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ABSTRACT

Time-Varying Risk Premia and the Cost of Capital: An Alternative Implication of the Q-Theory of Investment*

Evidence suggests that expected excess stock market returns vary over time, and that this variation is much larger than that of expected real interest rates. It follows that a large fraction of the movement in the cost of capital in standard investment models must be attributable to movements in equity risk premia. In this Paper we emphasize that such movements in equity risk premia should have implications not merely for investment today, but also for future investment over long horizons. In this case, predictive variables for excess stock returns over long horizons are also likely to forecast long-horizon fluctuations in the growth of marginal Q, and therefore investment. We test this implication directly by performing long-horizon forecasting regressions of aggregate investment growth using a variety of predictive variables shown elsewhere to have forecasting power for excess stock market returns.

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1 Introduction

Recent research in financial economics suggests that expected returns on aggregate stock market indexes in excess of a short-term interest rate vary over time (excess returns are forecastable). Moreover, this variation is found to be quite large relative to variation in expected real interest rates.[2] These findings suggest that a large fraction of the variation in the cost of capital in standard investment models must be attributable to movements in equity *risk premia*. Yet, perhaps owing to the long-standing intellectual divide between macroeconomics and finance, surprisingly little empirical research has been devoted to understanding the dynamic link between movements in equity risk premia and macroeconomic variables. Do movements in risk premia have important macroeconomic implications? And, if so, through what channel do they affect the real economy?

One might suspect that the principal means by which time-varying risk premia affect the real economy would be through the so-called wealth effect on consumption. But recent research suggests that fluctuations in equity risk premia primarily generate transitory movements in wealth, which appear to have a much smaller effect on consumption than do permanent changes in wealth. For example, Lettau and Ludvigson (2001a) show that an empirical proxy for the log consumption-wealth ratio (where wealth includes both human and non-human capital) is a powerful predictor of excess returns on aggregate stock market indexes, suggesting that the consumption-wealth ratio captures time-variation in equity risk premia. At the same time, however, these movements in the consumption-wealth ratio are largely associated with transitory movements in wealth and bear virtually no relation to contemporaneous or future consumption growth (Lettau and Ludvigson (2001b)).[3] These findings

[2] See, for example, the summary evidence in Campbell et al. (1997), chapter 8.

[3] This does not mean that wealth has no impact on consumption, but that only

suggest that the consumption channel is not an important one in transmitting the effects varying risk premia to the real economy.

That this consumption channel may be relatively unimportant is perhaps not too surprising. After all, investors who want to maintain relatively flat consumption paths will seek to smooth out transitory fluctuations in wealth and income, so that consumption tracks the permanent components in these resources.[4] Indeed, in the papers cited above, it is this very aspect of aggregate consumer spending behavior that generates forecastability of excess stock returns by the log consumption-wealth ratio.

But if consumption growth is the quiescent Cinderella of the economy, investment growth is its volatile step child. Sharp swings in aggregate investment spending characterize business cycle fluctuations and may therefore be directly linked to cyclical variation in excess stock returns. What's more, classic models of investment behavior imply such a link: when stock prices rise on the expectation of lower future returns, discount rates fall, a phenomenon that raises the expected present value of marginal profits and therefore the optimal rate of investment (Abel (1983); Abel and Blanchard (1986)). In short, the fabled Q theory of investment implies that stock returns should covary positively with investment, while discount rates (expected returns) should covary negatively with investment.

The difficulty with this implication is that it is scarcely apparent in aggregate data. Stock returns and aggregate investment growth have been found to have a significant *negative* contemporaneous correlation (stock returns and discount rates a significant *positive* correlation), and recent evidence suggests

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permanent changes in wealth influence consumer spending.

[4] This is a partial equilibrium statement about optimal consumption choice, assuming the behavior of the equity premium is an equilibrium outcome that households take as given.

that short-term lags between investment decisions and investment expenditures may be to blame (Lamont (2000)).

