gamma e_3 \rightarrow -e_2' \Phi (I - \rho\Phi)^{-1} \Gamma e_3, \quad (21)$$

$$\text{Cov}(v_t(H), v_t) = e_3' (\rho\Phi)^H \Gamma e_3 \rightarrow 0, \quad (22)$$

where the limits are as $H \rightarrow \infty$. In Table 7, the point estimates are sample analogs of these population moments, and the standard errors are estimated through the delta method using numerical gradients.

The VAR model implies that equation (12) can written as

$$e_1' \epsilon_{t+1} = -e_1' \rho \Phi (I - \rho\Phi)^{-1} \epsilon_{t+1} + e_2' (I - \rho\Phi)^{-1} \epsilon_{t+1}. \quad (23)$$

The variance of unexpected asset returns is therefore

$$\begin{aligned} e_1'\Sigma e_1 &= e_1'\rho\Phi(I-\rho\Phi)^{-1}\Sigma(I-\rho\Phi)^{-1\prime}\rho\Phi' e_1 + e_2'(I-\rho\Phi)^{-1}\Sigma(I-\rho\Phi)^{-1\prime}e_2 \\ &\quad -2e_1'\rho\Phi(I-\rho\Phi)^{-1}\Sigma(I-\rho\Phi)^{-1\prime}e_2. \end{aligned} \tag{24}$$

In Table 10, the point estimates are sample analogs of these population moments, and the standard errors are estimated through the delta method using numerical gradients.

Appendix D Log-Linear Present-Value Formula for Equity Payout Yield

The return on equity (2) takes the same form as the return on assets (5). However, equation (7) does not apply directly to equity payout yield since equity payout can be negative (see Figure 2). This appendix describes a technical (not conceptual) modification to equation (7) that handles this problem.

To make the connection to net payout yield explicit, we adopt the following notation in this appendix.

- D_t: Dividends plus equity repurchase in period t.
- E_t: Equity issuance in period t.
- $C_t = D_t - E_t$: Equity payout in period t.
- A_t: Market equity at the end of period t.

In this notation, equation (2) is

$$A_{t+1} + D_{t+1} - E_{t+1} = R_{t+1}A_t. \tag{25}$$

Let lowercase letters denote the log of the corresponding uppercase variables. Assume that $d_t - a_t$ and $e_t - a_t$ are stationary, and define the parameters

$$\begin{aligned}\phi &= \frac{1}{1 + \exp\{\mathbf{E}[d_t - a_t]\} - \exp\{\mathbf{E}[e_t - a_t]\}},\\ \theta &= \frac{\exp\{\mathbf{E}[d_t - a_t]\}}{\exp\{\mathbf{E}[d_t - a_t]\} - \exp\{\mathbf{E}[e_t - a_t]\}}.\end{aligned}$$

Empirically relevant values are $\phi < 1$ and $\theta > 1$ since $\mathbf{E}[d_t - a_t] > \mathbf{E}[e_t - a_t]$. Define the variable

$$v_t = \theta d_t - (\theta - 1)e_t - a_t. \tag{26}$$

This is essentially the log of equity payout yield, C_t/A_t. The outflow and inflow must be treated separately in equation (26) because equity payout can be negative.

Rewrite equation (25) as

$$\log[1 + \exp(d_{t+1} - a_{t+1}) - \exp(e_{t+1} - a_{t+1})] = r_{t+1} - \Delta a_{t+1}.$$

First-order Taylor approximation of the left side of this equation leads to a difference equation for equity payout yield

$$v_t \approx r_{t+1} - \theta \Delta d_{t+1} + (\theta - 1)\Delta e_{t+1} + \phi v_{t+1}, \tag{27}$$

up to an additive constant. Solving equation (27) forward H periods,

$$v_t = r_t(H) - \Delta d_t(H) + \Delta e_t(H) + v_t(H), \tag{28}$$

where

$$\begin{aligned} r_t(H) &= \sum_{s=1}^{H} \phi^{s-1} r_{t+s}, \\ \Delta d_t(H) &= \sum_{s=1}^{H} \phi^{s-1} \theta \Delta d_{t+s}, \\ \Delta e_t(H) &= \sum_{s=1}^{H} \phi^{s-1} (\theta - 1) \Delta e_{t+s}, \\ v_t(H) &= \phi^H v_{t+H}. \end{aligned}$$

The joint dynamics of equity return, equity payout growth, and equity payout yield are estimated through the VAR (13), where $x_t = (r_t, \theta \Delta d_t - (\theta - 1)\Delta e_t, v_t)'$. The variance decompositions of equity payout yield (Table 2) and unexpected equity returns (Table 9) are based on the VAR as described in Appendix C.

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Table 1: VAR in Equity Return, Cash Flow Growth, and Cash Flow Yield

Panel A reports estimates of a VAR in real equity return, real dividend growth, and log dividend yield. Panel B reports estimates of a VAR in real equity return, real equity payout growth, and log equity payout yield. The sample period is 1926–2004. Estimation is by constrained maximum likelihood. Heteroskedasticity-consistent standard errors are in parentheses.

