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Stock-Market Equilibrium and the Dividend Yield

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Abstract

Can fundamentals account for the recent performance of the U.S. stock market? The price/earnings ratio is out of line with historical averages, and the dividend/price ratio has recently reached a historic low. These developments and record levels of inflows into mutual funds have led some to conclude that stock prices are above their fundamental levels. This paper assesses the recent rise in the stock market using a model for the equilibrium dividend/price ratio. While economic variables can account for most of the recent fall in the dividend/price ratio, mutual-fund inflows still have some marginal explanatory power.

JEL Classification Numbers:
G10, G12

1/ I thank Christopher Towe and Steven Dunaway for helpful comments and discussions and Jeffrey Cole for research assistance.

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Summary

From the beginning of 1995 through mid-1996, broad indexes of U.S. stock prices rose substantially in real terms, while growth in real dividends was modest. Consequently, the dividend/price ratio for the Standard and Poor's 500 index reached a historic low. At the same time, inflows of money into stock-market mutual funds reached record highs. The coincidence of these events led to some concern about the level of stock market prices, as has the performance of some simple indicators of market valuation.

This paper investigates whether the behavior of the dividend/price ratio, also referred to as the dividend yield, is broadly consistent with economic fundamentals in the recent period. The analysis is based on a model that combines an approximation to a standard returns relationship and an econometric model for expected returns in terms of economic state variables. The paper tests this model as well as the hypothesis that mutual-fund inflows have some marginal explanatory power. It finds that the recent decline in the dividend/price ratio is broadly consistent with the model for expected returns. Mutual-fund inflows still have marginal explanatory power for the dividend/price ratio after accounting for the influence of economic state variables, though this finding is consistent with several different possible phenomena.

I. Introduction

From the beginning of 1995 through mid-1996, broad indexes of U.S. stock prices rose substantially in real terms, while growth in real dividends was unspectacular (Chart 1). Consequently, the dividend/price ratio for the Standard and Poor's 500 index reached a historic low in the recent period. At the same time, inflows of money into stock-market mutual funds have reached record highs. All this seems to have occurred in the absence of any news that should have made investors suddenly much more optimistic about the stock market's prospects. Indeed, other traditional indicators of stock-market valuation, such as the price/earnings ratio and the book-to-market ratio, imply that prices may be somewhat high relative to fundamentals. 1/

It would be useful to assess whether the recent behavior of stock prices accords with economic fundamentals. There has been a great deal of research that has sought to reconcile the behavior of stock prices with the behavior of dividends. While the question is of substantial importance, since the stock market is the nexus for a great deal of saving and investment funds, the literature is unfortunately both technical and inconclusive. 2/ This paper approaches the problem in a somewhat different way than is typical in the literature, by investigating whether the behavior of dividend/price ratio or dividend yield is broadly consistent with the state of the economy in the recent period. The hypothesis that mutual-fund inflows still have some explanatory power for the dividend/price ratio after accounting for the state of the economy is also tested. This approach draws on several literatures in empirical finance, namely the literatures on equilibrium pricing, time-variation in expected returns, and the relationship of stock returns and trading volume, applying the tools from these literatures to the study of the dividend/price ratio.

The plan of the paper is as follows. Chapter II describes recent developments in the stock market and a model for the dividend/price ratio based on Campbell and Shiller (1988). Chapter III presents some estimates of how well the model describes the evolution of the dividend/price ratio in the recent period and whether the rate of mutual-fund inflows has any additional explanatory power. Chapter IV concludes. An Appendix provides the details of the derivation of the model.

1/ See Helwege et al. (1995), Shiller (1996), and Patrick McGeehan, "A Doomsayer's Guide to Spotting a Downturn," Wall Street Journal June 3, 1996, page C1.

2/ A classic (though controversial) work on market efficiency is Shiller (1989); for an alternative view see Kleidon (1988). Fama (1991) gives a review of the recent literature.

II. Recent Developments in the Stock Market

The performance of the stock market since early 1995 has been remarkable (Chart 1). 1/ Price indexes for broad aggregates have risen on the order of 40 to 50 percent since January 1995. Dividends, meanwhile, have been fairly stable, and so dividend/price ratios have steadily eased downward, reaching historic lows in recent months (Chart 2). At the same time, inflows into equity mutual funds have reached all-time highs in recent months. The combination of accelerating prices, falling dividend/price ratios, and high inflows has led to concern that mutual-fund inflows may be pushing prices up past the level warranted by fundamentals, and that a "market correction" may be in store. Indeed, some have noted that the dividend/price ratio reached a historic low just prior to the crash of 1987.

Adding to the concern over the low level of the dividend/price ratio is some informal and anecdotal evidence that the promise of future dividend growth cannot plausibly account for the low dividend yield. For example, it seems that dividend growth would have to be very rapid (about 15 percent per year) to account for the present dividend yield. 2/ Also, while corporate earnings are expected to be strong in 1996, estimates by Standard and Poor's indicate that the dividend payout ratio (dividends paid as a percentage of earnings) will be at an all-time low this year. 3/

The case for an overvalued stock market seems strong based on this informal evidence. However, there is scope for a more formal approach in assessing the extent to which the dividend/price ratio is in line with fundamentals. A more formal approach would take into account the fundamental economic determinants of the dividend/price ratio--briefly, expected stock returns and dividend growth--in assessing whether the dividend/price ratio is too low relative to fundamentals. Such an approach is described in the subsequent sections.

