

The Asset Pricing-Macro Nexus and Return-Cash Flow Predictability*

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Abstract

In this paper we develop a measure of aggregate dividends (net payout) and a corresponding valuation ratio that incorporate the economic restrictions that all outstanding equity should be held by investors. Using this market clearing based aggregate measure of payouts changes the traditional views on the sources of asset price variation; with the aggregate dividend measure, a lot of the asset price variation is due to predictability of payout growth. In addition, the new aggregate payout measure is naturally cointegrated with aggregate consumption. We develop a long-run risks based economic model that incorporates this restriction. We show that the model can account for the return and payout growth predictability needed to explain the asset price variation in conjunction with the risk premium and volatility puzzles.

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1 Introduction

Identifying the economic channels for asset price variation is a central concern of financial economics. Three critical inputs for asset pricing are equity returns, dividends (cashflows), and the valuation ratio (asset price to dividend ratio). As asset prices equal discounted dividends, asset price (valuation ratio) fluctuations occur due to changes in expected dividends and or expected returns. However, present value restrictions, by themselves, do *not* identify the appropriate cashflow and price pair one should use in analyzing the aforementioned issues. In this paper we use macro-economic considerations to identify important restrictions regarding consumption and aggregate cashflows. These restrictions naturally identify an alternative (to the typical price and dividend per share) cashflow and price process which we use to analyze (i) the sources of variation and predictability of the price dividend ratio and (ii) the asset pricing implications of imposing cointegration of aggregate quantities.

Virtually all empirical work in asset pricing focuses on a very specific trading strategy to measure dividends and the corresponding valuation ratio.¹ The focus is on cash-dividends per-share and the corresponding per-share price to dividend ratio as the valuation ratio. That is, the concerns of an investor who wishes to hold one share forever are reflected in the measured dividends and valuation ratio. The economic motivations for focusing on this specific trading strategy, particularly from the perspective of the aggregate economy (i.e., representative agent), are not entirely clear.

In this paper we argue that the representative agent, that is all investors put together, should hold the entire supply of equity capital (market capitalization) at each point in time. Imposing this requirement provides an alternative trade to measure the aggregate dividends (transfers to investors in a given period) and valuation ratio, while the returns, as in the hold one share trade, equal the observed value weighted returns on the market portfolio.

¹Predictability of dividends and/or returns form, in many ways, the rational paradigm to interpret asset price variation. Campbell and Shiller (1988), Campbell (1991), Cochrane (1992) document that almost all of the variation in asset prices is due to changing expected returns, whereas dividend growth is essentially not predictable. Motivated by this empirical evidence, Campbell and Cochrane (1999), and Barberis, Huang and Santos (2004), develop aggregate general equilibrium models in which the key channel to account for the price variation, the equity premium, and the risk free rate puzzles is through changing risk-preferences of the representative agent. Bansal and Yaron (2004) provide a general equilibrium model where the key channels for asset price variation are changes in expected growth and the state of uncertainty of the economy. In that model, about half of the variation in the price-dividend ratio, is due to changes in expected cashflows.

Asset valuations reflect the present value of aggregate payouts. The payouts reflect the aggregate net transfer of resources in a given period between all investors and the corporate sector (firms). They account for aggregate cash payments and repurchases from corporations to investors and the aggregate purchase by investor of new issues. Given the alternative measurements, i.e. per share and aggregate dividends, there are two motivations for writing this paper. First, we ask if focusing on the measurements from the aggregate trade leads to different empirical insights about the channels of asset price variation. Second, we highlight that dividends from this trade and aggregate consumption share a natural common trend restriction (cointegration), and ask, if a general equilibrium model, with this restriction imposed, can simultaneously account for return-cash flow predictability, the risk premium, and volatility asset market puzzles.²

Using aggregate dividends, we document that predictability of aggregate payout growth accounts for a surprising 50% of asset price variability and expected returns accounts for the remaining 50%. Building on the Long-Run Risks model of Bansal and Yaron (2004), we show that one can largely account for the observed predictability of asset returns and dividends and the premium and volatility puzzles. However, the cointegration restriction makes it quite difficult to account for the 19% return volatility despite the 23% volatility of net payout growth. The lower return volatility relative to dividend growth volatility is entirely an outcome of enforcing cointegration between consumption and dividends. We also use the data from the model as a laboratory to conduct finite sample monte carlo experiments to evaluate the null that dividend and return predictability contribute respectively 50% each in accounting for asset price variation. In contrast, using the dividends per share series, Cochrane (2005) argues that the lack of predictability of these dividends, *ipso facto*, implies that return predictability is the key channel for asset price variation.

The dividend series in the hold-one-share trade grows at the rate of appreciation of price per share, and misses the growth in size of equity capital in the economy. Alternatively stated, from the perspective of the Lucas (1978) model, the per share dividend series misses on the growth in the number of trees across time. Trends in the size of the equity market

²Earlier work of Campbell and Cochrane (1999), Barberis, Huang, and Santos (2004) and Bansal and Yaron (2004) do not impose these cointegrating restrictions. Bansal, Dittmar, Lundblad (2005), Bansal, Gallant, and Tauchen (2005), Hansen, Heaton and Li (2005), Santos and Veronesi (2003) and Menzly, Santos, and Veronesi (2004) do impose cointegration, but their measure of dividends is very different from what is used in this paper. These papers use the traditional per share dividend series.

alter trends in the aggregate dividends relative to per share cash dividends. The latter series grows at the rate of price per share, which in its turn grows at a very different rate relative to market capitalization. To see the economic significance of this, consider an example where dividends per share are constant; hence their growth is zero. However, if the firm is increasing in size (number of shares are increasing), then aggregate dividends will rise. The latter series incorporates the scale effects that are missing in the per share series. Economically, this difference is important for understanding the cointegrating relation between consumption and dividends. While dividends per share are constant, aggregate dividends (and payouts) for the market will be cointegrated with consumption. Figure 1 provides a measure of scale of the economy by plotting the ratio of aggregate market capitalization to the price per share. The figure clearly demonstrates the pronounced increase in scale and a channel for why aggregate dividends would grow at a different rate than the per-share dividend. Predictability of the aggregate payout growth rates are related to incorporating the trend and fluctuations in the scale of the equity market relative to price per share. Incorporating this dimension is economically well motivated. From the perspective of aggregate economic models, such as the RBC model (e.g., King, Plosser, and Rebello (1985)), consumption, the stock of capital (market capitalization), and aggregate dividends share a common trend, which motivates our cointegration restriction between dividends and consumption. Our aggregate measurements of dividends capture this important economic intuition.

It is worth noting that Ang and Beakert (2004) and Bansal, Khatchatrian, and Yaron (2004) use earnings as a measure of cash flows to highlight the importance of cash flow predictability. These papers do not link the measure of cash flows to an achievable aggregate trading strategy. Bansal, Fang, and Yaron (2005), and Larrain and Yogo (2005) use the aggregate trading strategy to measure payouts and evaluate its predictability properties. This paper exploits some of the methods and insights from Bansal, Fang, and Yaron (2005). Larrain and Yogo (2005), also consider the predictability of measures that look at the aggregate value of the firm by including debt. This paper, unlike earlier work, explores the market clearing implication for the aggregate dividend measure, and its implications for asset prices within an equilibrium model.

The paper continues as follows: Section 2 presents the aggregate budget constraint, its implications for measuring cash flows, and the variance decomposition of valuation ratios. Section 3 presents the data, while Section 4 provides the results of our empirical analysis.

Section 5 presents the calibrated output of our model. Section 6 provides concluding remarks.

2 The Aggregate Budget Constraint and Present Value Implications

To derive the implications of different trading strategies for returns, dividends, and valuation ratios, consider the return on equity. It is useful to recognize that different trading strategies can have identical returns but have different cashflow and valuation ratios. To see this, start with the standard gross return on holding one share, R_{t+1} ,

$$R_{t+1} = \frac{P_{t+1} + D_{t+1}}{P_t} = \frac{P_{t+1}N_{t+1} - P_{t+1}N_{t+1} + P_{t+1}N_t + D_{t+1}N_t}{P_tN_t} \quad (1)$$

where P_t is the price per share and D_{t+1} is the dividend per share, N_t is the number of shares outstanding at date t , and $V_t = N_tP_t$ is the stock of market capital (market capitalization). The second equality in equation (1) reflects the gross return for a different trading strategy, namely, one in which the investor holds the entire supply of equity. We discuss this second trading strategy in more detail below. However, the immediate lesson from equation (1) is that these two strategies deliver the *same* gross return, although the measured payouts (dividends) to investors and the appropriate valuation ratio underlying these trading strategies can be quite different.

The measured payouts to holding one share strategy are simply the dividend per share sequence, D_{t+1} . To demonstrate the measured payouts corresponding to the strategy of holding the entire stock of capital it is first instructive to measure the transfer of resources between the firm and investors. Let,

$$D_{v,t+1} = N_tD_{t+1} - P_{t+1}(N_{t+1} - N_t)^-, \quad D_{v,t+1} \geq 0 \quad (2)$$

be the repurchase-adjusted cash dividends paid out by the equity markets. The second term lights up when $N_{t+1} - N_t \leq 0$, and thus reflects reduction in shares and effectively larger current payout to investors. Similarly, define

$$I_{t+1} = (N_{t+1} - N_t)^+P_{t+1}, \quad I_{t+1} \geq 0 \quad (3)$$

as the inflow of resources at date $t + 1$ into the corporate sector (firms), reflecting new investments in equity when N_{t+1} is greater than N_t . Given the quantities defined in equations

(2) and (3), reflecting the various transfers between the corporate sector and investors, the return equation (1), can be rewritten,

$$R_{t+1} = \frac{V_{t+1} - I_{t+1} + D_{v,t+1}}{V_t} = \frac{V_{t+1}(1 - \chi_{t+1}) + D_{v,t+1}}{V_t} \quad (4)$$

where $\chi_{t+1} \equiv I_{t+1}/V_{t+1}$ is the investment rate.³ We refer to $\frac{D_{v,t}}{V_{t-1}}$ as the payout yield; this includes outflows from firms to investors (cash+repurchases) relative to market capitalization. Similarly, we label $\frac{I_t}{V_{t-1}}$ as the investment yield, and it corresponds to inflows from investors into firms. These two yields measure the actual quantities of aggregate inflows and outflows, into and from the corporate sector.