Lagged Regressor	Equity Return	Cash Flow Growth	Cash Flow Yield
Panel A: Cash Flow = Dividend			
Equity Return	-0.02	-0.15	-0.13
	(0.15)	(0.09)	(0.10)
Dividend Growth	0.14	0.00	-0.15
	(0.18)	(0.14)	(0.14)
Dividend Yield	0.09	-0.01	0.93
	(0.05)	(0.04)	(0.04)
R^2	0.04	0.05	0.88
Panel B: Cash Flow = Equity Payout			
Equity Return	0.13	-1.79	-1.96
	(0.13)	(0.73)	(0.79)
Equity Payout Growth	0.02	-0.26	-0.29
	(0.02)	(0.13)	(0.14)
Equity Payout Yield	0.04	-0.17	0.81
	(0.01)	(0.07)	(0.07)
R^2	0.08	0.29	0.69

Table 2: Variance Decomposition of Dividend Yield and Equity Payout Yield

In Panel A, the variance of log dividend yield is decomposed into future equity returns, future dividend growth, and future dividend yield. The log-linearization parameter is $\rho = 0.97$. In Panel B, the variance of log equity payout yield is decomposed into future equity returns, future equity payout growth, and future equity payout yield. The log-linearization parameters are $\phi = 0.98$ and $\theta = 2.5$. The last line of each panel reports the standard deviation of expected equity returns and expected cash flow growth in the infinite-horizon present-value model. The sample period is 1926–2004. Estimation is through the VAR reported in Table 1. Heteroskedasticity-consistent standard errors are in parentheses.

Horizon (Years)	Fraction of Variance in Cash Flow Yield Explained by Future					
	Equity Returns		Cash Flow Growth		Cash Flow Yield	
Panel A: Cash Flow = Dividend						
1	0.10	(0.05)	0.00	(0.04)	0.90	(0.04)
2	0.18	(0.10)	0.02	(0.07)	0.80	(0.07)
5	0.37	(0.21)	0.07	(0.16)	0.57	(0.14)
10	0.57	(0.30)	0.11	(0.26)	0.32	(0.16)
Infinite	0.83	(0.38)	0.17	(0.38)		
Infinite: Std Dev	0.35	(0.19)	0.08	(0.15)		
Panel B: Cash Flow = Equity Payout						
1	0.04	(0.02)	0.20	(0.06)	0.76	(0.07)
2	0.07	(0.03)	0.35	(0.10)	0.59	(0.11)
5	0.12	(0.05)	0.61	(0.13)	0.28	(0.14)
10	0.15	(0.06)	0.77	(0.09)	0.08	(0.08)
Infinite	0.16	(0.06)	0.84	(0.06)		
Infinite: Std Dev	0.25	(0.10)	1.27	(0.19)		

Table 3: Decomposing the VAR in Equity Return, Equity Payout Growth, and Equity Payout Yield

The table reports estimates of a VAR in real equity return, real equity payout growth, log equity payout-dividend ratio, and log dividend yield. The sample period is 1926–2004. Estimation is by constrained maximum likelihood. Heteroskedasticity-consistent standard errors are in parentheses.

Lagged Regressor	Equity Return	Equity Payout Growth	Equity Payout − Dividends	Dividend Yield
Equity Return	0.13	-1.74	-1.56	-0.35
	(0.13)	(0.70)	(0.74)	(0.12)
Equity Payout Growth	0.02	-0.19	-0.19	-0.03
	(0.02)	(0.14)	(0.14)	(0.02)
Equity Payout − Dividends	0.05	-0.34	0.63	-0.01
	(0.02)	(0.11)	(0.11)	(0.02)
Dividend Yield	0.01	0.31	0.35	0.98
	(0.06)	(0.20)	(0.22)	(0.04)
R^2	0.08	0.31	0.61	0.89

Table 4: Summary Statistics for Net Payout and Asset Value

The table reports summary statistics for net payout and its components as fractions of the market value of assets. It also reports summary statistics for asset return and net payout growth, which are both in logs and deflated by the CPI.

As Fraction of Assets	Mean	Std Dev	Autocorrel	Correlation with								
				Dividends	Net Equity Repurchase	Equity Repurchase	Equity Issuance	Interest	Net Debt Repurchase	LTD Repurchase	LTD Issuance	Net STD Repurchase
Panel A: Flow of Funds 1926–2004												
Net Payout	0.017	0.010	0.814	0.455	0.337			0.526	0.553			
Dividends	0.015	0.006	0.843		-0.469			-0.133	0.367			
Net Equity Repurchase	-0.001	0.006	0.780					0.383	-0.257			
Interest	0.008	0.004	0.927						-0.128			
Net Debt Repurchase	-0.006	0.005	0.719									
Asset Return	0.054	0.122	0.086									
Net Payout Growth	0.038	0.384	-0.044									
Panel B: Compustat 1971–2004												
Net Payout	0.027	0.012	0.729	0.425	0.573	0.645	0.079	0.506	0.076	0.137	0.095	-0.023
Dividends	0.017	0.006	0.924		-0.295	-0.178	0.410	0.921	-0.566	-0.553	-0.162	0.006
Net Equity Repurchase	0.003	0.010	0.571			0.948	-0.381	-0.183	0.054	0.329	0.303	-0.232
Equity Repurchase	0.013	0.009	0.666				-0.068	-0.011	-0.011	0.319	0.344	-0.262
Equity Issuance	0.010	0.003	0.544					0.543	-0.202	-0.106	0.048	-0.035
Interest	0.018	0.007	0.869						-0.581	-0.381	0.070	-0.002
Net Debt Repurchase	-0.012	0.008	0.623							0.576	-0.153	0.246
LTD Repurchase	0.032	0.010	0.840								0.691	-0.126
LTD Issuance	0.044	0.008	0.499									-0.110
Net STD Repurchase	0.000	0.002	0.397									
Asset Return	0.064	0.108	0.037									
Net Payout Growth	0.067	0.258	-0.032									

Table 5: Accounting for Time Variation in Net Payout Yield

The table reports fraction of the variance in net payout yield explained by each of the components of net payout. Robust standard errors are in parentheses.