1. A simple accounting framework for stock returns and the dividend/price ratio

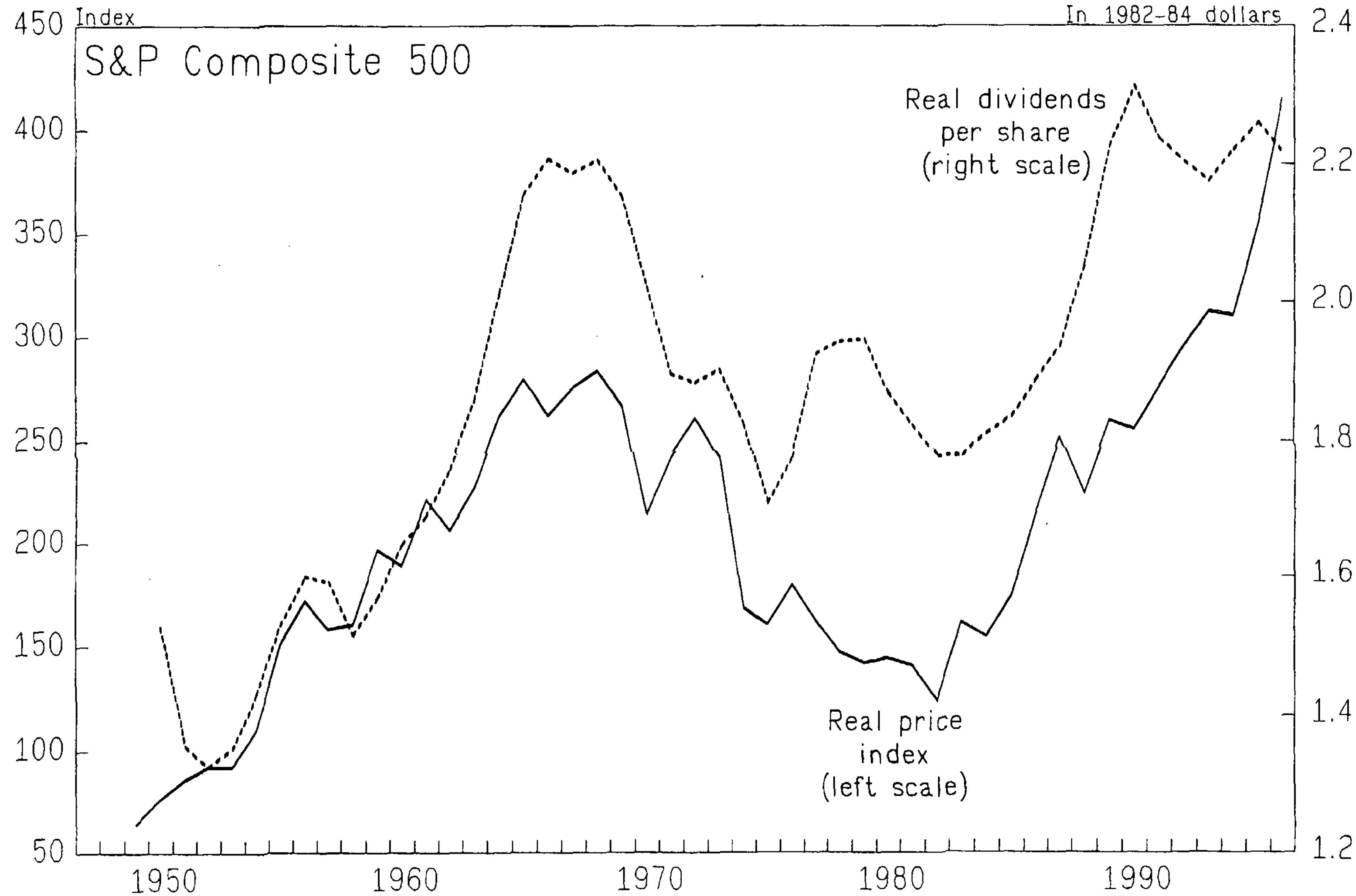
A simple accounting exercise styled on Campbell and Shiller (1988) can provide a framework for interpreting the level of the dividend/price ratio. 4/ Let P_t and D_t denote price at the end of period t and dividends paid during period t, respectively. The gross total rate of return R over period t is defined as

$$R_t \equiv (P_t + D_t)/P_{t-1} \tag{1}$$

1/ Real quantities are calculated using the CPI as a deflator.
2/ Some calculations are presented in the next section.
3/ McGeehan, op. cit.
4/ Similar implications can be derived from an equilibrium model of stock-price determination. See the Appendix.