In this paper we derive an explicit link between the time-varying risk premium on stocks and real investment spending. We emphasize that movements in the equity risk premium (time-variation in expected excess returns) should have implications not merely for investment *today*, but also for future investment over long horizons. We develop and test an alternative implication of Q theory for the relation between risk premia and investment that is less likely to be affected by short-term investment lags than is the more commonly tested implication, discussed above, that discount rates covary negatively with investment. We start with the observation that, if markets are complete, the definition of marginal Q may be transformed into an approximate log-linear expression relating expected asset returns to the expected growth rate of marginal Q. From this expression, it is easy to derive a present value formula in which variables that are long-horizon predictors of excess stock market returns also appear as long-horizon predictors of the growth rate of in marginal Q. If investment is a nondecreasing function of Q, it follows that long-horizon investment growth is likely to be forecastable by the same variables that predict long-horizon movements in excess stock returns, or equity risk premia. Because this implication of Q theory pertains to *long-horizon* changes in real investment, it is naturally less affected by short-term investment lags than is the implication that discount rates should display a negative contemporaneous correlation with investment. Thus our procedure provides an informal test of the hypothesis that some implications of the Q theory of investment may be satisfied in the long-run, even if temporary adjustment lags prevent its short-run implications from being fulfilled in the data. Our procedure also allows us to test the empirical importance of one possible link between time-varying equity risk-premia and aggregate investment behavior.

Notice that the sign of the implied long-horizon covariance between stock returns and investment that we emphasize here is opposite to that of the contemporaneous covariance upon which researchers typically focus. A decline in the equity risk premium drives up excess stock returns today, reduces the cost of capital, and is therefore likely to increase investment within a few quarters time. But because the decline in the equity premium must be associated with a reduction in expected future stock returns, the analysis presented here suggests that these favorable cost of capital effects will eventually deteriorate, foreshadowing a reduction in future investment growth over long horizons. Thus, on average, we should find a *negative* covariance between stock returns today and future investment growth over long horizons (alternatively, a *positive* covariance between discount rates and future investment growth over long horizons).

Consistent with this implication, we find that variables which forecast excess stock market returns are also long-horizon predictors of aggregate investment growth. In particular, we find that an empirical proxy for the log consumption-aggregate wealth ratio (developed in Lettau and Ludvigson (2001a)) is a long-horizon forecaster of real investment growth just as it is of excess returns on aggregate stock market indexes. Moreover, the sign of the forecasting relationship is positive with regard to both variables, consistent with the reasoning provided above. When the cost of capital is low because equity risk premia are low, investment is predicted to grow more slowly in the future as excess stock returns fall. To the best of our knowledge, these findings are the first to provide evidence of a direct connection between movements in equity risk premia and investment growth over long-horizons into the future.

Most empirical studies of aggregate investment have found only a weak relationship between discount rates, or the cost of capital component of marginal Q, and investment. For example, Abel and Blanchard (1986) find that, although most of the variability in marginal Q is generated by variability in the cost of capital component, it is the marginal profit component of Q that is more closely related to aggregate investment. Others (for example, Fama (1981); Fama and Gibbons (1982); Fama (1990); Barro (1990); Cochrane (1991); Blanchard et al. (1993)) have found a relation between *ex post* stock returns and real activity, and Cochrane (1991) finds that the some of the same variables that forecast stock returns also forecast investment *returns*; but all of these findings are distinct from one in which *ex ante* stock market returns influence real investment activity. An exception is Lamont (2000), who finds that investment plans have some forecasting power for both aggregate investment growth and excess stock returns, suggesting that fluctuations in equity risk premia affect investment with a lag. However, Lamont's forecasting evidence is concentrated at short horizons and reflects an intertemporal shifting of the widely investigated negative contemporaneous covariance between discount rates and investment, rather than the positive long-horizon covariance that is the focus of this paper.

Our work also builds on insights derived in Cochrane (1991) who studies a production-based asset pricing model. Cochrane shows that, if markets are complete, the producer's first-order condition implies that investment returns and asset returns are equal in equilibrium. Thus, the production based model Cochrane investigates (of which the Q theory of investment is a special case) allows us to explicitly connect stock returns to investment returns. We use these results on market completeness to show that proxies for slow-moving expected excess stock returns are also likely to be related to movements in investment growth many quarters into the future.