Aggregating over all investors, market clearing requires that all of the outstanding shares be held by the private sector. The private sector at date $t + 1$ holds the entire stock of equity capital. In sum, this trading strategy offers the observed equity returns, and ensures that investors at each date hold the entire market capitalization and receive a net transfer of aggregate resources of $D_{v,t+1} - I_{t+1}$ from all the firms (the corporate sector). Consequently, as shown in Bansal, Fang and Yaron (2005), the market value of all outstanding firms, V_t is the discounted (at the rate of the market return) present value of $D_{v,t+1} - I_{t+1}$. That is,

$$V_t = \sum_{j=1}^{\infty} \exp(-\sum_{k=1}^j \log R_{t+k}) (D_{v,t+j} - I_{t+j}). \quad (5)$$

The typical trading strategy that is the focus of most empirical work in asset pricing models (see Campbell and Shiller (1988), Cochrane (1992), Cochrane (2005), Campbell and Cochrane (1999), Bansal and Yaron (2004)), is to set $N_t = N_{t+1} = 1$, in equation (1). Consequently, the underlying price and dividend series correspond to the price and dividend per share (that is P_t and D_t rather than V_t and $D_{v,t} - I_t$). Analyzing asset markets from this perspective yields a different dividend and price series that do not take into account the implications of aggregate market clearing conditions in the sense that the measures of aggregate net payouts emanating from the aggregate strategy do.

³The investment rate χ_t is reflecting equity investment. However, in the data, which we discuss below, this equity investment rate has a correlation of 0.47 with physical (private domestic) investment to GDP – reaffirming the interpretation that I_t , defined above, reflects transfers of resources from the private to the corporate sector.

2.1 Sources of Price Variation

In this subsection we provide the present value based decomposition that links valuation ratios to future asset returns and expected payout growth. This decomposition, first shown in Bansal, Fang, and Yaron (2005), helps interpret the sources of variation in valuation ratios.

Starting with the right-hand side of equation (4), taking logs, and factoring out the aggregate dividend growth, the continuous return follows,

$$r_{t+1} = \Delta d_{v,t+1} - (v_t - d_{v,t}) + \log[\exp\{(v_{t+1} - d_{v,t+1}) + \log(1 - \chi_{t+1})\} + 1] \quad (6)$$

with $\Delta d_{v,t+1} \equiv \log(D_{v,t+1}/D_{v,t})$, and $v_t - d_{v,t} \equiv \log(V_t/D_{v,t})$. More generally, small letters denote the log of variables. We now make two approximations. First, the variable χ_{t+1} is relatively small, hence $\log(1 - \chi_{t+1}) \approx -\chi_{t+1}$. Second, using a first order Taylor series expansion around $(v_{t+1} - d_{v,t+1}) - \chi_{t+1}$, it follows that

$$r_{t+1} = \kappa_0 + \Delta d_{v,t+1} - (v_t - d_{v,t}) + \kappa_1[(v_{t+1} - d_{v,t+1}) - \chi_{t+1}] \quad (7)$$

where κ_1 is an approximation constant based on the average values of $v_t - d_{v,t}$ and χ_t .⁴ The above expression implies that,

$$v_t - d_{v,t} = \frac{\kappa_0}{1 - \kappa_1} + \sum_{j=1}^{\infty} \kappa_1^{j-1} [(\Delta d_{v,t+j} - \kappa_1 \chi_{t+j}) - r_{t+j}] \quad (8)$$

Hence we have the usual formula, but with the modified growth rate $\Delta d_{v,t+j} - \kappa_1 \chi_{t+j}$.

Equation (8) implies that the variation in the aggregate valuation ratio, $v_t - d_{v,t}$, can be decomposed as follows:

$$Var(v_t - d_{v,t}) = cov\left(\sum_{j=1}^{\infty} \kappa_1^{j-1} (\Delta d_{v,t+j} - \kappa_1 \chi_{t+j}), v_t - d_{v,t}\right) - cov\left(\sum_{j=1}^{\infty} \kappa_1^{j-1} r_{t+j}, v_t - d_{v,t}\right) \quad (9)$$

This decomposition shows that the variation in the aggregate valuation ratio, $v_t - d_{v,t}$, is due to the variation in net payoff growth and/or due to the variation in expected returns. That is, fluctuations in market capitalization to aggregate dividends are due to market

⁴Specifically, $\kappa_1 = \frac{\exp(v-d-\bar{\chi})}{1+\exp(v-d-\bar{\chi})}$.

anticipation of future returns (return predictability), or due to anticipation of net net payout growth (cash flow predictability).

The above decomposition is the analog to the per share price-dividend variance decomposition as put forth by Campbell and Shiller (1988) and Cochrane (1992), namely

$$Var(p_t - d_t) = cov\left(\sum_{j=1}^{\infty} \kappa_2^{j-1} \Delta d_{t+j}, p_t - d_t\right) - cov\left(\sum_{j=1}^{\infty} \kappa_2^{j-1} r_{t+j}, p_t - d_t\right) \quad (10)$$

where Δd_{t+1} is the growth in cash dividends per share, $p_t - d_t$ is the log of the price per share to cash dividends per share ratio. The parameter κ_2 is the steady state corresponding to the cash dividends per share.⁵ The valuation ratio in this case fluctuates as it anticipates growth in cash dividends per share or returns. While these last two equations, (9) and (10), seem deceptively similar, it is important to note that the decomposition is with regard to different quantities – in one case the left-hand side is the log aggregate market capitalization to total dividends while in the other it is the log per share price to cash dividends. The underlying cash flows that these valuations anticipate are very different as well, in the one case the growth is of aggregate payouts, and in the other, is of cash dividends. In essence, this reflects different implications of very different trading strategies.

2.2 Alternative Dividend Growth Rates—Why does it matter?

The aggregate dividend growth can be written as

$$\Delta d_{v,t+1} - \kappa_1 \chi_{t+1} = \Delta v_{t+1} - \Delta(v_{t+1} - d_{v,t+1}) - \kappa_1 \chi_{t+1}. \quad (11)$$

Since the valuation ratio itself is stationary, this measure grows on average at a rate of $E[\Delta v_{t+1}] - \kappa_1 E[\chi_{t+1}]$. Hence, the growth rate includes the growth rate in equity capital. On the other hand, the measure of dividend per share growth can be rewritten as,

$$\Delta d_{t+1} = \Delta p_{t+1} + \Delta(d_{t+1} - p_{t+1}) \quad (12)$$

where Δp_{t+1} is the capital gain component, and $\Delta(d_{t+1} - p_{t+1})$ is the change in the dividend-price ratio. The average growth rate of this series equals the average capital gain in price per share, $E[\Delta p_{t+1}]$, which *differs* from the average growth rate of market capitalization. Thus, the growth rates of the aggregate and per share cash flow measures are very different. Figure

⁵That is, $\kappa_2 = \exp(\overline{p-d}) / (1 + \exp(\overline{p-d}))$.

2 shows the time series of these two measures for the sample period 1930-2003. Figure 3 shows that the *level* of aggregate dividends has a trend that mirrors that of aggregate consumption, while that of dividends per share does not. This difference mirrors the differences in the average growth of aggregate equity capital relative to that of price per share.

Alternatively stated, aggregate dividend measure incorporates the evolution and expansion of the scale of equity capital, while price per share need not. Accounting for the growth and fluctuations in the scale of the economy is the reason for the differences in these two alternative measures of dividend growth rates. The aggregate trading strategy tracks the evolution of market capitalization, while the per share trading strategy that of price per share. Figure 4 displays this intuition by plotting the growth rate in the (scale of the economy) aggregate number of shares of the economy (based on the ratio of market capitalization to the price per share) and the valuation ratio $v_t - d_{v,t}$. The two track each other quite noticeably and have a correlation of 0.64. The per-share trading strategy price ignores adjustments in the scale of the economy via the changes in N_t over time. However, from a macro perspective, and in terms of thinking about the trading strategy of the representative agent, it is not clear why hold-one-share trading strategy should be the the central concern.

3 Data

In this section we describe the construction of the various measures of interest. We start with monthly data which includes all firms from NYSE, AMEX, and NASDAQ from 1929-2003. Based on that data we construct the annual data that we use in our empirical work. The return can always be stated as,

$$R_{t+1} = h_{t+1} + y_{c,t+1} \quad (13)$$

where h_{t+1} is the price per share capital gain and $y_{c,t+1}$ is the conventional cash-dividend yield. To construct $D_{v,t+1}$, the total aggregate dividends, the approach presented in Bansal, Dittmar and Lundblad (2005) is pursued. First, the re-purchase adjusted capital gain is defined for each stock in the portfolio,

$$h_{t+1}^* = \left[\frac{P_{t+1}}{P_t} \right] \cdot \min \left[\frac{N_{t+1}}{N_t}, 1 \right]. \quad (14)$$

Then the payout (cash dividends plus repurchases) yield is $y_{o,t+1} = R_{t+1} - h_{t+1}^*$, which implies that aggregate dividends (inclusive of repurchases) are,

$$D_{v,t+1} = y_{o,t+1} V_t \quad (15)$$

where V_t is the market value of all stocks in the portfolio. Further, the yield that reflects both inflows and outflows, y_{t+1} is constructed via,

$$y_{t+1} \equiv \frac{D_{v,t+1} - I_{t+1}}{V_t} = R_{t+1} - \frac{V_{t+1}}{V_t} \quad (16)$$

Hence, y_{t+1} can be computed by subtracting the growth in market capitalization from gross returns. Now, given y_{t+1} , the inflow yield, the investment ratio $y_{n,t+1}$, can be computed as follows,

$$y_{n,t+1} \equiv \frac{I_{t+1}}{V_t} = (y_{o,t+1} - y_{t+1}) \quad (17)$$

and therefore I_{t+1} can be computed by multiplying $y_{n,t+1}$ by V_t .

4 Empirical Results

Table 1 provides the means and standard deviations of consumption growth rate, net aggregate dividend growth, valuation ratio, $v_t - d_{v,t}$ - the market capitalization to aggregate dividend ratio, the market return, and the per share price dividend ratio. The data is comparable to evidence in other papers. The one important dimension to note is the fact that aggregate dividend growth volatility is almost twice that of the conventional dividend per share volatility. This feature is partly reflecting the evolution of change in scale of equity investment.