Fraction of Var Explained by	Flow of Funds 1926–2004	Compustat 1971–2004
Dividends	0.27	0.22
	(0.08)	(0.08)
Net Equity Repurchase	0.20	0.45
	(0.08)	(0.15)
Equity Repurchase		0.47
		(0.14)
Equity Issuance		-0.02
		(0.04)
Interest	0.24	0.28
	(0.05)	(0.07)
Net Debt Repurchase	0.30	0.05
	(0.06)	(0.09)
LTD Repurchase		0.12
		(0.14)
LTD Issuance		-0.06
		(0.12)
Net STD Repurchase		0.00
		(0.03)

Table 6: VAR in Asset Return, Net Payout Growth, and Net Payout Yield

The table reports estimates of a VAR in real asset return, real net payout growth, and log net payout yield. Estimation is by constrained maximum likelihood. Heteroskedasticity-consistent standard errors are in parentheses.

Lagged Regressor	Asset Return	Net Payout Growth	Net Payout Yield
Panel A: Flow of Funds 1926–2004			
Asset Return	0.10	0.49	0.39
	(0.13)	(0.31)	(0.35)
Net Payout Growth	-0.01	0.05	0.06
	(0.04)	(0.13)	(0.14)
Net Payout Yield	0.03	-0.21	0.78
	(0.02)	(0.07)	(0.07)
R^2	0.01	0.15	0.61
Panel B: Compustat 1971–2004			
Asset Return	0.07	0.21	0.15
	(0.18)	(0.42)	(0.51)
Net Payout Growth	-0.02	0.07	0.09
	(0.08)	(0.12)	(0.16)
Net Payout Yield	0.08	-0.19	0.75
	(0.04)	(0.09)	(0.11)
R^2	0.09	0.12	0.60

Table 7: Variance Decomposition of Net Payout Yield

The variance of log net payout yield is decomposed into future asset returns, future net payout growth, and future net payout yield. The last line of each panel reports the standard deviation of expected asset returns and expected net payout growth in the infinite-horizon present-value model. The log-linearization parameter is $\rho = 0.98$. Estimation is through the VAR reported in Table 6. Heteroskedasticity-consistent standard errors are in parentheses.

Horizon (Years)	Fraction of Variance in Net Payout Yield Explained by Future					
	Asset Returns		Net Payout Growth		Net Payout Yield	
Panel A: Flow of Funds 1926–2004						
1	0.02	(0.02)	0.21	(0.08)	0.76	(0.07)
2	0.05	(0.05)	0.38	(0.11)	0.58	(0.11)
5	0.09	(0.10)	0.66	(0.16)	0.25	(0.12)
10	0.12	(0.13)	0.82	(0.15)	0.06	(0.06)
Infinite	0.12	(0.14)	0.88	(0.14)		
Infinite: Std Dev	0.08	(0.09)	0.53	(0.11)		
Panel B: Compustat 1971–2004						
1	0.07	(0.04)	0.18	(0.10)	0.75	(0.10)
2	0.13	(0.07)	0.32	(0.15)	0.54	(0.16)
5	0.24	(0.12)	0.55	(0.20)	0.21	(0.17)
10	0.29	(0.16)	0.66	(0.20)	0.04	(0.07)
Infinite	0.31	(0.17)	0.69	(0.19)		
Infinite: Std Dev	0.13	(0.09)	0.30	(0.09)		

Table 8: Decomposing the VAR in Asset Return, Net Payout Growth, and Net Payout Yield
The table reports estimates of a VAR in real asset return, real net payout growth, log net payout-equity payout ratio, and log equity payout-assets ratio. Estimation is by constrained maximum likelihood. Heteroskedasticity-consistent standard errors are in parentheses.

Lagged Regressor	Asset Return	Net Payout Growth	Net Payout − Equity Payout	Equity Payout − Assets
Panel A: Flow of Funds 1926–2004				
Asset Return	0.12	0.48	0.26	0.11
	(0.12)	(0.31)	(0.30)	(0.32)
Net Payout Growth	0.00	0.05	0.11	-0.06
	(0.04)	(0.12)	(0.11)	(0.09)
Net Payout − Equity Payout	-0.04	-0.21	0.67	0.18
	(0.03)	(0.12)	(0.09)	(0.10)
Equity Payout − Assets	0.07	-0.23	0.03	0.68
	(0.03)	(0.08)	(0.09)	(0.11)
R^2	0.10	0.15	0.49	0.48
Panel B: Compustat 1971–2004				
Asset Return	0.06	0.21	-0.84	0.99
	(0.18)	(0.40)	(0.50)	(0.44)
Net Payout Growth	-0.02	0.05	-0.17	0.24
	(0.08)	(0.14)	(0.12)	(0.19)
Net Payout − Equity Payout	0.06	-0.03	0.64	0.28
	(0.05)	(0.12)	(0.14)	(0.21)
Equity Payout − Assets	0.08	-0.29	0.05	0.59
	(0.04)	(0.09)	(0.08)	(0.13)
R^2	0.10	0.23	0.44	0.38

Table 9: Variance Decomposition of Equity Return

In Panel A (Panel B), the variance of unexpected equity returns is decomposed into changes in expected equity returns, changes in expected dividend (equity payout) growth, and minus two times the covariance between the changes. The sum need not equal one because of log-linear approximation error. The sample period is 1926–2004. Estimation is through the VAR reported in Tables 1 and 3. Heteroskedasticity-consistent standard errors are in parentheses.