CHART 1

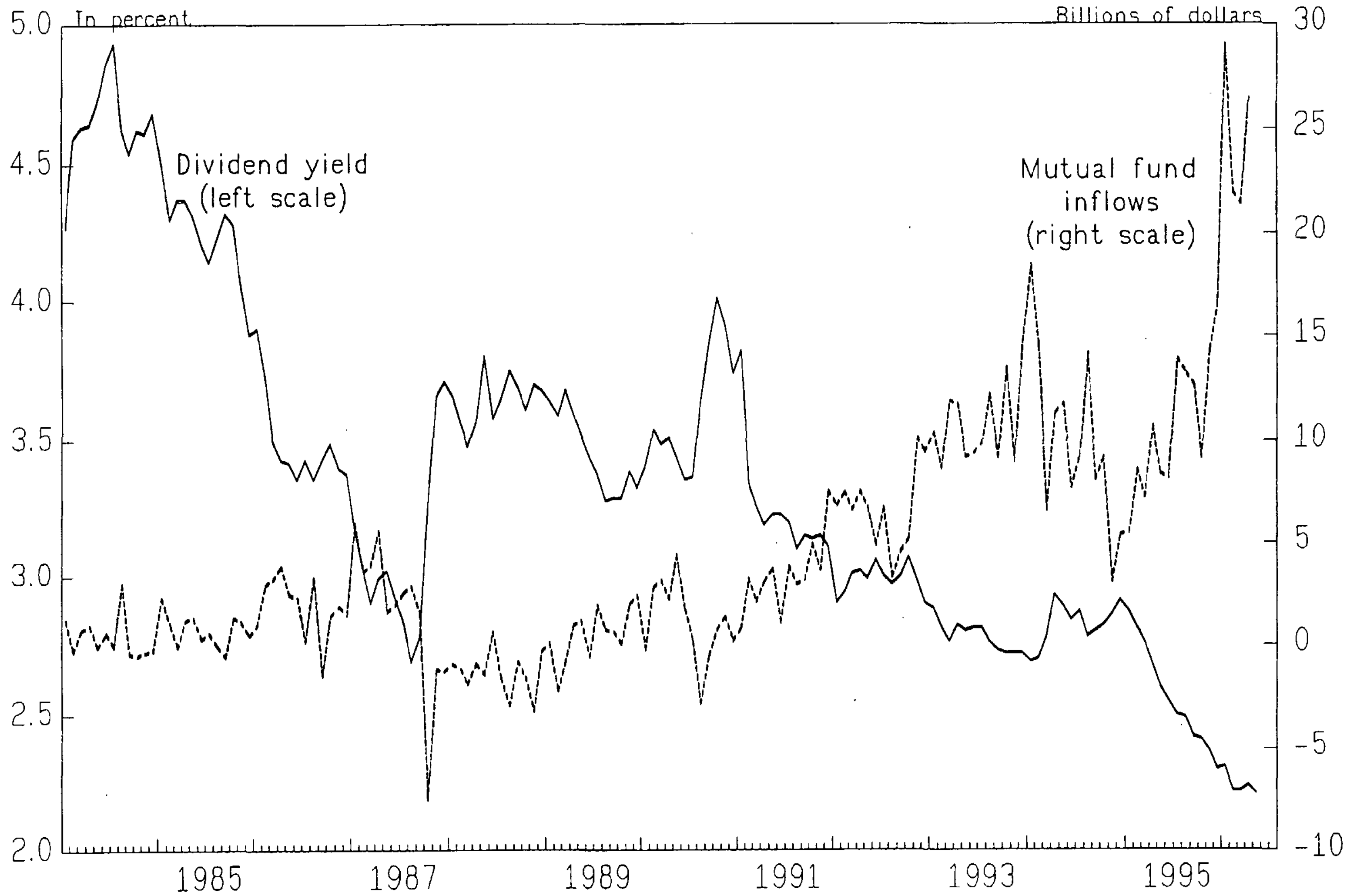
REAL STOCK PRICES AND REAL DIVIDEND PERFORMANCE, 1947-1996



Source: Haver Analytics.

CHART 2

DIVIDEND YIELDS AND MUTUAL FUND INFLOWS, 1982-1996



Source: Haver Analytics.

Some algebra shows that $r_t = \ln(R_t)$ can be written as a function of the current and lagged log dividend/price ratio $\delta_t \equiv \ln(D_t/P_t)$ and the growth rate of dividends $g_t \equiv \ln(D_t/D_{t-1})$. 1/ A first-order approximation of the function $r_t = r_t(\delta_t, \delta_{t-1}, g_t)$ around $(\bar{\delta}, \bar{\delta}, \bar{g})$ yields

$$r_t \approx g_t + \alpha - \beta\ \delta_t - \delta_{t-1} \tag{2}$$

where β is between 0 and 1. If r, g, and δ are constant over time, then

$$\delta = 1/(1+\beta)\ [\alpha+g-r] \tag{3}$$

Estimated values for α and β, based on the expressions shown in the Appendix, imply that α is about 0.37 and β is about 0.31. If expected real stock returns (r) are about 6 percent per annum (about the historical average real return on the stock market) or about 1/2 percent per month, and if the dividend/price ratio is expected to be constant, this implies a dividend growth rate of around 1.2 percent on a monthly basis, or about 15 percent on an annual basis:

$$\begin{array}{llllll} g_t & \approx r_t & - & \alpha & + (1+\beta) & \delta \\ 1.2 & = 0.5 & - & 0.37 & + (1.31) & 0.8 \end{array} \tag{4}$$

Such a growth rate of dividends would be extreme indeed, well above even historical <u>nominal</u> rates of growth of dividends. However, this result is derived in a static setting. In a dynamic setting, there is more to the dividend/price ratio than future dividend growth rates: dividend/price ratios also depend on expected returns. I next proceed to examine the issue of the equilibrium dividend/price ratio in a dynamic setting.

2. Extending the accounting framework

Campbell and Shiller (1988) point out that the approximation in Equation (2) can be written in the form

$$\delta_{t-1} = r_t - g_t - \alpha + \beta\ \delta_t \tag{5}$$

and iterated forward to yield

1/ See the Appendix for details.

$$\delta_{t-1} = \sum_{i=0} \beta^i (r_{t+i} - g_{t+i} - \alpha)$$
$$= - \alpha/(1-\beta) + \sum_{i=0} \beta^i (r_{t+i} - g_{t+i}) \tag{6}$$

That is, the log dividend yield is the discounted value of future rates of return net of dividend growth rates. This expression points up how higher future growth rates of dividends could thus be responsible for a low current dividend yield. It also makes a convenient form for testing and analysis of models for dividend yields, but first one must add some restrictions that give this expression some economic content; in its current form, it is nothing but an approximation to an ex-post identity.

This content is given by a model (explicit or implicit) for dividend growth rates and rates of return. For example, one may have a model that posits

$$E_{t-1} [r_t] = E_{t-1} [\gamma z_t] + \mu, \tag{7}$$

with μ a constant, where $E_t[\cdot]$ denotes the market's expectation taken with respect to information available at date t. Equation (7) is a model of a time-varying risk premium, where the vector z consists of state variables that describe the time-variation in risk premia. 1/ In this case one could write Equation (6) as

$$\delta_{t-1} = (\alpha-\mu)/(1-\beta) + E_{t-1} \sum_{i=0} \beta^i (\gamma z_{t+i} - g_{t+i}). \tag{8}$$

The log dividend/price ratio thus forecasts risk premia and dividend growth rates.