Table 2 presents evidence regarding the autocorrelation function of the valuation ratios and the consumption to dividend ratios. First note that the conventional per share price dividend ratio is very persistent with a first order autocorrelation of 0.91. On the other hand, the first order autocorrelation for the aggregate valuation to dividend ratio is 0.65. Unit root tests, which evaluate whether price and dividend are cointegrated at one, show that the unit root hypothesis can not be rejected for the conventional per share price dividend ratio ($p_t - d_t$), while it is rejected for the case of aggregate valuation ratio ($v_t - d_{v,t}$). More intuitively, the autocorrelation function of the $p_t - d_t$ ratio declines very slowly compared to

that of the $v_t - d_{v,t}$ ratio. Consequently, statistical inference on long-horizon predictability of returns and dividend growth rates is more reliable using the $v_t - d_{v,t}$ ratio relative to the conventional $p_t - d_t$ ratio. We also report in this table the unit root properties of log consumption to aggregate dividend ratio and log consumption to conventional dividend per share ratio. As discussed earlier, there are very natural economic restrictions that suggest that the aggregate dividends to consumption ratio should be stationary; the evidence in the table confirms this view. On the other hand, the autocorrelation function of $d_t - c_t$ suggests that the consumption to conventional dividend per share ratio is very persistent and the two series may not be cointegrated. These phenomena are perhaps best represented in Figure 3 which displays log consumption against the two measures of dividends.

Based on equations (9) and (10), we provide the following projection information to analyze what percentage of the valuation ratio variability is due to cash flow predictability and that due to return predictability. In Table 3 we provide these projections for the adjusted aggregate dividends and the corresponding aggregate valuation ratio, while Table 4 provides analogous information based on the conventional price per share dividend ratio. Specifically, the left-hand panel of Table 3 provides the results from the following projection

$$\sum_{j=1}^K \kappa_1^{j-1} (\Delta d_{v,t+j} - \kappa_1 \chi_{t+j}) = \beta_{0,d} + \beta_{K,d_v} (v_t - d_{v,t}) + error. \quad (18)$$

in which the dependent variable is cash flow. The right-hand panel provides the information on return predictability, using the projection

$$\sum_{j=1}^K \kappa_1^{j-1} r_{t+j} = \beta_{0,r} + \beta_{K,r} (v_t - d_{v,t}) + error. \quad (19)$$

The slope estimates measure the percentage of the variation in the valuation ratio coming from growth rates and expected returns respectively. The evidence in Table 4 using the conventional per share price-dividend ratio is similar to that in Campbell Shiller (1988) and Cochrane (1992). At all horizons there is very little cash flow predictability, while there is measurable return predictability. The \bar{R}^2 for return predictability goes up to about 20% at the 5 year horizon. If we go as far as 10 years out, the slope coefficients on returns and cash flows are -0.77 and -0.18 respectively, which is close to the magnitude in other papers. The predictability numbers are somewhat weaker than those traditionally reported due to the behavior of the dividend yield in the last ten years. If we end the sample in 1995, the 10 year

projection coefficients on returns and dividend growth are -1.06 and -0.20 respectively, the familiar quantities reported in the literature. Overall, the message from the decomposition in Table 4 is that asset price variation is almost entirely due to expected return variation and cash flow predictability plays virtually no role in accounting for price variation.

The evidence is very different when using aggregate dividend growth rates and market capitalization to aggregate dividend ratio. Table 3 shows that the slope coefficients and the \bar{R}^2 rise with the horizon for both aggregate dividend growth and returns. At the horizon of 5 years the two sources of variation contribute about 50% each in explaining asset price variation.

To see the robustness of this evidence, we also consider 12 industry portfolios. The data for each sector is constructed in analogous manner to the construction for the market portfolio (specific details on each sector are given in Bansal, Fang and Yaron (2005)). The evidence, given in Table 5, is broadly consistent with that of the market portfolio. However, there is considerable variation in the fraction of the cash flow versus return contribution in explaining valuation ratios across these different sectors. Generally, industry specific components in dividend growth rates, as one would suspect, would enhance the contribution of cash flows in accounting for price-variation. This is indeed true for most of the sectors. However, using the conventional price-dividend ratio and dividend growth measure, the evidence is no different than that documented above for the market portfolio using price per share measures. Again, this is due to the specific features of trading strategy of holding one share as oppose to thinking about the evolution of the overall output scale of different industries over time.

4.1 Estimating via EC-VAR

The above analysis can only be used to measure the contribution of the dividends and expected return pieces for finite horizon K . An alternative approach, is to specify the VAR and measure the contribution of expected returns and dividend growth rates to the valuations at all horizons, including $K = \infty$. Hamilton (1994) provides a simple way to compute the counterparts to $\beta_{K,d}$ and $\beta_{K,r}$ from a VAR.

We model the dynamics of consumption, aggregate dividends and equity market capital-

ization using the following error-correction VAR(1) specification:

$$\begin{pmatrix} \Delta c_t \\ d_{v,t} - c_t \\ v_t - d_{v,t} \end{pmatrix} = \begin{pmatrix} a_{11} & 0 & 0 \\ a_{21} & a_{22} & a_{23} \\ a_{31} & a_{32} & a_{33} \end{pmatrix} \begin{pmatrix} \Delta c_{t-1} \\ d_{v,t-1} - c_{t-1} \\ v_{t-1} - d_{v,t-1} \end{pmatrix} + \begin{pmatrix} \eta_{1t} \\ \eta_{2t} \\ \eta_{3t} \end{pmatrix}, \quad (20)$$

where Δc_t is the growth rate of aggregate consumption, $d_{v,t} - c_t \equiv \log(D_{v,t}/C_t)$ is the logarithm of dividends to consumption ratio. For expositional simplicity, we assume that all variables are de-measured at the outset.

Denoting $x_t = (\Delta c_t, d_{v,t} - c_t, v_t - d_{v,t})'$, equation (20) can be compactly written as

$$x_t = Ax_{t-1} + \eta_t. \quad (21)$$

Note that the three variables in x_t are sufficient to derive the contribution of expected returns and dividend growth rates to variability in $v_t - d_{v,t}$. In particular, note that $\Delta d_{v,t} = \Delta c_t + \Delta(d_{v,t} - c_t)$, and given equation (7), equity return is a linear combination of dividend growth and $v_t - d_{v,t}$. These derivations and more details regarding the EC-VAR are given in the appendix. The point estimates and t-statistics are given in Table 6. The results in Table 7 and Figure 5 show that at long horizons the contribution from dividend predictability and return predictability is about 50%. Further, an important implication is the effect of the error correction variable $d_{v,t} - c_t$. Excluding this variable, and hence ignoring the effects of cointegration, seems to make a difference at horizons of 5-10 years. This can be seen by comparing the results to those in Table 8 and Figure 6 where the error-correction piece is not imposed.

We also run a similar VAR based variance decomposition for the conventional price-dividend per share measure but we do not impose the cointegration restriction between dividend per share and consumption. This follows from the evidence suggesting the two series are not cointegrated as seen earlier in Figure 3 and the large autocorrelation of $d_t - c_t$ given in Table 2. The results for the per share dividend growth rates are reported in Table 9. This table clearly documents that much of the variation in $p_t - d_t$ is due to expected returns. This evidence is standard, and is consistent with what is reported in Campbell and Shiller (1988) and Cochrane (1992).

The message from the above evidence is that with the hold-one-share trading strategy the dividend per share growth is not predicted by $p_t - d_t$ and the variability in this valuation

ratio is entirely due to the variation in expected returns. The story is significantly different with the aggregate trading strategy; in this case about 50% of the variability in the valuation ratio, $v_t - d_{v,t}$, is due to aggregate dividend growth predictability and the remaining 50% due to return predictability.⁶ Note that returns are quite predictable with the $v_t - d_{v,t}$ measure as well, the predictability here is only slightly smaller than that from using $p_t - d_t$ as a predictive variable. Moreover, inference about return predictability using $v_t - d_{v,t}$ is more reliable, as the level of persistence in this series is much less than that in the traditional $p_t - d_t$ measure.

5 Model

In this section we specify a model based on Bansal and Yaron (2004) and add the cointegration feature (as in Bansal, Gallant, and Tauchen (2004)) between consumption and aggregate dividends. To model dividend growth we treat the primitive series for dividend growth as the one corresponding to net payouts $D_{v,t} - I_t$. This approach follows directly from equation (5). The model will serve as a vehicle for showing that the constructed aggregate dividend series is consistent with an equilibrium model that reproduces many of the observed asset pricing stylized facts. In addition it will allow us to further investigate the plausibility of the valuation ratio decomposition given in equation (9).

⁶One consideration with any such decomposition is the potential endogeneity of movements in both expected growth rates and expected returns. Any such common movements can make it difficult to interpret the sources of variation in valuation ratios solely in terms of variation in expected returns or expected growth rates. Nonetheless, based on the VAR this correlation is -0.30 for the $v_t - d_{v,t}$ ratio while it is about 0 for the $p_t - d_t$ ratio. Thus, quantitatively there is an important independent variation in expected cashflows and expected returns.

Thus, consumption and net dividends follow,

$$\begin{aligned}
\Delta c_{t+1} &= \mu_c + x_t + \sigma_t \eta_{t+1} \\
x_{t+1} &= \rho x_t + \sigma_t \varphi_e e_{t+1} \\
d_{v,t+1} - c_{t+1} &\equiv \mu_{d_v c} + s_{t+1} \\
s_{t+1} &= \rho_s s_t + \phi_{sx} x_t + \varphi_d \sigma_t u_{t+1} \\
\sigma_{t+1}^2 &= \bar{\sigma}^2 + \nu(\sigma_t^2 - \bar{\sigma}^2) + \sigma_w w_{t+1} \\
\eta_{t+1}, e_{t+1}, u_{t+1}, w_{t+1} &\sim Niid(0, 1) \\
corr_t(u_{t+1}, \eta_{t+1}) &= \alpha, \\
corr_t(u_{t+1}, e_{t+1}) &= corr_t(\eta_{t+1}, e_{t+1}) = 0
\end{aligned} \tag{22}$$

where Δc_{t+1} is the growth rate of consumption. As in the long run risks model of Bansal and Yaron (2004), $\mu_c + x_t$ is the conditional expectation of consumption growth, and x_t is a small but persistent component that captures the long run risks in consumption growth. For parsimony, as in Bansal and Yaron (2004), we have a common time-varying volatility in consumption and dividends, which, as shown in that paper, leads to time-varying risk premia. In essence, save for the common trend in consumption and dividends, the dynamics are similar to those in Bansal and Yaron (2004). Note that this analysis is quite different from Bansal, Gallant, and Tauchen (2005) who do impose cointegration but focus on dividends per share (i.e., p_t and d_t). On the other hand, the analysis here focuses on the cointegration between the new aggregate dividend measure and its corresponding aggregate market capitalization (i.e., v_t and $d_{v,t}$).