To confront our long-horizon prognosis with the data, we employ a variety of predictive variables that have been shown elsewhere to forecast excess stock returns and test whether they are related to future investment growth. These predictive variables are, an aggregate dividend-price ratio, a default spread, a term spread, a short-term interest rate, and the consumption-wealth variable developed in Lettau and Ludvigson (2001a). Price-earnings ratios have also been used as forecasting variables for stock returns. A caveat with the price-earnings ratio that is shared with the price-dividend ratio is that its short-term predictive power for excess returns has been severely compromised by the inclusion of stock market data since 1995. Undoubtedly some of this reduction in predictive power is attributable to recent changes in the way dividends and earnings are paid-out and reported. For example, firms have been distributing an increasing fraction of total cash paid to shareholders in the form of stock repurchases. If the data on dividends do not include such repurchases, changes of this type would distort measured dividends and reduce the forecasting power of the dividend-price ratio. Similarly, shifts in accounting practices that refashion the type of costs that are excluded from earnings or the type of investments that are written off, or changes in compensation practices toward the use of stock options which are not treated as an expense, can all create one-time movements in measured price-earnings ratios that are unrelated to the future path of earnings or discount rates. By contrast, data on aggregate consumption is largely free of at least these measurement problems. This may partly explain why Lettau and Ludvigson (2001a) find that the consumption-wealth variable has better predictive power for excess stock returns than all of the financial variables listed above in both in-sample and out-of-sample tests. For this reason, we emphasize most our results using the consumption-wealth ratio as a proxy for time-varying equity risk-premia.

The rest of this paper is organized as follows. The next section motivates our analysis by deriving a loglinear Q model. We show that the log stock price and the log of Q have expected returns as a common component, and then move on to derive the relationship between proxies for time-varying equity risk premia and the future growth rate in marginal Q. Section 2.2 reviews the material in Lettau and Ludvigson (2001a) motivating the use of the log consumption-wealth ratio as forecasting variable for excess returns. Section 3 describes the data, defines a set of control variables for both return forecasts and investment forecasts, and discusses our predictive regression specifications. Section 4 presents empirical results on the long-horizon forecastability of aggregate investment spending. Section 5 concludes.

2 Loglinear *Q* Theory

This section presents a loglinear framework for linking time-varying risk premia to the log difference in future Q, and therefore future investment growth. Consider a representative firm with maximized net cash flow, $\pi_t(K_t, I_t)$, physical capital stock, K_t, and rate of gross investment in physical capital, I_t. The accumulation equation for the firm's capital stock may be written

$$K_t = (1-\delta)K_{t-1} + I_t. \tag{1}$$

Abel and Blanchard (1986) assume that the firm chooses I_t so as to maximize the value of the firm at time t, and show that the marginal cost of investment, $-E_t\left(\frac{\partial \pi_t}{\partial I_t}\right)$, must be equal to the expected present value of marginal profits to capital:

$$Q_t = E_t\Big[\sum_{j=1}^{\infty}\prod_{i=1}^{j}\frac{1}{1+R_{t+i}}M_{t+j}\Big], \tag{2}$$

where E_t is the expectation operator conditional on information at time t, R_t is the *ex ante* rate of return to investment, and $M_t \equiv (1-\delta)\partial\pi_t/\partial K_t$. Subject to a transversality condition, (2) is equivalent to

$$E_t\big[1+R_{t+1}\big] = \frac{E_t\big[Q_{t+1}+M_{t+1}\big]}{Q_t}. \tag{3}$$

Abel and Blanchard (1986) follow the early adjustment cost literature and assume a simple convex adjustment cost structure, so that $\partial\pi_t/\partial I_t < 0$ and $\partial^2\pi_t/\partial I_t^2 < 0$, implying that $I_t = f(Q_t)$, with$f' \geq 0$. Alternatively, Abel and Eberly (1994) show that investment will be a nondecreasing function of Q_t in an extended framework that also incorporates fixed costs of investment, a wedge between the purchase price and sale price of capital, and possible irreversible investment.