VAR Model	Fraction of Variance Explained by Changes in Expected		
	Equity Returns	Cash Flow Growth	$-2\times$ Covariance
	Panel A: Cash Flow = Dividend		
Table 1A	0.49	0.38	0.14
	(0.41)	(0.13)	(0.31)
	Panel B: Cash Flow = Equity Payout		
Table 1B	0.58	0.61	-0.20
	(0.39)	(0.14)	(0.38)
Table 3	0.93	0.31	-0.25
	(0.64)	(0.06)	(0.63)

Table 10: Variance Decomposition of Asset Return

In each panel, the variance of unexpected asset returns is decomposed into changes in expected asset returns, changes in expected net payout growth, and minus two times the covariance between the changes. The sum need not equal one because of log-linear approximation error. Estimation is through the VAR reported in Tables 6 and 8. Heteroskedasticity-consistent standard errors are in parentheses.

VAR Model	Fraction of Variance Explained by Changes in Expected		
	Asset Returns	Net Payout Growth	$-2\times$ Covariance
Panel A: Flow of Funds 1926–2004			
Table 6A	0.14	1.24	-0.38
	(0.28)	(0.40)	(0.63)
Table 8A	0.40	1.14	-0.54
	(0.34)	(0.34)	(0.63)
Panel B: Compustat 1971–2004			
Table 6B	0.65	1.12	-0.66
	(0.65)	(0.47)	(1.11)
Table 8B	0.54	0.92	-0.34
	(0.46)	(0.26)	(0.68)

Table 11: Compustat Variables

Variable	Data Item	Item Number
DEBT_NET	Changes in Current Debt	301
DIV	Cash Dividends	127
DIV_PREF	Dividends – Preferred	19
EQ_ISS	Sale of Common and Preferred Stock	108
EQ_REP	Purchase of Common and Preferred Stock	115
INT	Interest Expense	15
LIAB_CUR	Current Liabilities – Total	5
LIAB_OTH	Liabilities – Other	75
LTD	Long-Term Debt – Total	9
LTD_ISS	Long-Term Debt – Issuance	111
LTD_REP	Long-Term Debt – Reduction	114
MINORITY	Minority Interest	38
TAX	Deferred Taxes and Investment Tax Credit	35