Aggregate dividends have unit cointegration with consumption, and the deviation between d_t and c_t , the error correcting term, is labelled s_t . The parameter ρ_s determines the speed of mean reversion in this stationary process, and $\phi_{sx} > 0$ controls the leverage of the corporate sector to long-run expected growth movements in the economy. As $\Delta d_{v,t+1} \equiv \Delta s_{t+1} + \Delta c_{t+1}$, the above specification for s_{t+1} implies that aggregate dividend growth is

$$\Delta d_{v,t+1} = \mu_c + (1 + \phi_{sx})x_t + (\rho_s - 1)s_t + \sigma_t \eta_{t+1} + \varphi_d \sigma_t u_{t+1} \tag{23}$$

To compute $v_t - d_{v,t}$ we require the present value of net payout growth rates $\Delta d_{v,t+1} - \kappa_1 \chi_{t+1}$, (see equation (11)). Hence, to solve the model we need the dynamics of the net payout growth rate. It is important to note that in the data the correlation between $\Delta d_{v,t}$ and $\Delta d_{v,t} - \kappa_1 \chi_t$ is about 0.99. With this feature, and the desire to keep the number of state variables

manageable, we further assume that the investment rate, χ_t , is constant. Consequently, the specification of the net payout growth $\Delta d_{v,t+1} - \kappa_1 \chi_{t+1}$ is the same as $\Delta d_{v,t}$ given in equation (23) above, *except* that the intercept μ_c is replaced by $\mu_c - \kappa_1 \bar{\chi}$ due to the mean investment rate.

In equation (23) the term $(1 + \phi_{sx})$ is interpreted as the leverage of corporate payouts to long run expected growth movements in consumption. This captures the intuition that the corporate sector is more risky than aggregate consumption. A key point of departure from the Bansal and Yaron (2004) model is the effect of the error correction term s_t in the dividend growth process. The net effect of this restriction is that the aggregate dividends and consumption pair have only one unit root in them. This restriction ought to be imposed on aggregate consumption and dividend series as these aggregate quantities cannot permanently deviate from each other. The per share dividend series may or may not be cointegrated with aggregate consumption; this is an empirical question. The aggregate dividend series on the other hand, simply based on economic consideration, ought to be cointegrated, as the corporate sector's profits (and dividends) as a fraction of aggregate consumption have to be stationary.

We assume as in the long-run risks model of Bansal and Yaron (2004) that preferences follow the Epstein and Zin (1989) specification. The intertemporal marginal rate of substitution with these preferences is

$$\mathcal{M}_{t+1} = \exp(\theta \log \delta - \frac{\theta}{\psi} \Delta c_{t+1} + (\theta - 1)r_{a,t+1}) \quad (24)$$

where $r_{a,t+1}$ is the endogenous continuous (i.e., log) return on the asset that delivers aggregate consumption as its dividends each period. The key preference parameters are, γ , the risk aversion, and the intertemporal elasticity of substitution (IES) parameter, ψ . The parameter $\theta \equiv \frac{1-\gamma}{1-\frac{1}{\psi}}$, is determined by the IES and the risk aversion. When θ equals one, the IES equals the reciprocal of the risk aversion parameter, and the preferences collapse to the standard CRRA preferences. With the Epstein and Zin (1989) preferences, the Euler condition (pricing condition) for any asset's continuous return $r_{i,t+1}$ is,

$$E_t[\exp(\theta \log \delta - \frac{\theta}{\psi} \Delta c_{t+1} + (\theta - 1)r_{a,t+1} + r_{i,t+1})] = 1$$

5.1 Model Implications

To derive implications for risk premia, valuation ratios, and the predictability of returns and cash flows, we need to first solve for the endogenous return $r_{a,t+1}$, and then solve for the return on the dividend claim which corresponds to the market return. We provide approximate analytical solutions for intuition, the results we report are however based on numerical solutions.

Bansal and Yaron (2004) provide the approximate analytical solution for the $p_{c,t} - c_t$, the log price of consumption stream to consumption ratio. Given the consumption dynamics, and the Campbell-Shiller log-linear expression for the return, one can solve for the return $r_{a,t+1}$. The conjectured solution for $p_{c,t} - c_t$ is $A_{0,c} + A_{1,c}x_t + A_{2,c}\sigma_t^2$, in which,

$$A_{1,c} = \frac{1 - \frac{1}{\psi}}{1 - \kappa_c \rho} \quad (25)$$

$$A_{2,c} = \frac{0.5[(\theta - \frac{\theta}{\psi})^2 + (\theta A_{1,c} \kappa_c \varphi_e)^2]}{\theta(1 - \kappa_c \nu_1)} \quad (26)$$

For brevity we simply highlight some key features. If the IES is larger than one, then wealth to consumption ratio rises as x_t increases, that is, if agents expect higher growth in the economy, they are willing to buy more assets, and drive-up the valuation ratio (see equation (25)). If risk aversion and IES are both larger than one, an increase in economic uncertainty, that is, a rise in σ_t^2 , lowers the wealth to consumption ratio. While an increase in uncertainty lowers the risk free rate, it also increases the risk premia sufficiently to lower asset valuations (see equation (26)). We name this the "volatility channel". This latter channel further motivates the choice of an IES that is larger than one. Bansal and Yaron (2004) and Bansal, Khatchatrian, and Yaron (2004) provide empirical evidence supporting the implications of the volatility channel.

Using the solution for $p_{c,t} - c_t$ to derive the endogenous return $r_{a,t+1}$, and substituting it into the IMRS, one can show the market prices for various risk sources in the economy. Specifically, the innovation in the log pricing kernel, m_{t+1} is,

$$m_{t+1} - E_t[m_{t+1}] = -\lambda_\eta \sigma_t \eta_{t+1} - \lambda_e \sigma_t e_{t+1} - \lambda_w \sigma_w w_{t+1}, \quad (27)$$

where the λ 's are the market prices for short-run risks in consumption, long-run expected growth risks, and volatility risks. More specifically, the short-run risk compensation is simply

governed by risk aversion $\lambda_\eta = \gamma$, the long-run expected growth risk compensation, $\lambda_e = (\gamma - \frac{1}{\psi}) \frac{\kappa_c \varphi_e}{1 - \kappa_c \rho}$, which increases as ρ rises. The volatility risk compensation is $\lambda_w = (1 - \theta) A_{2,c} \kappa_c$, which is negative when IES and risk aversion are larger than one; however, as shown below, the *beta* of assets to this risk is also negative, consequently, this risk contributes positively to equity risk compensation. In the special case of power utility, where $\theta = 1$ (that is, $\gamma - \frac{1}{\psi} = 0$), the market price of risks for the long-run expected growth, and volatility are zero. That is, with power utility there is no separate risk compensation for long-run growth rate risks and volatility risks. However, when risk aversion differs from the reciprocal of IES, both these risks influence the risk premia on assets. The role of long-run expected growth risks and volatility risks in driving risk premia is an important and novel feature of the Bansal and Yaron (2004) model.

Given the solution for the endogenous return on aggregate wealth, one can solve for the return on the dividend asset. The solution for $v_t - d_{v,t}$ depends on the three state variables, x_t , s_t , and σ_t^2 . Using a log-linear approximation, and conjecturing that the solution is $v_t - d_{v,t} = A_{0,d} + A_{1,d}x_t + A_{2,d}\sigma_t^2 + A_{3,d}s_t$, one can derive,

$$\begin{aligned} A_{1,d} &= \frac{(1 - \frac{1}{\psi}) + \phi_{sx} [\frac{1 - \kappa_d}{1 - \kappa_d \rho_s}]}{1 - \kappa_d \rho} \\ A_{3,d} &= \frac{\rho_s - 1}{1 - \kappa_d \rho_s} \\ A_{2,d} &= \frac{A_{2,c}(1 - \kappa_c \nu)(1 - \theta) + 0.5[H_1 + H_2]}{1 - \kappa_d \nu} \end{aligned}$$

where $H_1 = (1 - \gamma)^2 + \left(\varphi_d [\frac{1 - \kappa_d}{1 - \kappa_d \rho_s}]\right)^2 + 2\alpha(1 - \gamma)\left(\varphi_d [\frac{1 - \kappa_d}{1 - \kappa_d \rho_s}]\right)$, and $H_2 = \left[\left((\theta - 1)\kappa_c A_{c,1} + \kappa_d A_{1,d}\right)\varphi_e\right]^2$.

After substituting the solution for the valuation ratio and the dividend growth dynamics, one can show that the innovation into return is

$$r_{t+1} - E_t[r_{t+1}] = \kappa_d A_{1,d} \varphi_e \sigma_t e_{t+1} + (1 + \kappa_d A_{3,d}) \varphi_d \sigma_t u_{t+1} + \sigma_t \eta_{t+1} + \kappa_d A_{2,d} \sigma_w w_{t+1} \quad (28)$$

An important feature to note is the exposure of the return to the dividend growth shock u_{t+1} . With cointegration, the impact of this dividend innovation shock on the ex-post return can be well below one. For example, if $\kappa_d = 0.99$ and $\rho_s = 0.90$, then the term $(1 + \kappa_d A_{3,d}) = \frac{1 - \kappa_d}{1 - \kappa_d \rho_s}$ equals 0.09. Hence, cointegration lowers the impact of this shock on ex-post returns

considerably, to about 10% of its magnitude. This will explain the result presented below that despite high dividend growth volatility, the return volatility is only 16%. In the case when $\rho_s = 1$, that is, when cointegration is not imposed, the impact of this shock on the ex-post return is 100%. Hence, with cointegration, the return volatility can be far less than the dividend volatility. This result reflects the fact that, at long horizons, dividends and consumption look the same to the investor.

In addition, the loadings on various shocks give the betas of the market return. While the market price of volatility risk is negative, so is the beta of the asset, hence, this piece contributes positively to risk premia. The largest source of risk premia is long run risks emanating from shocks to the expected growth component.

5.2 Calibration and Results

In calibrating this economy we choose the parameters of consumption and dividend process to match the annual data. As in Campbell and Cochrane (1999) and Bansal and Yaron (2004) the agent's decision interval is one month and the model's output is time-aggregated to the annual frequency. The calibration of the consumption dynamics is similar to that in Bansal and Yaron (2004). In particular, the parameters of the consumption and dividend processes are chosen to match their annual counterparts for the sample period of 1930-2003. However, this paper deviates significantly from Bansal and Yaron (2004) in the specification for dividends' dynamics in that it enforces dividends to be cointegrated with consumption. The paper also differs significantly from Bansal, Gallant, and Tauchen (2005) in that the underlying dividend series is aggregate dividend series corresponding to the equilibrium strategy rather than the standard dividend per-share series. One important challenging aspect of this calibration is in matching a dividend series with a volatility of about 23% and a market return volatility of about 20%.