Throughout this paper, we use lower case letters to denote log variables, e.g., $q_t = \ln(Q_t)$. A loglinear approximation of (3) may be obtained by first noting that $s_t \equiv \ln[(Q_{t+1} + M_{t+1})/Q_t] = q_{t+1} - q_t + \ln(1 + \exp(m_{t+1} - q_{t+1})$. The last term is a nonlinear function of the log Q-marginal profit ratio and may be approximated around its mean using a first order Taylor expansion. Defining a parameter $\rho_q \equiv 1/(1 + \exp(\overline{m - q}))$, this approximation may be written

$$s_t \approx k + \rho_q \Delta q_{t+1} + (1 - \rho_q)(m_{t+1} - q_t), \tag{4}$$

where k is defined by $k \equiv -\ln(\rho_q) - (1 - \rho_q)\ln(1/\rho_q - 1)$. Taking logs of both sides of (3), using (4), and assuming, either that Δq_t and m_t are jointly lognormally distributed, or applying a second-order Taylor expansion, (3) can be written in loglinear form as

$$E_t r_{t+1} \approx \rho_q E_t \Delta q_{t+1} + (1 - \rho_q) E_t \big[m_{t+1} - q_t\big] + \Phi_t, \tag{5}$$

where Φ_t contains linearization constants, variance and covariance terms [5].

Equation (5) relates the *ex ante* investment return to the *ex ante* rate of growth in marginal Q. If we solve this equation forward, apply the law of iterated expectations, and impose the condition $\lim_{j \to \infty} E_t \rho_q q_{t+j} = 0$, we obtain the following expression (ignoring constants) [6]

$$q_t \approx E_t \Big[\sum_{j=0}^{\infty} \rho_q^j \big[(1 - \rho_q) m_{t+1+j} - r_{t+1+j} + \Phi_{t+j}\big]\Big]. \tag{6}$$

Equation (6) shows that q_t is a first-order function of two components, discounted to an infinite horizon: expected marginal profits, m_{t+1+j}, and expected

[5] Assuming that r_t is lognormal and Δq_{t+1} and $m_{t+1} - q_t$ are jointly log-normal, $\Phi_t = \frac{1}{2}(\mathrm{Var}_t[\rho \Delta q_{t+1} + (1 - \rho)(m_{t+1} - q_t)] - \mathrm{Var}_t[r_{t+1}])$

[6] Throughout this paper we ignore unimportant linearization constants.

future investment returns, r_{t+1+j}. We refer to the first as the marginal profit component, and the second as the cost of capital component. A virtually identical expression is derived in Abel and Blanchard (1986) for an approximate formulation in levels rather than logs. This expression says that a decrease in expected future returns or an increase in expected future marginal profits raises q_t, and under simple convex adjustment costs, raises the optimal rate of investment.

An expression similar to (6) for the stock price, P_t, paying a dividend, D_t, may be obtained by taking a first-order Taylor expansion of the equation defining the log stock return, $r_{st+1} \equiv \ln(P_{t+1} + D_{t+1}) - \ln(P_t)$, iterating forward, and imposing the condition $\lim_{j\to\infty} E_t \rho_p p_{t+j} = 0$:

$$p_t \approx E_t\Big[\sum_{j=0}^{\infty} \rho_p^j \big[(1-\rho)d_{t+1+j} - r_{st+1+j}\big]\Big], \tag{7}$$

where $\rho_p = 1/(1 + \exp(\overline{d-p}))$. The stock return, r_{st}, can always be expressed as the sum of excess stock returns, $r_{st} - r_{ft}$, and real interest rates, r_{ft}. Equity risk premia vary over time if the conditional expected excess stock return component, $E_{t-1}(r_{st} - r_{ft})$, fluctuates over time.

Comparing (6) and (7), it is evident that both p_t and q_t depend on expected returns but that q_t depends on the expected investment return while p_t depends on the expected stock return. The expected investment return and the expected stock return are likely to be closely related, however. Indeed, Cochrane (1991) shows that, if managers have access to complete financial markets, and if aggregate stock prices represent a claim to the capital stock corresponding to investment, I_t, then the equilibrium stock return, r_{st}, will equal the equilibrium investment return, r_t. Intuitively, firms will remove arbitrage opportunities between asset returns and investment returns until the two are equal *ex post*, in every state of nature. Under these circumstances, equations (6) and (7) imply that p_t and q_t have a common component: they both depend on expected future stock returns, $r_{st} = r_t$. Equation (7) says that stock prices are high when dividends are expected to increase rapidly or when they are discounted at a low rate. Similarly, equation (6) says that, fixing Φ_{t+j}, q_t is high when marginal profits are expected to grow quickly or when those profits are discounted at a low rate.