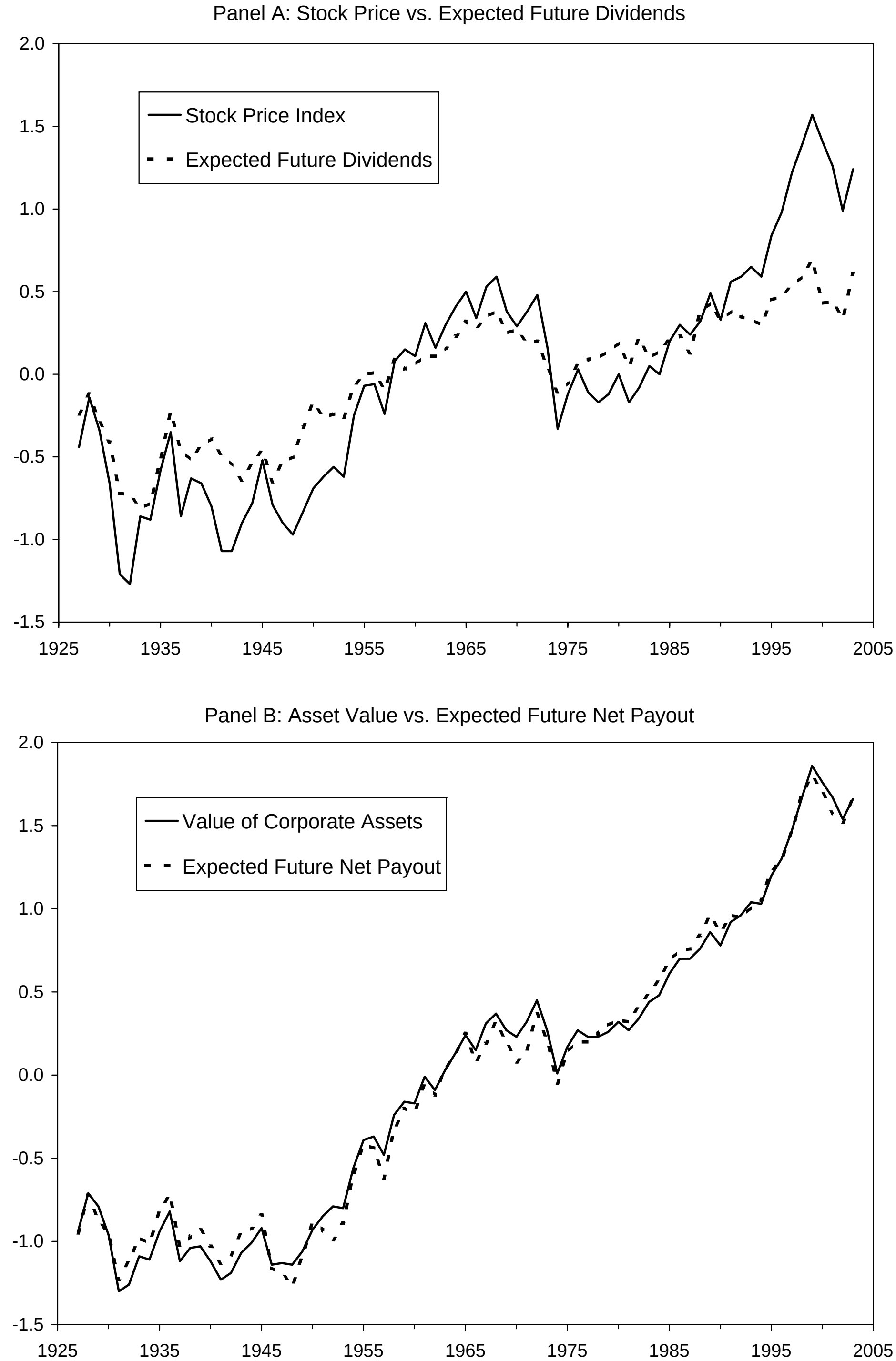


Figure 1: Expected Future Dividends and Expected Future Net Payout

Panel A shows the real value of the CRSP value-weighted index for NYSE, AMEX, and NASDAQ stocks. A VAR in real equity return, real dividend growth, and log dividend yield (reported in Table 1) is used to estimate expected future dividends discounted at a constant rate. Panel B shows the real market value of assets for U.S. nonfinancial corporations. A VAR in real asset return, real net payout growth, and log net payout yield (reported in Table 6) is used to estimate expected future net payout discounted at a constant rate. All series are deflated by the CPI and reported in demeaned log units.