Table 10 presents the simulated output for this economy. At the calibrated parameters, presented below Table 10, the model is able to match the observed consumption and dividend growth rate dynamics. The preference parameters are quite similar to those chosen in Bansal and Yaron (2004).

As can be seen from Table 10, this model is quite capable of replicating many features of the market return and the aggregate valuation ratio. In particular, note that the model is

able to generate a return volatility that is comparable to that in the data in spite of the fact that the volatility of the constructed aggregate cash flow is quite large relative to the dividend per share volatility and the return volatility itself. This feature is an important outcome of the cointegration restriction, which as we mentioned earlier, corresponds naturally to the equilibrium restriction between aggregate dividends and consumption. Cointegration says that at long horizons dividend growth volatility and consumption growth volatility are the same from the perspective of the investor.

Table 11 provides the model's based valuation ratio decomposition as in equations (18) and (19). Based on the projection of dividend growth rates onto valuation ratios, at horizon of 5 years, dividend growth rates account for about 53% of the variability of the aggregate price-dividend ratio. For the same horizon, the future return projection accounts for about 36% of the variation in the valuation ratio. The model's decomposition highlights the fact that about half of the variation in the valuation ratio is due to cash flows and another half is due to expected returns.

5.3 Monte Carlo

Cochrane (2005) evaluates the evidence on return predictability. A central theme of the paper is the idea that although the evidence on return predictability might be questioned on statistical grounds, there is important auxiliary information based on the variance decomposition of the per share price dividend ratio, and the inability to predict per share dividend growth. The variance decomposition, as in equation (10), implies that return predictability and dividend predictability must add up to 100% of the variation in price dividend ratio. Thus, Cochrane emphasizes that the return predictability is a *joint* hypothesis about return predictability and dividend per share predictability. Cochrane runs Monte-Carlo in which the null is centered at zero predictability. Since, there is no evidence for per share dividend predictability, Cochrane rejects the null and concludes that the variation must be coming from return predictability.

Our empirical findings above suggest setting a different null hypothesis in which 50% of the variance of the valuation ratio is due to variation in returns, and 50% to variation in dividend growth — the "50/50" null. We use the model above to simulate 2500 samples, each with 76 observations, the length of our sample. In principle one could use a more reduced

form model for returns, dividend growth, and valuation ratio as data generation. However, by using the model in the previous section we are in essence testing a more encompassing *joint* hypothesis – one that focuses on return predictability but imposes that it is also consistent with many other features of asset market data. The empirical distribution of the cash flow and return predictability projection coefficients (i.e., the projections (18) and (19)) given in Table 12 shows that the null of "50/50" is plausible.

6 Conclusion

There is considerable interest in having a unified approach for understanding macroeconomic fluctuations and asset prices. One popular view is that asset price fluctuations are driven by variation in costs of capital. This view rests, to a large degree, on the view that dividends are generally unpredictable while returns are predicted by the price per share dividend ratio. This view is based on using the conventional dividends and price per share measures, which ignore the change in scale of the economy.

In this paper we argue that an important macroeconomic restriction is that the representative agent needs to hold the entire equity capital. This restriction uniquely measures the aggregate payout and the corresponding asset price valuation pair. Quantitatively, we show that using this aggregate dividend series (adjusted for repurchases and issuance) and its corresponding price (market capitalization) alters the implications for sources of price variation. About 50% of the asset price variation, unlike in the traditional measure, is due to payout growth predictability. Hence we argue that a reasonable view for sources of asset price variation is a 50/50 view—expected returns and cash flows contribute equally to fluctuations in asset prices, in the aggregate. Economically, the aggregate dividend series incorporate changes in the scale of the economy – features that are absent from the per share dividend series and that make the aggregate series be more predictable.

Further, the aggregate series seems to be consistent with the macro restrictions whereby aggregate dividends are cointegrated with consumption while the typical dividend per share do not. We develop a long run risks model that incorporates this aggregate cointegration restriction. Our model can broadly rationalize many of the puzzling asset markets features in the data and thus provide a unified view of asset market movements. In particular, the model is consistent with the view in which 50% of the variation in valuation ratio are due

to variation in cashflows while the rest is due to variation in expected returns.

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7 Appendix- EC-VAR

This appendix details the Error-Correction VAR we employ for the predictability decomposition given in section 4.1. The dynamics of consumption, aggregate dividends and equity market capitalization follow the error-correction VAR(1) specification below:

$$\begin{pmatrix} \Delta c_t \\ d_{v,t} - c_t \\ v_t - d_{v,t} \end{pmatrix} = \begin{pmatrix} a_{11} & 0 & 0 \\ a_{21} & a_{22} & a_{23} \\ a_{31} & a_{32} & a_{33} \end{pmatrix} \begin{pmatrix} \Delta c_{t-1} \\ d_{v,t-1} - c_{t-1} \\ v_{t-1} - d_{v,t-1} \end{pmatrix} + \begin{pmatrix} \eta_{1t} \\ \eta_{2t} \\ \eta_{3t} \end{pmatrix}, \quad (29)$$

where Δc_t is the growth rate of aggregate consumption, $d_{v,t} - c_t \equiv \log(D_t/C_t)$ is the logarithm of dividends to consumption ratio, and $v_t - d_{v,t} \equiv \log(V_t/D_t)$ is the logarithm of the market value to dividends ratio. For expositional simplicity, we assume that all variables are demeaned at the outset.

Denoting $x_t = (\Delta c_t, d_{v,t} - c_t, v_t - d_{v,t})'$, equation (29) can be compactly written as

$$x_t = Ax_{t-1} + \eta_t. \quad (30)$$

In order to compute the variance decomposition of the vd -ratio, it is easier to work with an augmented VAR specification. Let $y_t = (x_t, \Delta d_{v,t}, r_t)'$, where Δd_t is the growth rate of dividends, and r_t is the log return. The dynamics of the additional variables in y_t are derived from the dynamics of x_t . In particular, $\Delta d_{v,t} = \Delta c_t + \Delta(d_{v,t} - c_t)$, $r_t = \Delta d_{v,t} + (\kappa_1 - 1)v_t - d_{v,t} - \Delta(v_t - d_{v,t})$, and $\Delta d_{v,t} - c_t$ and $\Delta(v_t - d_{v,t})$ are the first differences of $d_{v,t} - c_t$ and $v_t - d_{v,t}$, respectively. The evolution of y_t , therefore, can be similarly described by a first-order VAR

$$y_t = By_{t-1} + \epsilon_t, \quad (31)$$

where the elements of matrix B and innovation vector ϵ_t are deduced from A and η_t .

The percentage of variance of the $v - d$ -ratio explained by future returns is

$$\beta_r(k) = - \frac{Cov\left(\sum_{j=1}^k \kappa_1^{j-1} r_{t+j}, v_t - d_{v,t}\right)}{Var(v_t - d_{v,t})} = - \frac{e_r' \left[\Sigma(1) + \kappa_1 \Sigma(2) + \dots + \kappa_1^{k-1} \Sigma(k) \right] e_{vd}}{e_{vd}' \Sigma(0) e_{vd}}, \quad (32)$$

where k is the horizon, e_r and e_{vd} are zero vectors with 1 in the return and $v-d$ -ratio positions, respectively, $\Sigma(k)$ is the k^{th} -order autocovariance of y_t , and $\Sigma(0)$ is the unconditional variance of y_t .

Similarly, the percentage of variance of the vd -ratio due to variations in future dividend growth rates is given by

$$\beta_{\Delta d_v}(k) = \frac{Cov\left(\sum_{j=1}^k \kappa_1^{j-1} \Delta d_{v,t+j}, v_t - d_{v,t}\right)}{Var(v_t - d_{v,t})} = \frac{e'_{\Delta d_v} \left[\Sigma(1) + \kappa_1 \Sigma(2) + \dots + \kappa_1^{k-1} \Sigma(k) \right] e_{vd}}{e'_{vd} \Sigma(0) e_{vd}}, \quad (33)$$

where $e_{\Delta d_v}$ is a zero vector with 1 in the dividend growth position.

Using the VAR representation, the unconditional variance of y_t can be computed as

$$\Sigma(0) = vec^{-1}[(I_{q^2} - B \otimes B)^{-1} vec(\Sigma_\epsilon)], \quad (34)$$

where Σ_ϵ is the variance-covariance matrix of ϵ_t ; vec is the operator that transforms a matrix into a vector by stacking the columns of the matrix one below the other (starting from left to right), and vec^{-1} performs the reverse transformation; q is the dimension of y_t , which in our case is equal to 5. Notice that, since the autocorrelation function of y_t is given by

$$\Sigma(j) = B^j \Sigma(0), \quad (35)$$

the variance decomposition in equations (32) and (33) can also be compactly written as

$$\beta_r(k) = - \frac{e'_r B [I_q - (\kappa_1 B)^k] [I - \kappa_1 B]^{-1} \Sigma(0) e_{vd}}{e'_{vd} \Sigma(0) e_{vd}}, \quad (36)$$

$$\beta_{\Delta d_v}(k) = \frac{e'_{\Delta d_v} B [I_q - (\kappa_1 B)^k] [I - \kappa_1 B]^{-1} \Sigma(0) e_{vd}}{e'_{vd} \Sigma(0) e_{vd}}. \quad (37)$$

In the limit, as $k \rightarrow \infty$, $(\kappa_1 B)^k$ -term disappears, and the fractions converge to

$$\beta_r(\infty) = - \frac{e'_r B [I - \kappa_1 B]^{-1} \Sigma(0) e_{vd}}{e'_{vd} \Sigma(0) e_{vd}}, \quad (38)$$

$$\beta_{\Delta d_v}(\infty) = \frac{e'_{\Delta d_v} B [I - \kappa_1 B]^{-1} \Sigma(0) e_{vd}}{e'_{vd} \Sigma(0) e_{vd}}. \quad (39)$$

Table 1: Summary Statistics

Variable	Mean	Standard Deviation
Δc_t	0.020	0.022
$p_t - d_t$	3.284	0.410
$v_t - d_{v,t}$	3.037	0.343
$\Delta d_{v,t} - \kappa \chi_t$	0.008	0.231
$\Delta d_{v,t}$	0.035	0.237
χ_t	0.028	0.023
Δd_t	0.003	0.133
R_t	0.086	0.198

The entries are the mean and standard deviation for each variable for the sample period 1930-2003. The variables are consumption growth (Δc_t), log per share price dividend ($p_t - d_t$), log aggregate market capitalization to dividend ratio ($v_t - d_{v,t}$), growth rate of adjusted aggregate dividends ($\Delta d_{v,t}$), investment rate (χ_t), and the market return (R_t).