In principle, one could test this kind of model directly, by positing a joint process for the time-variation in risk premia and dividend growth rates, then testing the rational expectations restrictions consistent with that joint process. 2/ However, here a simpler, alternative approach is pursued. The approach is to determine if the time variation in the log dividend/price ratio can be accounted for by economic variables that themselves plausibly forecast risk premia and dividend growth rates. If there has been a large speculative swing in the stock market in the recent

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1/ The Appendix provides some motivation for the role of these state variables in the context of an equilibrium model.

2/ There are other potentially interesting econometric implications of the forecasting relationship in Equation (8), such as Granger causality (see Hamilton (1994), pp. 306-7 for a discussion). For brevity, these are not fully explored here.

period, economic variables should not be able to account for the recent decline in the log dividend/price ratio.

If the log dividend/price ratio were difference stationary (e.g., unit-root nonstationary), there would be additional interesting and testable econometric implications. Some tests suggested that the log dividend/price ratio might be characterized by a unit root in the sample considered here. 1/ However, the bulk of evidence from longer samples suggests that it is stationary (Scott (1985), Campbell and Shiller (1988)); moreover, the tests employed are known to have low power in short time series (Campbell and Perron (1991)). Finally, as Cochrane (1991) points out, "theory and common sense" suggest that the dividend/price ratio must be stationary. Indeed, failure to reject the unit-root null may stem from structural changes in the dividend-generating process (e.g., changes in the tax treatment of dividend income). 2/ Hence, the log dividend/price ratio is assumed to be stationary for the subsequent econometric work.

3. An operational version of the model

To make the model operational, it is assumed that there exists a linear representation of the expectation on the right-hand side of Equation (8) in terms of a vector of variables observable at date (t-1), as

$$E_{t-1} \sum_{i=0} \beta^{i} (\gamma z_{t+i} - g_{t+i}) = \theta_1 x_{t-1}. \tag{9}$$

Replacing the right-hand side of Equation (8) (agents' conditional expectation) with the right-hand side of Equation (9) (a projection of that conditional expectation on a subset of information available at t-1) yields the empirical model

$$\delta_{t-1} = \theta_0 + \theta_1 x_{t-1} + \zeta_t. \tag{10}$$

Note that, if the forecast representation embedded in x_{t-1} is rational, ζ_t (a forecast error) is uncorrelated with any element of x_{t-1}. This is the model tested in the next section.

Candidates were chosen for x that on the basis of previous studies are thought to relate to either the business cycle or to systematic movements in

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1/ I will provide the results of these tests upon request.

2/ Evans (1995) finds that a model with regime switches in the dividend-payout process can account for 90 percent of the variability in the dividend/price ratio. For the data employed in this paper, in a sample from 1947 to 1996, the unit-root null is rejected for the log dividend/price ratio if structural breaks are accommodated.

stock prices. 1/ The variables are listed in Table 1. They consisted of the growth rate of real consumption, CG; the default premium for corporate bonds, DEF; the CPI inflation rate, PI; a measure of real wages, REALW; the inflation-adjusted yield on the three-month Treasury bill, RTB; the unemployment rate, URATE; and the slope of the yield curve, YC. These six variables were candidates for inclusion in the basic version of the model. Equity mutual-fund inflows, denoted MUFI, were included in an augmented version of the model. The log of the dividend/price ratio for the Standard and Poor's 500, denoted LDP, was used as the dependent variable.

The six economic variables series make sense as candidates for the forecasting variables, in that each plausibly relates either to future rates of return or to future dividend growth rates. For example, an increased growth rate of real consumption, a higher inflation rate, higher real wages, or lower unemployment might indicate expanding economic activity, and hence higher future dividends and a higher current price. 2/ Since the dividend/price ratio is based on current dividends, this would imply a lower dividend/price ratio. Various asset-pricing theories relate consumption growth and inflation to asset returns. 3/ A steeper yield curve is also consistent with expanding economic activity and a lower dividend/price ratio. 4/ Finally, in equilibrium models, discount factors (and hence expected returns) relate to intertemporal substitution and risk aversion, and hence to short-term real rates of return, the premium on long-maturity assets, and the premium on assets with default risk. This means that the dividend/price ratio may increase when these variables increase. 5/

If a model with stable parameters can account for the evolution of the log dividend/price ratio over the last year, then the residuals in Equation (10) should not show any systematic variation. In particular, forecasting δ_t with the model should not result in systematic forecast errors. I check this condition in the next section. I also examine whether the dollar value of inflows into equity funds (from the Investment Company Institute) can account for any of the recent declines in the dividend/price ratio, after accounting for the effects of the economic variables that explain the equilibrium dividend/price ratio.

1/ See Chen, Roll, and Ross (1986), Fama (1991), Fama and French (1988, 1993), Ferson and Harvey (1991), and Epps and Kramer (1996). For a theoretical discussion of time-varying risk premia see Cox, Ingersoll, and Ross (1978); also Bansal and Viswanathan (1993), who claim that similar variables can proxy for time variation in stochastic discount factors in a dynamic optimizing model.

2/ Indeed, one might suspect that collinearity among these variables might significantly influence the test results. However, some experiments with different specifications implied that it did not.

3/ See Chen, Roll, and Ross (1986).

4/ See Estrella and Hardouvelis (1991) and Hu (1993).

5/ However, one factor that might limit the responsiveness of the dividend/price ratio to economic fluctuations is the tendency of firms to smooth dividends; see Marsh and Merton (1986).