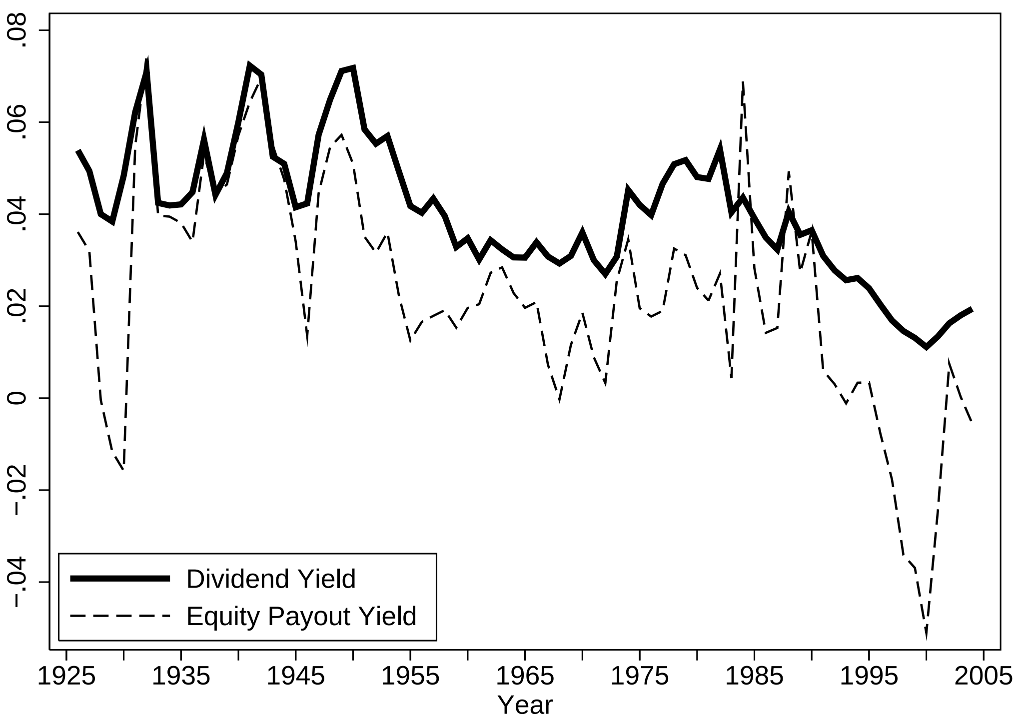


Figure 2: Dividend Yield and Equity Payout Yield

Dividend yield is dividends divided by the CRSP value-weighted index. Equity payout yield is equity payout (i.e., dividends plus equity repurchase minus equity issuance) divided by the market equity of NYSE, AMEX, and NASDAQ stocks.

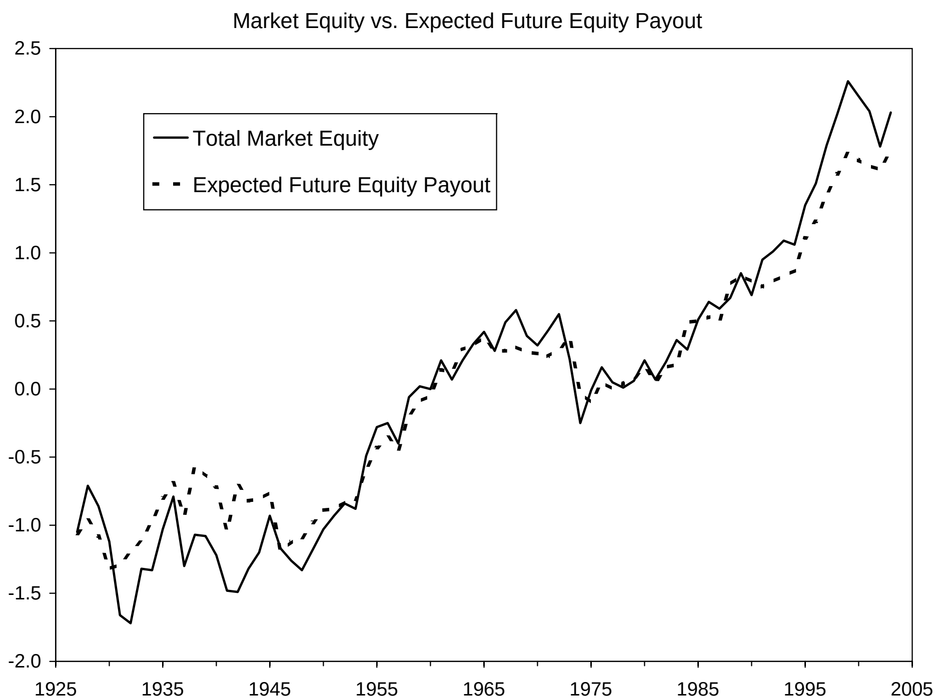


Figure 3: Expected Future Equity Payout
The figure shows the real market equity of NYSE, AMEX, and NASDAQ stocks. A VAR in real equity return, real equity payout growth, and log equity payout yield is used to estimate expected future equity payout discounted at a constant rate. All series are deflated by the CPI and reported in demeaned log units.