Table 2: Persistence of Valuation Ratios

ACF	$v_t - d_{v,t}$	$p_t - d_t$	$d_{v,t} - \kappa\chi_t - c_t$	$d_t - c_t$
1	0.65	0.91	0.69	0.92
2	0.57	0.80	0.60	0.86
3	0.44	0.69	0.44	0.80
4	0.39	0.60	0.35	0.75
5	0.32	0.51	0.25	0.71

The entries are the autocorrelation functions of the two valuation ratios. $v_t - d_{v,t}$ correspond to the log of the aggregate market capitalization to aggregate dividend ratio, $d_t - c_t$ and $d_{v,t} - c_t$ are the per share to consumption ratio and aggregate dividends to consumption ratio respectively. $p_t - d_t$ is the log of the per share price-dividend ratio. The sample period is 1930-2003.

Table 3: Valuation Ratio Decomposition: Aggregate Market Capitalization to Dividend Ratio, $v_t - d_{v,t}$

Horizon	Cash flow			Returns		
	Slope	S.E.	\bar{R}^2	Slope	S.E.	\bar{R}^2
1	0.23	0.09	0.10	0.17	0.06	0.09
2	0.24	0.10	0.11	0.30	0.10	0.16
3	0.32	0.13	0.15	0.37	0.13	0.22
4	0.35	0.16	0.16	0.41	0.14	0.24
5	0.40	0.17	0.19	0.44	0.16	0.24

The left panel reports projections of cash flows onto the valuation ratio $v_t - d_{v,t}$, while the right panel reports return predictability projections onto the valuation ratio $v_t - d_{v,t}$. Specifically, the left panel is based on the following projection

$$\sum_{j=1}^K \kappa_1^{j-1} (\Delta d_{v,t+j} - \kappa_1 \chi_{t+j}) = \beta_{0,d} + \beta_{K,d_v} (v_t - d_{v,t}) + error.$$

while the right hand panel is based on the projection,

$$\sum_{j=1}^K \kappa_1^{j-1} r_{t+j} = \beta_{0,r} + \beta_{K,r} (v_t - d_{v,t}) + error.$$

Standard errors are Newey-West corrected.

Table 4: Valuation Ratio Decomposition: Per Share Price Dividend Ratio, $p_t - d_t$

Horizon	Cash flow			Returns		
	Slope	S.E.	\bar{R}^2	Slope	S.E.	\bar{R}^2
1	0.00	0.026	-0.01	0.09	0.047	0.02
2	-0.01	0.044	-0.01	0.19	0.086	0.08
3	-0.04	0.052	-0.01	0.26	0.111	0.13
4	-0.09	0.074	0.02	0.32	0.151	0.13
5	-0.09	0.087	0.01	0.35	0.204	0.12

The left panel, reports projections of per-share dividend growth onto the per share price dividend ratio, $p_t - d_t$. The right panel reports return predictability projections onto the per share price dividend ratio, $p_t - d_t$. Specifically, the left panel is based on the following projection

$$\sum_{j=1}^K \kappa_1^{j-1} \Delta d_{t+j} = \beta_{0,d} + \beta_{K,d}(p_t - d_t) + error.$$

while the right hand panel is based on the projection,

$$\sum_{j=1}^K \kappa_1^{j-1} r_{t+j} = \beta_{0,r} + \beta_{K,r}(p_t - d_t) + error.$$

Standard errors are Newey-West corrected.

Table 5: Valuation Ratio Decomposition: Sectoral Evidence

Sector	Cash flow						Returns					
	Horizon						Horizon					
	1 Year			5 Year			1 Year			5 Year		
	Slope	S.E.	R^2	Slope	S.E.	R^2	Slope	S.E.	R^2	Slope	S.E.	R^2
Bus Eqp	0.195	0.093	0.086	0.241	0.167	0.062	0.096	0.051	0.021	0.339	0.194	0.104
Chems	0.343	0.094	0.134	0.529	0.193	0.183	0.246	0.067	0.196	0.413	0.145	0.192
Durbl	0.414	0.134	0.135	0.691	0.278	0.219	0.162	0.063	0.030	0.319	0.275	0.064
Enrgy	0.392	0.105	0.166	0.623	0.119	0.349	0.164	0.070	0.069	0.299	0.133	0.104
Hlth	0.214	0.110	0.097	0.265	0.119	0.172	0.089	0.041	0.047	0.237	0.184	0.098
Manuf	0.319	0.130	0.158	0.352	0.203	0.109	0.101	0.057	0.015	0.451	0.155	0.244
Money	0.597	0.101	0.375	0.848	0.076	0.557	0.065	0.034	0.015	0.177	0.094	0.072
NoDur	0.180	0.089	0.063	0.297	0.135	0.109	0.216	0.052	0.155	0.506	0.157	0.266
Other	0.503	0.139	0.285	0.707	0.158	0.352	0.075	0.064	0.015	0.349	0.150	0.219
Shops	0.296	0.144	0.123	0.211	0.146	0.050	0.129	0.051	0.061	0.402	0.158	0.261
Telcm	0.571	0.130	0.325	0.486	0.140	0.296	0.108	0.035	0.051	0.333	0.075	0.173
Utils	0.199	0.092	0.050	0.264	0.062	0.090	0.110	0.065	0.022	0.328	0.134	0.118

This table reports return and cashflow predictability regressions onto the valuation ratio $v_t - d_t$ for the 12 industries. The data is taken from Bansal, Fang and Yaron (2005). For each sector, the cash flow measure corresponds to the investment rate adjusted sector specific aggregate dividend growth. The return corresponds to the return on holding this sectors. Specifically, the left panel provides information from

$$\sum_{j=1}^K \kappa_1^{j-1} (\Delta d_{v,t+j}^i - \kappa_1 \chi_{t+j}^i) = \beta_{0,d} + \beta_{K,d_v} (v_t^i - d_{v,t}^i) + error.$$

while the right hand panel is based on the projection,

$$\sum_{j=1}^K \kappa_1^{j-1} r_{t+j}^i = \beta_{0,r} + \beta_{K,r} (v_t^i - d_{v,t}^i) + error.$$

where i index the various industries. Standard errors are Newey-West corrected.

Table 6: EC-VAR Output

Estimated coefficients:

$$\hat{A} = \begin{pmatrix} 0.402 & 0.011 & 0.013 \\ -0.785 & 0.782 & 0.145 \\ -0.504 & 0.105 & 0.702 \end{pmatrix}$$

t-statistics:

$$\hat{t} = \begin{pmatrix} 2.73 & 2.59 & 1.92 \\ -0.82 & 8.79 & 1.77 \\ -0.33 & 1.03 & 9.67 \end{pmatrix}$$

The entries display the point estimates and the corresponding t-statistics from estimating the EC-VAR:

$$x_t = Ax_{t-1} + \eta_t$$

where $x_t = (\Delta c_t, d_{v,t} - c_t, v_t - d_{v,t})'$. The t-statistics are calculated using the Newey-West covariance estimator with 4 lags.

Table 7: Fraction of $Var(v_t - d_{v,t})$ Explained by Future Dividend Growth and Returns using an EC-VAR

Horizon	Dividend Growth	S.E.	Returns	S.E.
1	0.23	0.068	0.15	0.090
2	0.36	0.092	0.25	0.124
3	0.43	0.097	0.32	0.129
4	0.46	0.095	0.37	0.121
5	0.48	0.092	0.41	0.107
10	0.48	0.090	0.50	0.069
LR	0.47	0.105	0.53	0.105

This table provides the variance decomposition of the valuation ratio, $v_t - d_{v,t}$ using a VAR system with an error-correction (EC-VAR(1)). LR stands for setting the horizon to infinity.

Table 8: Fraction of $Var(v_t - d_{v,t})$ Explained by Future Dividend Growth and Returns using a VAR

Horizon	Dividend Growth	S.E.	Returns	S.E.
1	0.23	0.068	0.15	0.101
2	0.26	0.084	0.23	0.151
3	0.33	0.117	0.30	0.191
4	0.37	0.139	0.36	0.217
5	0.41	0.160	0.39	0.233
10	0.47	0.218	0.48	0.252
LR	0.49	0.245	0.51	0.245

This table provides the variance decomposition of the valuation ratio, $v_t - d_{v,t}$, using growth rate specification in a VAR(1). The column Dividend Growth provides the coefficients $\beta_{\Delta d_v}$ and the column Returns provides the coefficients β_r – both described in detail in the appendix. LR stands for setting the horizon to infinity.

Table 9: Fraction of $Var(p_t - d_t)$ Explained by Future Dividend Growth and Returns using a VAR

Horizon	Dividend Growth	S.E.	Returns	S.E.
1	-0.01	0.032	0.09	0.061
2	-0.02	0.060	0.17	0.113
3	-0.02	0.087	0.24	0.158
4	-0.03	0.112	0.31	0.197
5	-0.04	0.135	0.37	0.229
10	-0.06	0.225	0.62	0.329
LR	-0.12	0.411	1.12	0.411

This table provides the variance decomposition of the valuation ratio, $p_t - d_t$, using growth rate specification in a VAR(1). The column Dividend Growth reports the coefficients $\beta_{\Delta d}$ and the column Returns provides the coefficients β_r – both described in detail in the appendix. LR stands for setting horizon to infinity.

Table 10: Data and Model Output

	Data		Model
	Estimate	Std. Error	
$\mu_{\Delta c}$	1.96	0.32	1.94
$\sigma(\Delta c)$	2.20	0.45	2.11
$\mu_{\Delta d_v - \kappa \chi}$	0.76	1.47	0.72
$\sigma(\Delta d_v - \kappa \chi)$	23.11	3.54	23.91
$E[R_m - R_f]$	7.62	1.86	7.56
$\sigma(R_m)$	19.9	2.52	15.82
$E[R_f]$	0.85	0.40	1.14
$\sigma(R_f)$	1.22	0.33	0.84
$E(v - d_v)$	3.04	0.09	2.91
$\sigma(v - d_v)$	0.34	0.04	0.39

The table provides model and data summary statistics regarding key asset pricing moments. The data is for the sample period 1930-2003. The model is calibrated on a monthly decision period and then time aggregated to yield the annual output. The model's parameter values are as follows: $\delta = 0.9989$, $\gamma = 15$, $\psi = 1.5$, $\mu_c = 0.0015$, $\rho = 0.973$, $\varphi_e = 0.035$, $\sigma_w = 2.7e - 5$, $\nu = 0.998$, $\bar{\sigma}_0 = 0.0042$, $\mu_{\Delta d_v} = 6e - 4$, $\rho_s = 0.977$, $\phi_{sx} = 2$, $\varphi_d = 14$, $\alpha = -0.1$.