III. Estimation Results

1. Economic variables and the dividend/price ratio

The initial version of the basic model included all the economic variables listed in Table 1 (except the inflow variable) and four lags. Variables and lags were then dropped from the model based on t-tests for the significance of individual coefficients and F-tests for the significance of groups of coefficients. The final version of the model contained two lags of the log dividend/price ratio, and contemporaneous values and two lags of the default premium (DEF), inflation (PI), the real Treasury bill rate (RTB), and the yield curve (YC). All variables except the default premium were significant for all lags taken together (e.g., the hypothesis that the coefficients on PI, PI(-1), and PI(-2) are all zero was rejected) and each lag of all variables was significant as well (e.g., the hypothesis that the coefficients on DP(-1), DEF(-1), PI(-1), RTB(-1), and YC(-1) are all zero was rejected). The constant was insignificant, but as in Campbell and Shiller (1988) is unrestricted. Because the contemporaneous value of DEF was significant based on its t-statistic, DEF was retained in the model. The final version of the basic model passed specification tests for autoregressive conditional heteroskedasticity (ARCH) and autoregressive errors.

The estimation results are summarized in Table 2, which shows the static (long-run) version of the dynamic model employed. All long-run estimated coefficients have signs that make sense. A higher default premium could signify worsening economic conditions (higher default risk for firms) and hence imply lower expected dividend growth and higher future risk premia. Investors will demand a higher return, the higher the rate of inflation. 1/ Higher yields on alternative assets (such as Treasury bills) implies a higher required return on stocks, and hence a higher dividend/price ratio. The positive coefficient on the yield-curve variable is harder to understand from an economic standpoint, as a steepening yield curve normally means increasing economic growth and (presumably) increasing dividend growth. As explained above, this would mean a higher current stock price, and a lower dividend/price ratio (i.e., based on the current dividend). However, a steeper yield curve could also reflect a shift in preferences that is reflected in higher required returns on long-maturity assets relative to short-maturity ones. Since stocks are long-maturity assets, such a shift would imply a higher dividend/price ratio.

The model also does a good job of forecasting over the recent period. Chart 3 shows one-step forecasts for the log dividend/price ratio from the model alongside the actual log dividend/price ratio and $\pm 2\sigma$ error bands for the forecast. 2/ Only in February 1996 does the forecast differ from the

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1/ See Stulz (1986) for a theoretical discussion of inflation and expected stock returns.

2/ The forecasts are $\hat{\delta}_t = \hat{\theta}_{0t} + \hat{\theta}_{1t} x_t$, where $\hat{\theta}_{it}$ denotes a coefficient estimated using data through period t. The standard errors are likewise calculated using rolling samples.

actual log dividend/price ratio by more than two standard errors. However, a t-test of the hypothesis that the mean forecast error is zero is rejected, and implies that the actual log dividend/price ratio is consistently lower than the prediction of the model.

An additional question (and a useful check on the model) is whether the variables chosen forecast future rates of return and dividend growth rates, as the model would suggest. Table 3 presents tests of exclusion restrictions in two forecasting regressions: first, a regression including all the candidate variables; and second, a regression including the four variables included above. 1/ In the first regression (which includes all the variables), except for the default premium (DEF), all the variables chosen for the basic model are useful for forecasting returns less dividend growth, as the model suggests they should be, while none of the variables excluded from the basic model are useful in forecasting. When the insignificant variables are excluded, DEF has significant forecast power for returns less dividend growth. This implies that the four variables play the role that the model suggests they should in explaining the behavior of the log dividend/price ratio.

2. The role of mutual-fund inflows

Economic variables do a reasonably good job in explaining the movements in the log dividend/price ratio in the recent period. The next task is to see if inflows into equity mutual funds can add any explanatory power. The results for an augmented model that adds inflows are in the second half of Table 2. Inflows are significant in determining the log dividend/price ratio and have a negative long-run coefficient. The model with inflows also passes specification tests for autocorrelated and ARCH residuals. One-step forecasts, shown in Chart 4, are generally more accurate than the forecasts from the basic model, and did not show the same tendency to overpredict that the basic model showed. As with the basic model, over the period January 1995-April 1996 there is one month (January 1996) with a forecast error of greater than two standard deviations. However, the t-test now no longer rejects the hypothesis that the mean forecast error is zero.

The negative and significant long-run coefficient on mutual-fund inflows raises a tantalizing possibility: that inflows have pushed stock prices above the level consistent with economic fundamentals. This is indeed one possibility, but only one of several. The economic variables are (as mentioned before) only a strict subset of variables that agents use to forecast dividend growth rates and risk premia. If a variable were omitted, and if mutual-fund inflows were related to the future prospects of the stock market (both quite possible), we would not be surprised to find a