Equation (6) also shows that a decline in expected future returns (discount rates), raises q_t, and therefore the optimal rate of investment. Since a decline in expected future returns is associated with an increase in stock prices today, the model predicts a positive contemporaneous correlation between stock prices and investment. Even if discount rates are constant, an increase in stock prices today reflects an increase in expected future profits, again raising q_t, and with it the optimal rate of investment. Either way, the most basic form of the Q theory of investment implies a positive covariance between stock prices and investment.

We now return to the enterprise of explicitly linking equity risk premia to future Δq_t, and therefore to future investment growth. The first step in this process is to link equity risk premia (expected excess stock returns) to observable variables. This is done by deriving expressions that connect observable variables to expected stock returns, of which expected excess returns are one component. To build intuition, we begin by presenting an example of one such expression, now familiar in the finance literature, given by the linearized formula for log dividend-price ratio. This expression may be obtained by rewriting (7) in terms of the log dividend-price ratio rather than the log stock price, where we now use the complete markets result and set $r_{st} = r_t$:

$$d_t - p_t \approx E_t\Big[\sum_{j=0}^{\infty} \rho_p^j \big[r_{t+1+j} - \Delta d_{t+1+j}\big]\Big]. \tag{8}$$

This equation says that if the dividend-price ratio is high, agents must be expecting either high returns on assets in the future or low dividend growth rates (Campbell and Shiller (1988)). As long as dividends and prices are cointegrated, this approximation says that the dividend-price ratio can vary only if it forecasts returns or dividend growth or both. If expected dividend growth rates are constant, then the dividend-price ratio acts as a state variable that drives expected returns. If, in addition, real interest rates are not well forecast by $d_t - p_t$, the dividend-price ratio acts as a state variable that drives expected *excess* returns, or risk premia. Both of these propositions appear well satisfied in the data, thus the dividend-price ratio is often thought of as such a state variable. To investigate this implication empirically, researchers have have regressed long-horizon stock returns on the lagged dividend-price ratio. [7] This links equity risk-premia to an observable variable, namely the log dividend-price ratio. To the extent that $d_t - p_t$ forecasts excess stock returns, it may be thought of as a proxy for the time-varying equity risk-premium.

The second step in explicitly linking equity risk premia to future Δq_t is to combine (5) with an expression like (8), which delivers an equation relating the equity risk-premium proxy (e.g., the log dividend-price ratio) to future changes in q_t:

$$d_t - p_t \approx E_t\Big[\sum_{j=0}^{\infty} \rho_p^j \big[\rho_q \Delta q_{t+1+j} + (1-\rho_q)(m_{t+1+j} - q_{t+j}) + \Phi_{t+j} - \Delta d_{t+1+j}\big]\Big]. \quad (9)$$

Equation (9) says that state variables which forecast long-horizon returns, in this case $d_t - p_t$, are also likely to forecast long-horizon variation in the growth rate of Q_t. Under the presumption that investment is an increasing function of q_t, the testable implication here is that the dividend-price ratio is likely to forecast investment growth over long horizons.

To understand the sign of this forecasting relationship, it is useful to consider a concrete example. If expected returns fall (i.e., from (8), $d_t - p_t$ falls), (9) implies that the growth rate of Q and therefore investment is forecast to fall

[7] For example, see Campbell and Shiller (1988); Fama and French (1988); Campbell (1991); Hodrick (1992).

over long-horizons into the future. This says that *future* investment growth should covary *positively* with expected returns. Notice that the sign of this covariance is the opposite of that implied for the covariance between *contemporaneous* investment and expected returns. Equation (6) demonstrates that contemporaneous investment should covary *negatively* with expected returns. This reason is simple: a decline in the discount rate today causes stock prices to rise and immediately lowers the cost of capital; therefore the optimal rate of investment today rises. But the decline in discount rates also foretells, on average, lower future stock returns and higher future capital costs; therefore the optimal rate of investment in the future is predicted to fall.