Table 11: Model Based Valuation Ratio Decomposition: Aggregate Market Capitalization to Dividend Ratio, $v_t - d_t$

Horizon	Cashflow			Returns		
	Slope	S.E.	R^2	Slope	S.E.	R^2
1	0.12	0.02	0.08	0.11	0.02	0.20
2	0.31	0.02	0.18	0.21	0.03	0.31
3	0.41	0.03	0.27	0.25	0.02	0.37
4	0.47	0.02	0.31	0.31	0.02	0.41
5	0.53	0.03	0.35	0.36	0.02	0.44

The entries are the model (see Table 10) implied projection coefficients of future return and future dividend growth with the valuation ratio $v_t - d_t$.

Table 12: Model Based Valuation Ratio Decomposition: Monte-Carlo

Horizon	5%	50%	95%
Future Dividend Growth Rates			
1	0.09	0.16	0.25
2	0.20	0.34	0.54
3	0.29	0.48	0.71
4	0.37	0.56	0.80
5	0.42	0.62	0.89
Future Returns			
1	0.07	0.10	0.15
2	0.11	0.17	0.27
3	0.14	0.22	0.34
4	0.16	0.25	0.36
5	0.18	0.27	0.43

The entries are the 5, 50 and 95 percentiles of the empirical distribution of projection coefficients from 2500 Samples, each with 76 observations, of the model presented in Table 10. The top panel reports projection coefficients of future dividend growth and the valuation ratio $v_t - d_t$; the bottom panel reports projections of future returns with the valuation ratio.

Figure 1: **Measure of Scale:** $\log(V_t/P_t)$

The plot provides a measure of scale of the economy by plotting $\log(V_t/P_t)$ – the log ratio of market capitalization to price per share. The sample period is 1930-2003.

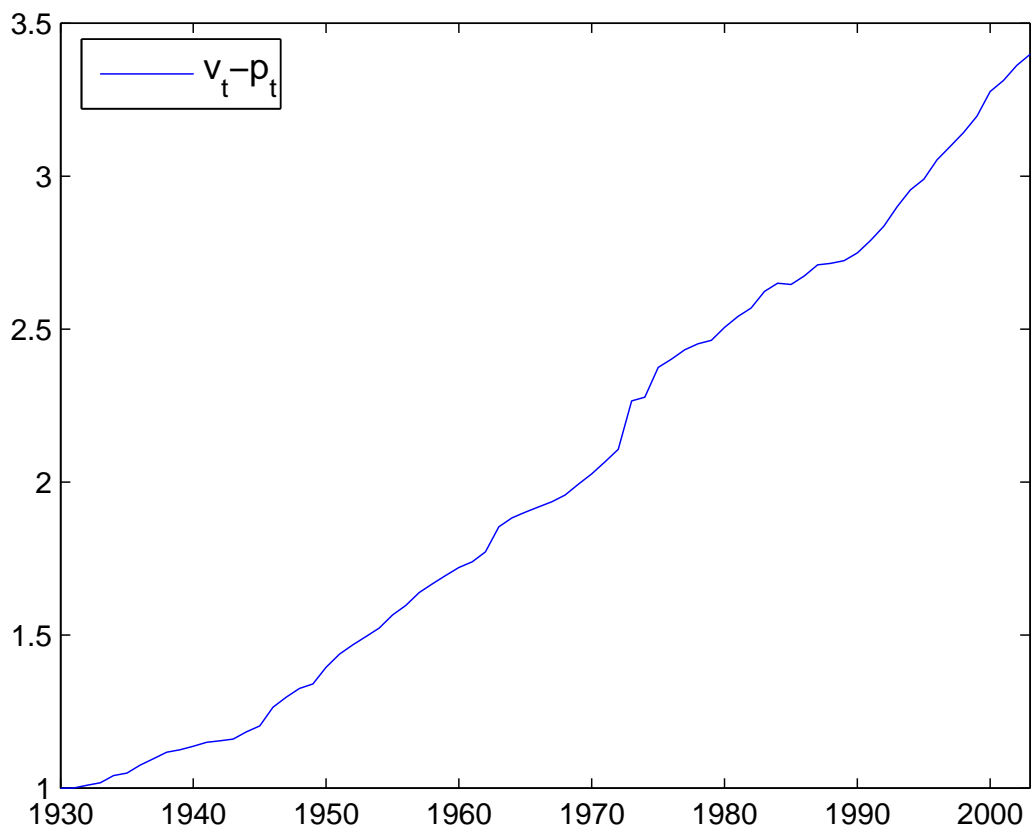


Figure 2: **Cashflow Growth Rates**

The plot provides growth rates of the per share dividend and the aggregate adjusted dividend. The sample period is 1930-2003.

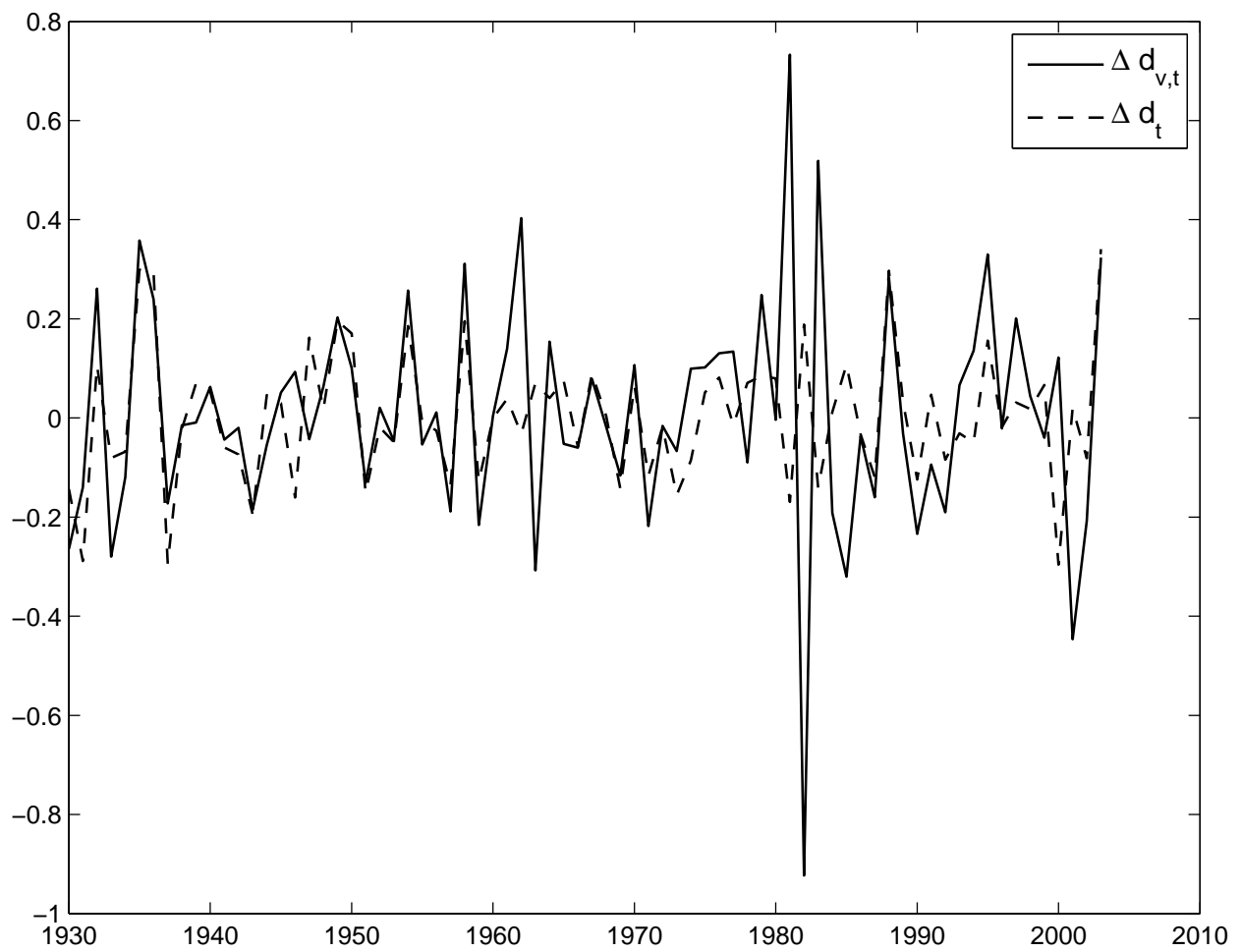


Figure 3: **Dividends, Dividends Per Share, and Consumption**

The plot present the time series for the aggregate adjusted dividends $d_{v,t}$, the dividends per share d_t , and consumption c_t . The sample period is 1930-2003.

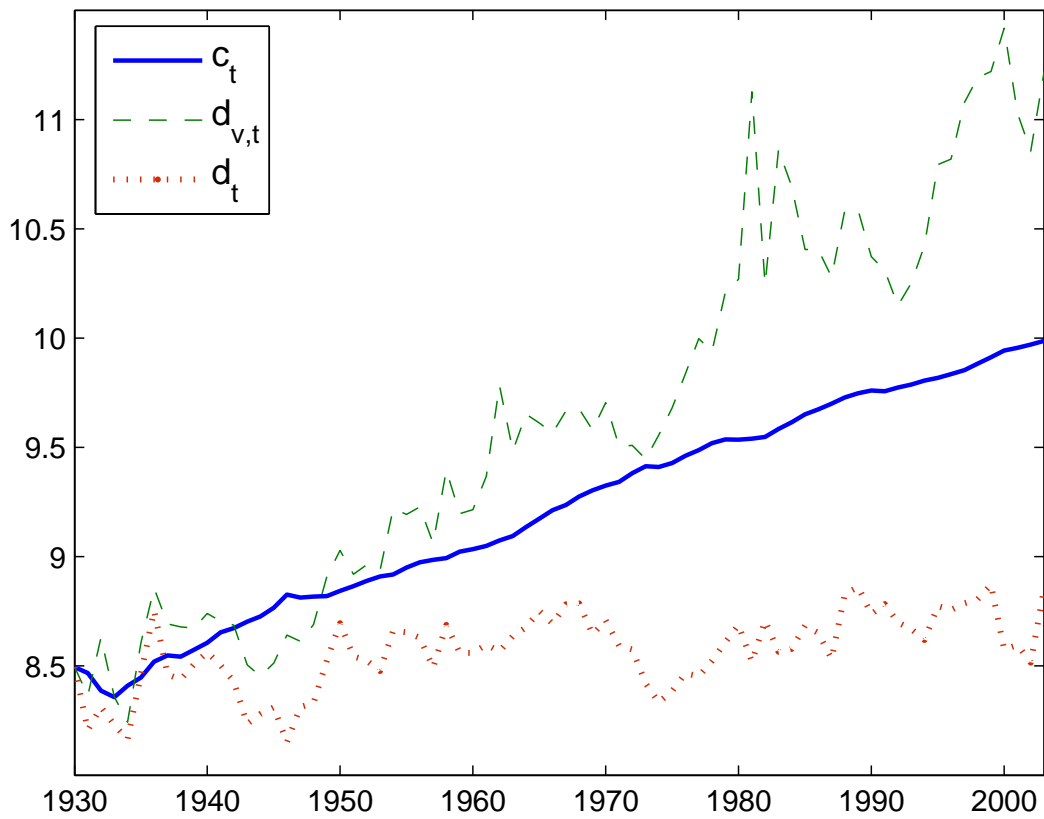


Figure 4: **Variation in Scale and Valuation Ratio**

The plot presents the time series for the growth rate in scale, measured as described in figure (1), and the log aggregate valuation ratio $v_t - d_{v,t}$. The correlation between the series is 0.64. The sample period is 1930-2003.