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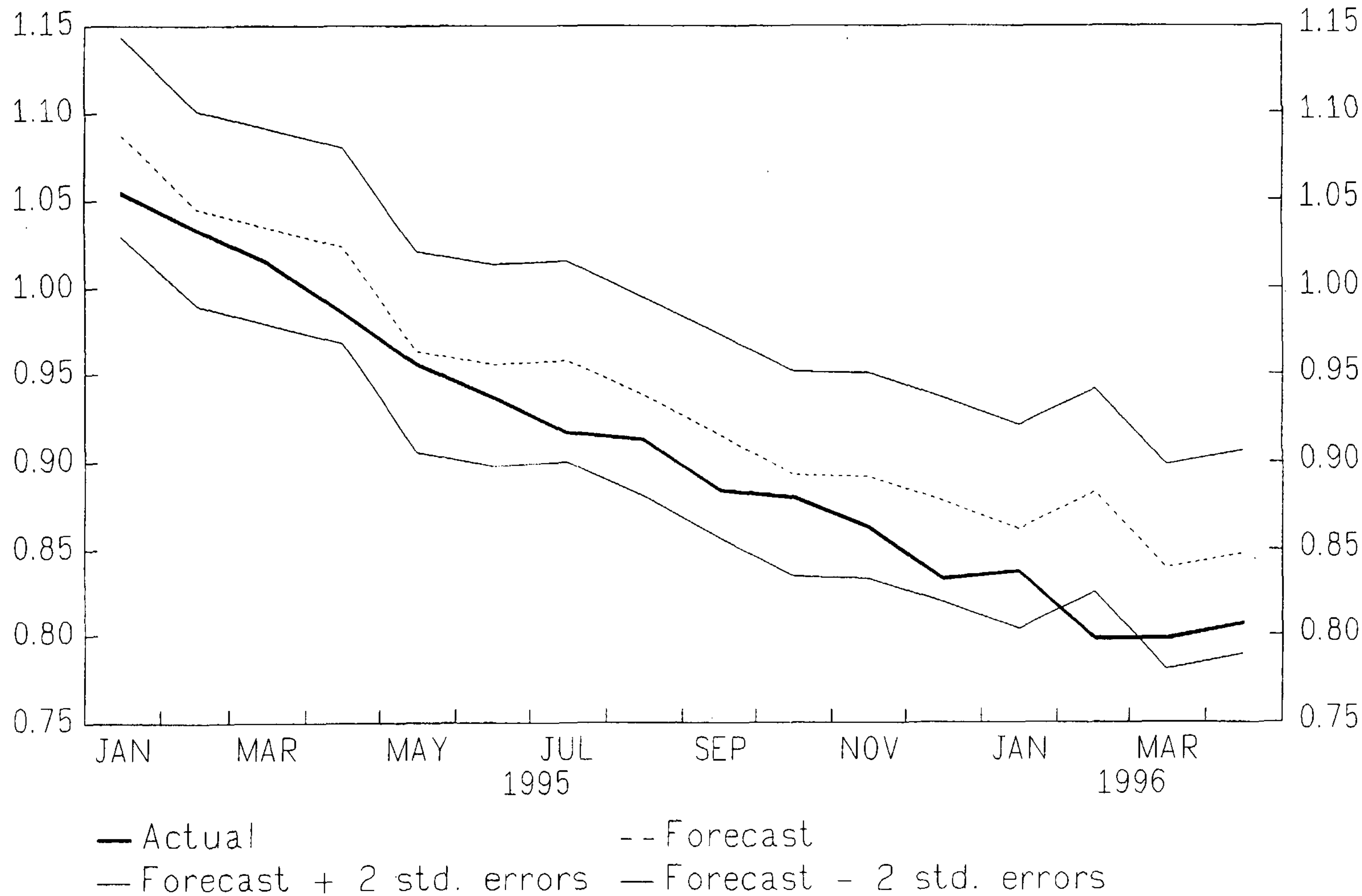
1/ The sample period is extended slightly since MUFI is not employed in this regression.

CHART 3

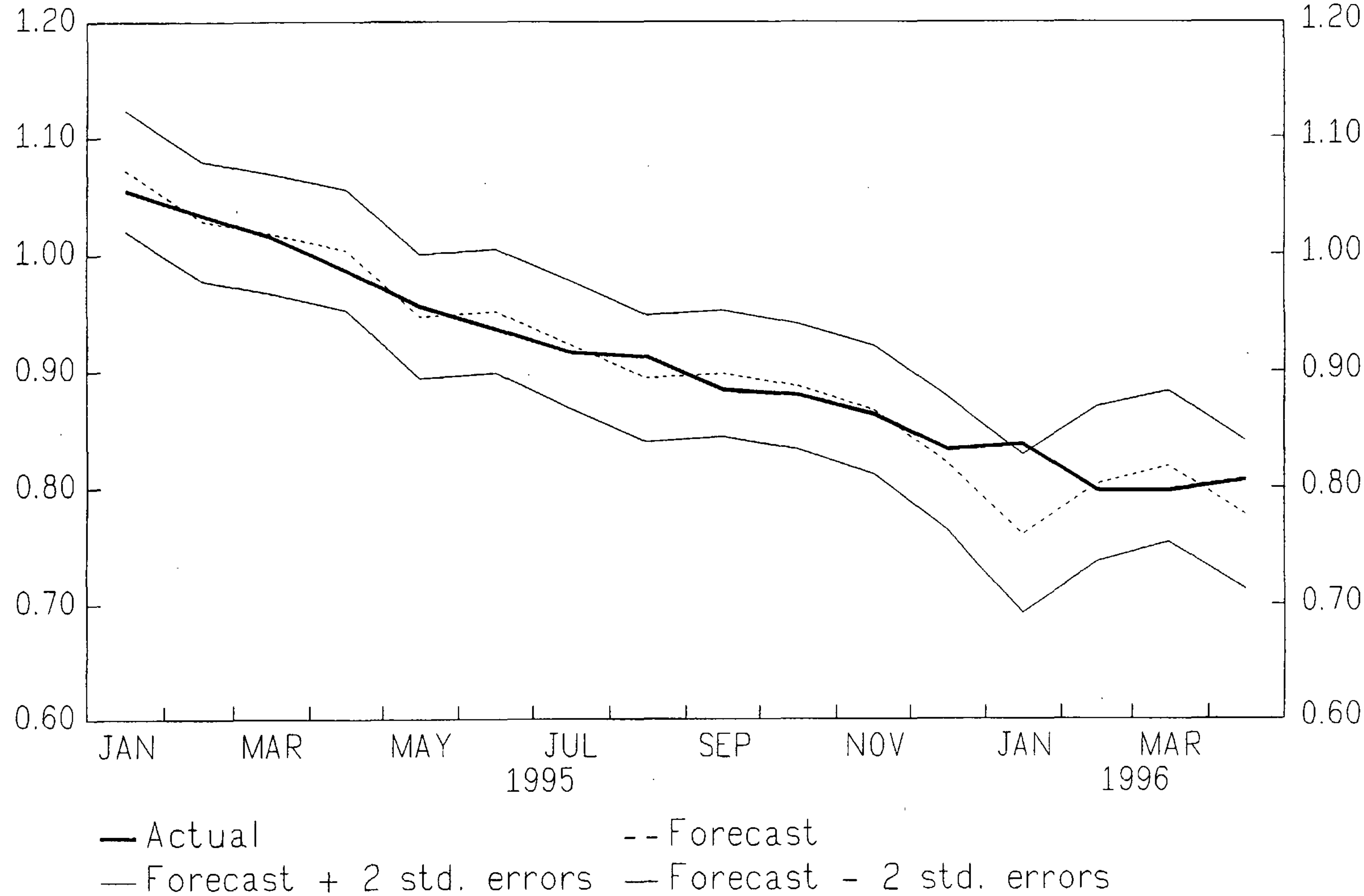
LOG DIVIDEND YIELD: FORECAST AND ACTUAL (BASIC MODEL)



Sources: Haver Analytics, and Fund staff estimates.