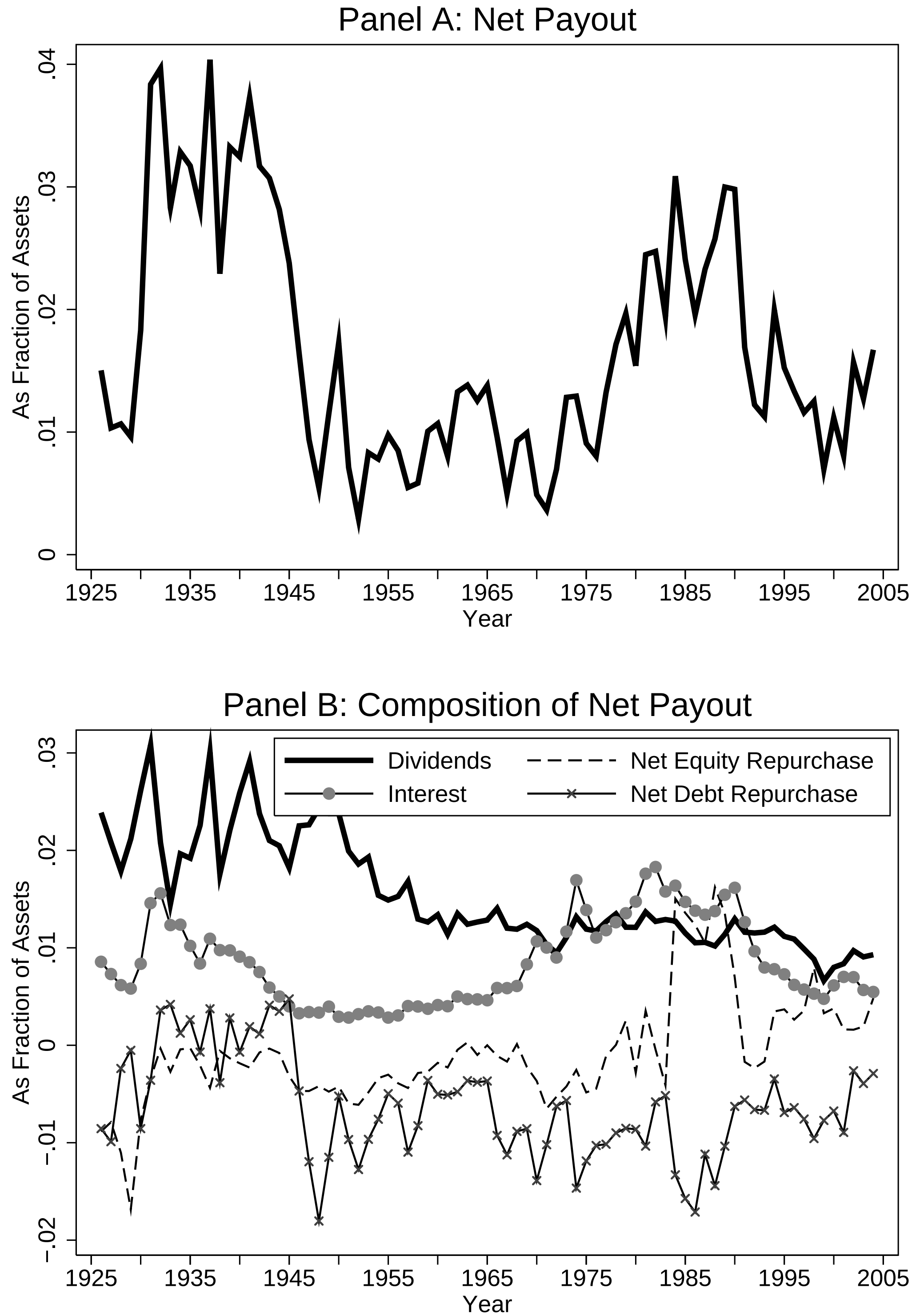
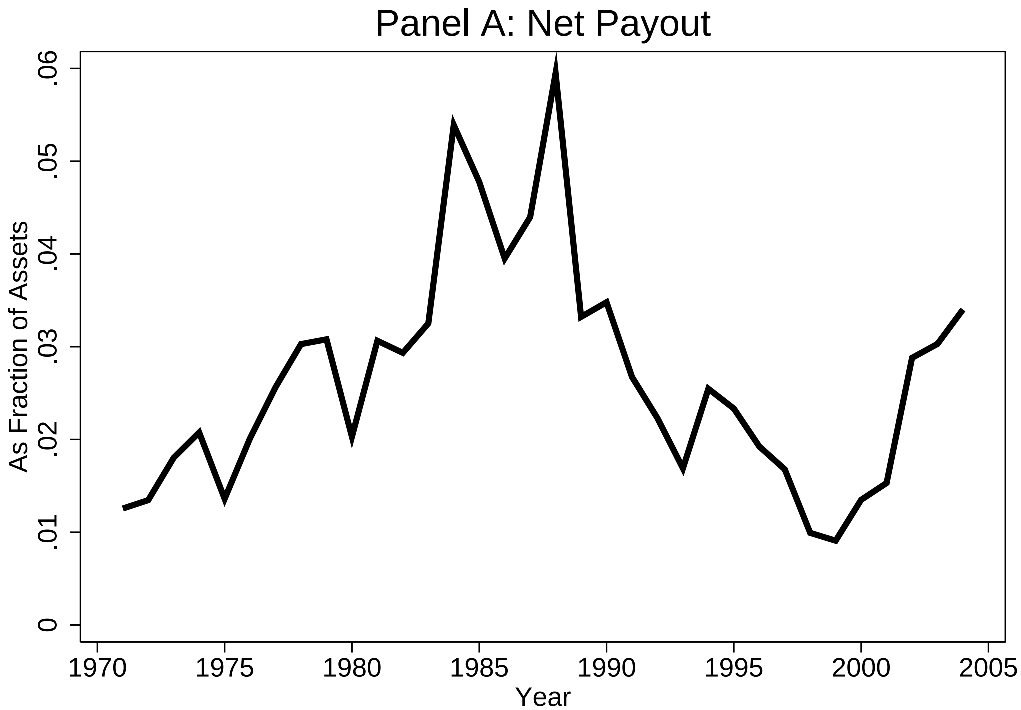
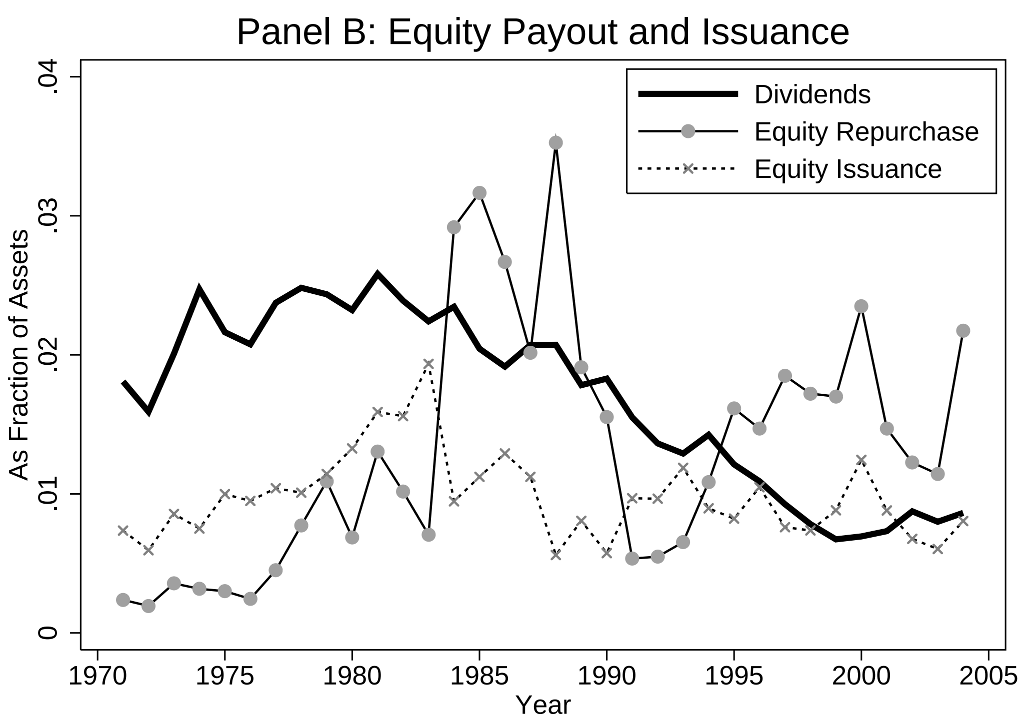