Despite the intuitive appeal of equations (8) and (9), there is an important difficulty with using the dividend-price ratio as a proxy variable for time-varying risk premia: the predictive power of this variable for excess returns has weakened substantially in samples that use recent data. The suggests that the usefulness of the dividend-price ratio as a proxy for conditional expected stock returns may have broken down. Thus we now briefly review the material in Lettau and Ludvigson (2001a) which develops an alternative forecasting variable for excess stock returns: a proxy for the log consumption-aggregate wealth ratio. As we show next, this alternative predictive variable preserves the intuitive appeal of equations (8) and (9), since the expression connecting the log consumption-aggregate wealth ratio with future returns to aggregate wealth is directly analogous to the expression connecting the log dividend-price ratio with future returns to equity.

2.1 The Consumption-Wealth Ratio

Consider a representative agent economy in which all wealth, including human capital, is tradable. Let W_t be aggregate wealth (human capital plus asset holdings) in period t. C_t is consumption and $R_{w,t+1}$ is the net return on aggregate wealth. The accumulation equation for aggregate wealth may be written[8]

$$W_{t+1} = (1 + R_{w,t+1})(W_t - C_t). \tag{10}$$

We define $r \equiv \log(1 + R)$, and use lowercase letters to denote log variables throughout. If the consumption-aggregate wealth ratio is stationary, the budget constraint may be approximated by taking a first-order Taylor expansion of the equation. The resulting approximation gives an expression for the log difference in aggregate wealth as a function of the log consumption-wealth ratio:

$$\Delta w_{t+1} \approx k + r_{w,t+1} + (1 - 1/\rho_w)(c_t - w_t), \tag{11}$$

where ρ_w is the steady-state ratio of new investment to total wealth, $(W - C)/W$, and k is a constant that plays no role in our analysis. Solving this difference equation forward, imposing the condition that $\lim_{i\to\infty} \rho_w^i (c_{t+i} - w_{t+i}) = 0$ and taking expectations, the log consumption-wealth ratio may be written

$$c_t - w_t = E_t \sum_{i=1}^{\infty} \rho_w^i (r_{w,t+i} - \Delta c_{t+i}), \tag{12}$$

where E_t is the expectation operator conditional on information available at time t.[9]

The expression for the consumption-wealth ratio, (12), is directly analogous to the linearized formula for the log dividend price ratio (8). Both hold *ex post* as well as *ex ante*. When the consumption-aggregate wealth ratio is high, agents must be expecting either high returns on the aggregate wealth portfolio in the future or low consumption growth rates. Thus, consumption may be thought as the dividend paid from aggregate wealth.

The practical difficulty with using (12) to forecast returns is that aggregate wealth–specifically the human capital component of it–is not observable. To

[8] Labor income does not appear explicitly in this equation because of the assumption that the market value of tradable human capital is included in aggregate wealth.
[9] This expression was originally derived by Campbell and Mankiw (1989).

overcome this obstacle, Lettau and Ludvigson (2001a) assume that the nonstationary component of human capital, denoted H_t, can be well described by aggregate labor income, Y_t, which is observable, implying that $h_t = \kappa + y_t + z_t$, where κ is a constant and z_t is a mean zero stationary random variable. This assumption may be rationalized by a number of different specifications linking labor income to the stock of human capital.[10] If, in addition, we write total wealth as the sum of human wealth and asset (nonhuman) wealth, A_t, so that $W_t = A_t + H_t$ (or in logs $w_t \approx \omega a_t + (1-\omega)h_t$ where $\omega = \overline{A/W}$ is the average share of nonhuman wealth in total wealth), the left-hand-side of (12) may be expressed as the difference between log consumption and a weighted average of log asset wealth and log labor income:

$$cay_t \equiv c_t - \omega a_t - (1-\omega)y_t = E_t \sum_{i=1}^{\infty} \rho_w^i \left(r_{w,t+i} - \Delta c_{t+i} \right) + (1-\omega)z_t. \quad (13)$$