CHART 4

LOG DIVIDEND YIELD: FORECAST AND ACTUAL (AUGMENTED MODEL)



Sources: Haver Analytics, and Fund staff estimates.

significant relationship between inflows and the dividend/price ratio. 1/ Indeed, in the stock-market literature, the empirical relationship between trading (e.g., turnover or trading volume) and stock prices is often ascribed to information flow rather than speculative excess. 2/ In fact, mutual-fund inflows have correlations with the economic variables ranging from 15 percent to 40 percent in absolute value, so that some omitted variable might well account for the significance of MUFI.

Still another possibility is that mutual-fund inflows reflect a welcome reallocation of private portfolios toward equity. Historically, private equity holdings have been concentrated among relatively few households. 3/ Also, the very high real return on equity relative to short-term riskless returns has been difficult to explain using economic models--the so-called "equity premium puzzle." 4/ Thus, it might be that the coincidence of mutual-fund inflows and rising prices might reflect the realization by individual investors that they have been missing out on attractive rates of return. Indeed, if higher prices mean more economically sensible rates of return on equity, the recent rise in the stock market might reflect a movement toward equilibrium, rather than away from it.

IV. Conclusions

Three recent events in the U.S. stock market--the steep rise in stock prices, the similarly steep decline in the dividend yield to historic lows, and record mutual-fund inflows--have led some observers to conclude that the stock market is overvalued. This paper examines a model of the dividend yield for evidence that the dividend yield is out of line with fundamentals in the recent period. There is no evidence that the dividend yield for the Standard and Poor's 500 has drifted far from the predictions of a simple model, but even after accounting for the model's variables, mutual-fund inflows have explanatory power for the dividend yield. This finding is consistent with the notion that mutual-fund inflows have pushed stock prices above fundamentals, though it is also consistent with a rational reallocation of private portfolios and a movement of stock-market yields toward levels that can be rationalized on an economic basis.

1/ This follows from what is known as the joint hypothesis problem in empirical finance: the problem that market efficiency and model specification cannot be tested separately (see Fama (1991)).

2/ See Hiemstra and Jones (1994) for a recent example, and DeLong, Shleifer, Summers, and Waldmann (1991) for an opposing view.

3/ See Poterba and Samwick (1995).

4/ See Kocherlakota (1996).

The Approximation for the Dividend/Price Ratio

As in the text, gross returns R are by definition

$$R_t = (P_t + D_t)/P_{t-1}. \tag{A1}$$

Dividing the numerator and denominator of (A1) by D_{t-1} gives

$$R_t = (P_t/D_{t-1} + D_t/D_{t-1})/(P_{t-1}/D_{t-1}) \tag{A2}$$

or denoting D_t/D_{t-1}, the gross growth rate of dividends, by G_t,

$$R_t = (P_t/(D_t/G_t) + G_t)/(P_{t-1}/D_{t-1}). \tag{A3}$$

Taking logarithms of both sides of (A3) yields

$$r_t = \ln\{[G_t\ (P_t/D_t + 1)]/[P_{t-1}/D_{t-1}]\} \tag{A4}$$

or

$$r_t = g_t + \ln(P_t/D_t+1) - \delta_{t-1} \tag{A5}$$

where $\delta_t=\ln(D_t/P_t)$ denotes the log dividend/price ratio, and $g_t = \ln(G_t)$ is the net growth rate of dividends.

A first-order approximation of the function $r_t = r_t(\delta_t,\delta_{t-1},g_t)$ in (A5) around $(\bar{\delta},\bar{\delta},\bar{g})$ yields

$$r_t \approx g_t + \alpha - \beta\ \delta_t - \delta_{t-1} \tag{A6}$$

where $\beta = \exp(-\bar{\delta})/(1+\exp(-\bar{\delta}))$ and $\alpha = \ln(\exp(-\bar{\delta})+1)$.

Stock-market equilibrium and the dividend/price ratio

It is possible to derive similar implications from an explicit economic model of stock returns. Start with the standard equation for stock prices in either intertemporal equilibrium or in arbitrage-free frictionless markets: 1/

$$P_t = E_t\ [m_{t+1}\ (P_{t+1} + D_{t+1})]. \tag{A7}$$

For example, in the context of an intertemporal optimizing model, m_{t+1} would be the intertemporal marginal rate of substitution. Rearranging yields

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1/ See Duffie (1992), Chapter 1.

$$1 = E_t \{m_{t+1} [(P_{t+1}/P_t) + (D_{t+1}/D_t) D_t/P_t]\} \tag{A8}$$

or (if D_t and P_t are known at date t)

$$D_t/P_t = \{E_t[m_{t+1}(D_{t+1}/D_t)]\}^{-1} \{1-E_t[m_{t+1}(P_{t+1}/P_t)]\}, \tag{A9}$$

so that as in the text, e.g., the dividend/price ratio relates inversely to the discounted growth rate of dividends. Since a great deal of work has been done on modeling asset returns in this context, this relationship opens up a rich set of possibilities for modeling the dividend/price ratio.