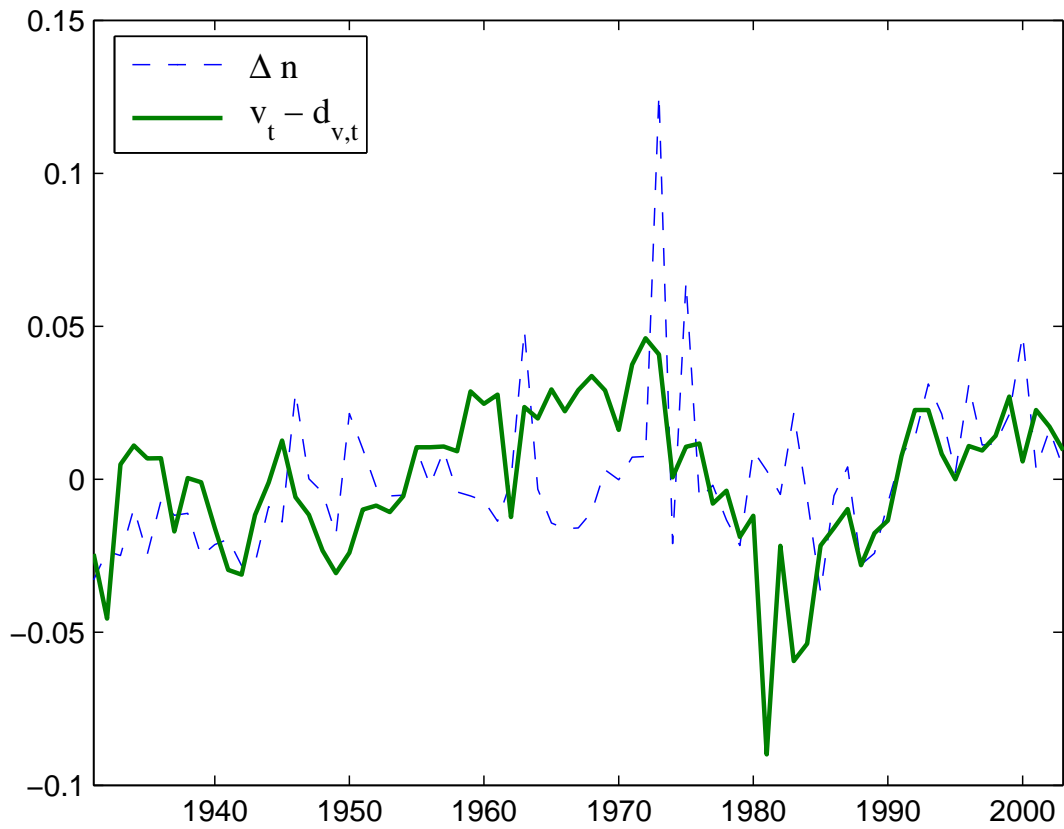


Figure 5: **EC-VAR - Variance Decomposition: Aggregate Valuation Ratio**

The figure displays the EC-VAR implied dividend growth and return predictability projection coefficients for different horizons. The VAR specification includes aggregate consumption growth, aggregate valuation ratio, and an error correction term between consumption and aggregate dividends.

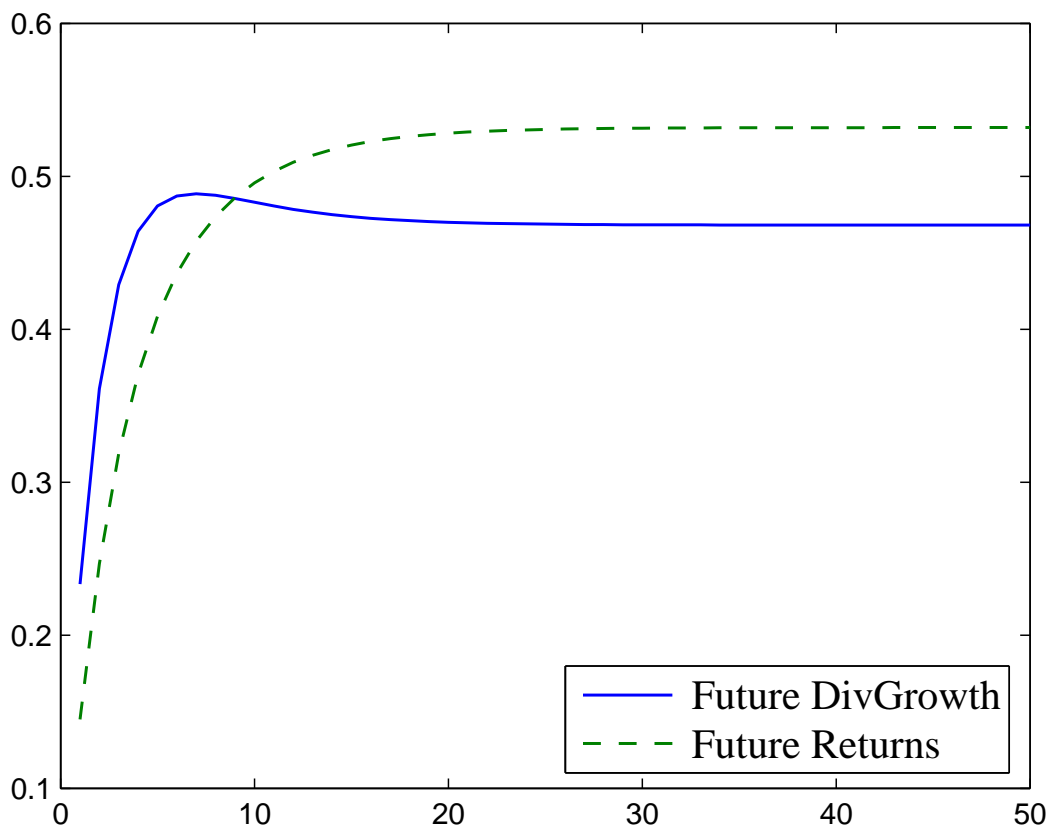


Figure 6: **VAR - Variance Decomposition: Aggregate Valuation Ratio**

The figure displays the VAR implied dividend growth and return predictability projection coefficients for different horizons. The VAR specification includes aggregate consumption growth, the adjusted aggregate dividend growth, and aggregate valuation ratio.

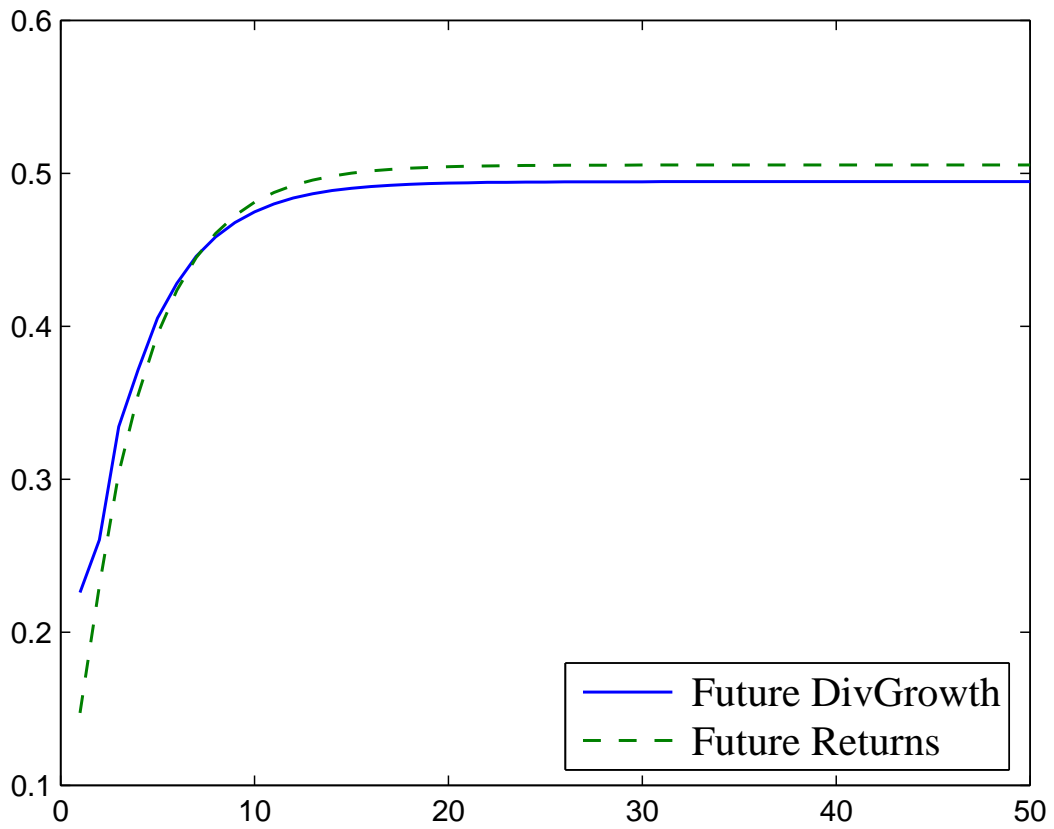


Figure 7: VAR - Variance Decomposition: Per Share Price Dividend Ratio

The figure displays the VAR implied dividend growth and return predictability projection coefficients for different horizons. The VAR specification includes consumption growth, per share dividend growth, and price-dividend ratio.