Figure 4: Net Payout Yield in the Flow of Funds

Net payout in Panel A is the sum of dividends, net equity repurchase, interest, and net debt repurchase in Panel B. The data represent nonfinancial corporations in the Flow of Funds for the period 1926–2004.





[**Figure 5 continued on the next page**]

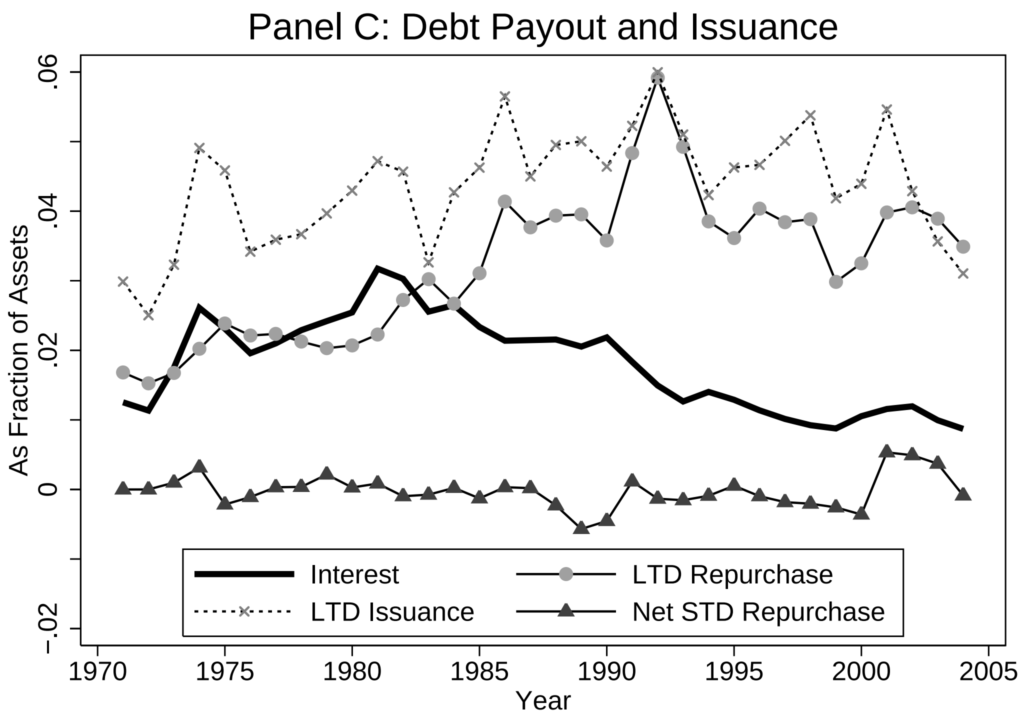


Figure 5: Net Payout Yield in Compustat

Net payout in Panel A is the sum of Panel B (dividends plus equity repurchase minus equity issuance) and Panel C (interest plus long-term debt repurchase minus long-term debt issuance plus net short-term debt repurchase). The data represent nonfinancial firms in Compustat for the period 1971–2004.

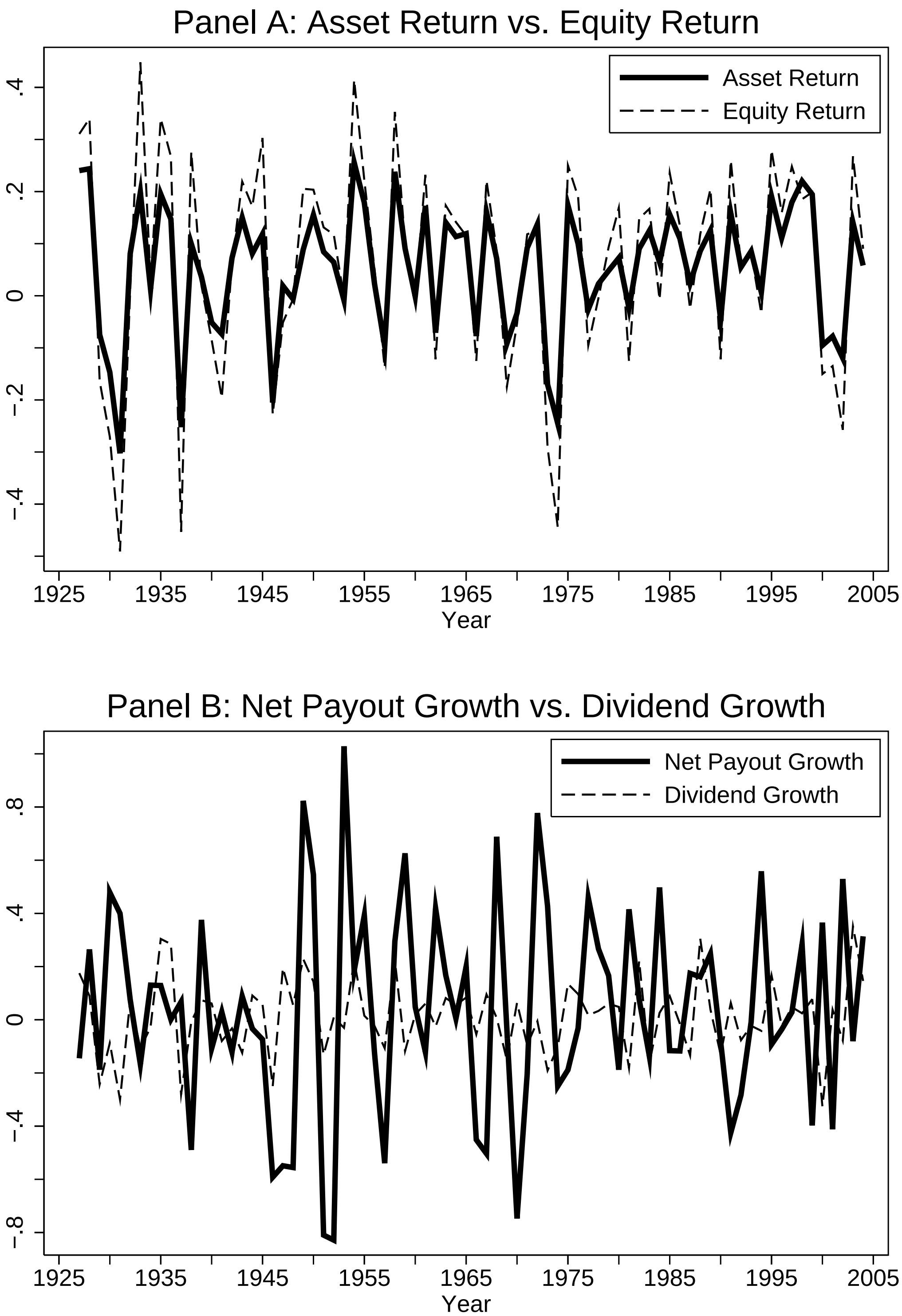


Figure 6: A Comparison of Returns and Cash Flow Growth
Asset returns and net payout growth are for nonfinancial corporations in the Flow of Funds. Equity returns and dividend growth are for the CRSP value-weighted index.