For example, suppose following Bansal and Viswanathan that m_{t+1} is a smooth function of some set of state variables X_{t+1}. To save on algebra, X_{t+1} is assumed to be a scalar (the results would be similar if X_{t+1} were a vector). Suppose also that X_{t+1} and R_{t+1} have a joint normal distribution. 1/ Then by the Stein's lemma 2/ we can write (A7) as

$$1=E_t \{m'_{t+1}\} \, Cov_t[R_{t+1},X_{t+1}]+E_t[m_{t+1}]E_t[P_{t+1}/P_t + D_{t+1}/D_t \, D_t/P_t], \tag{A10}$$

or rearranging

$$D_t/P_t = \alpha_t + \lambda_t \, Cov_t[X_{t+1},R_{t+1}] \tag{A11}$$

where $\lambda_t = -E[m'_{t+1}]/(E_t[m_{t+1}]E_t[D_{t+1}/D_t])$

and $\alpha_t = (1-E_t[m_{t+1}]E_t[P_{t+1}/P_t])/(E_t[m_{t+1}]E_t[D_{t+1}/D_t])$.

Equation (A11) is a time-varying Capital Asset Pricing Model (CAPM) for the dividend/price ratio, where the covariance between state variables and stock returns determines the equilibrium dividend yield. Additional assumptions on preferences and the relationship of capital gains and dividend growth rates would yield constant α_t and λ_t, in which case a model of time-varying covariances would produce a version of (A11) amenable to empirical tests. 3/ This example makes clear that in this context, the importance of the state variables employed in the text is in producing a good linear proxy for the covariance of returns and state variables, e.g., the determinants of the equilibrium dividend yield.

1/ Admittedly, this is not a very good approximation to reality, at least for monthly data. However, this sort of assumption would be much less objectionable in a continuous-time model, and is merely invoked in order to avoid strong economic restrictions in what follows.

2/ See Huang and Litzenberger (1988).

3/ See Bollerslev, Engle, and Wooldridge (1988), Ferson (1990) and Epps and Kramer (1996) for empirical models of time-varying covariances in the CAPM and Arbitrage Pricing Theory.

Table 1. Data Series

(Sample Period: January 1984-April 1996)

Series	Mnemonic	Source
Consumption growth (growth in real consumption) 1/	CG	Department of Commerce
Default premium (Aaa-rated corporate yield less 30-year Treasury bond yield)	DEF	Moody's/Federal Reserve
Dividend/price ratio (Standard and Poor's 500)	DP	Standard and Poor's
Log dividend/price ratio (ln(DP))	LDP	---
Inflation (percent change in CPI, all urban consumers)	PI	Department of Labor
Real wage (hourly earnings deflated by CPI)	REALW	Department of Labor
Real Treasury bill yield (3-month Treasury bill yield less CPI inflation)	RTB	Federal Reserve/ Department of Labor
Unemployment rate	URATE	Department of Labor
Yield curve (30-year Treasury bond yield less 3-month Treasury bill yield)	YC	Federal Reserve
Inflows into equity mutual funds (dollars) 2/	MUFI	Investment Company Institute

1/ Using per-capita real consumption gave qualitatively similar results.
2/ Some experiments with real inflows (deflated by the CPI) yielded qualitatively similar results.

Table 2. Summary of Econometric Results

Basic model:

Static (long-run) version of model: 1/

LDP	=	+0.36	+0.07 DEF	+0.09 PI	+0.09 RTB	+0.08 YC
		(0.12)	(0.05)	(0.01)	(0.01)	(0.02)

T-test for mean-zero forecast errors: -5.12 (significant)

Augmented model:

Static (long-run) version of model: 1/

LDP	=	+0.77	-0.04 DEF	+0.06 PI	+0.06 RTB	+0.07 YC
		(0.28)	(0.09)	(0.02)	(0.02)	(0.02)
		-0.21 MUFI 2/				
		(0.11)				

T-test for mean-zero forecast errors: 0.27 (insignificant)

1/ Standard errors in parentheses.
2/ Coefficient and standard error multiplied by 10^4 for ease of presentation.

Table 3. Forecasting Returns and Dividend Growth Rates

Model: Forecasting returns less dividend growth (r-g) by 2 lags of each of: consumption growth (CG), default premium (DEF), inflation(PI), real Treasury bill yield (RTB), the real wage (REALW), the unemployment rate (URATE), and the slope of the yield curve(YC)

(Sample: 1982 (1) to 1996 (4))

Tests for the forecasting significance of each variable 1/

Variable	F(num,denom)	Value	P-value	
CONSTANT	F(1,157) =	0.000	[0.990]	
CG	F(2,157) =	1.385	[0.253]	
DEF	F(2,157) =	1.549	[0.216]	
PI	F(2,157) =	9.801	[0.000]	**
REALW	F(2,157) =	1.145	[0.321]	
RTB	F(2,157) =	9.619	[0.000]	**
URATE	F(2,157) =	0.981	[0.377]	
YC	F(2,157) =	4.697	[0.010]	*

Model: Forecasting returns less dividend growth (r-g) by 2 lags of each of: default premium (DEF), inflation(PI), real Treasury bill yield (RTB), and the slope of the yield curve(YC)

(Sample: 1982 (1) to 1996 (4))

Tests for the forecasting significance of each variable 1/

Variable	F(num,denom)	Value	P-value	
CONSTANT	F(1,163) =	0.025	[0.874]	
DEF	F(2,163) =	3.513	[0.032]	*
PI	F(2,163) =	10.739	[0.000]	**
RTB	F(2,163) =	10.974	[0.000]	**
YC	F(2,163) =	6.005	[0.003]	**

1/ F-tests for the null hypothesis that the variable can be excluded from the forecasting regression. One asterisk indicates significance at the 5 percent level; two indicate significance at the one percent level.

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