The left-hand-side of (13), which we denote cay_t, is observable as a cointegrating residual for consumption, asset wealth and labor income. Although cay_t is proportional to $c_t - w_t$ only if the last term on the right-hand-side of (13) is constant, Lettau and Ludvigson (2001b) show that this term is primarily a function of expected future labor income growth, which does not appear to vary much in aggregate data. Thus, cay_t may be thought of as a proxy for the log consumption-aggregate wealth ratio, $c_t - w_t$.[11]

[10] See Lettau and Ludvigson (2001a), and Lettau and Ludvigson (2001b) for detailed examples. One such example is the case where aggregate labor income is modelled as the dividend payed to human capital, as in Campbell (1996). In this case, the return to human capital may be defined $R_{h,t+1} = \frac{H_{t+1}+Y_{t+1}}{H_t}$, and a log-linear approximation of $R_{h,t+1}$ implies that $z_t = E_t \sum_{j=0}^{\infty} \rho_h^j (\Delta y_{t+1+j} - r_{h,t+1+j})$. Under the maintained hypothesis that labor income growth and the return to human capital are stationary, z_t is stationary .

[11] In the case where labor income growth is a random walk and the return to human capital is constant, cay_t is exactly proportional to $c_t - w_t$.

Note that stock returns, r_{st}, are but one component of the return to aggregate wealth, $r_{w,t}$. Stock returns, in turn, are the sum of excess stock returns and the real interest rate. Thus, equation (13) says that the log consumption-aggregate wealth ratio embodies rational forecasts of excess returns, interest rates, returns to nonstock market wealth, and consumption growth. Nevertheless, the conditional expected value of the last three of these appears to be much less volatile than the first, and the empirical result is that it is excess returns to equity that are forecastable by cay_t.

Lettau and Ludvigson (2001a) find that an estimated value of cay_t is a strong forecaster of excess returns on aggregate stock market indexes such as the Standard & Poor 500 Index and the CRSP-value weighted Index: a high consumption-wealth ratio forecasts high future stock returns and vice versa. This proxy for the log-consumption wealth ratio has marginal predictive power controlling for other popular forecasting variables, explains a large fraction of the variation in excess returns, and displays its greatest predictive power for returns over business cycle frequencies, those ranging from one to eight quarters. In addition, Lettau and Ludvigson (2001a) find that observations on this variable would have improved out-of-sample forecasts of excess stock returns in post-war data relative to a host of traditional forecasting variables based on financial market data.

At the same time, Lettau and Ludvigson (2001a) and Lettau and Ludvigson (2001b) show that cay_t has virtually no forecasting power for consumption growth or labor income growth (the latter of which may be part of z_t), suggesting that cay_t *summarizes* conditional expectations of future excess returns to the aggregate wealth portfolio. When an increase in stock prices drives asset values above its long-term trend with consumption and labor earnings, it is future stock market returns, rather than future consumption or labor income growth, that is forecast to adjust until the equilibrating relation is restored. This result says that households hold back on consuming out of current wealth when stock returns are temporarily high but expected to be lower in the future. As the infinite sum in (13) makes clear, however, the consumption-wealth ratio, like the dividend-price ratio, should track longer-term tendencies in asset markets rather than provide accurate short-term forecasts of booms or crashes.

Why does a high consumption-wealth ratio forecast high future stock returns? The answer must lie with investor preferences. Investors who want to maintain a flat consumption path over time will attempt to smooth out fluctuations in their wealth arising from time-variation in expected returns. When excess returns are expected to be higher in the future, forward looking investors will allow consumption out of current asset wealth and labor income, to rise above its long-term trend with those variables. When excess returns are expected to be lower in the future, investors will react by allowing consumption out of current asset wealth and labor income to fall below its long-term trend with these variables. In this way, investors may insulate future consumption from fluctuations in expected returns. An example in which this intuition can be seen clearly is one in which the representative investor has power preferences for consumption: $U_t = C_t^{1-\gamma}/1 - \gamma$. With these preferences, and assuming for simplicity that asset returns and consumption growth are conditionally homoskedastic, the first-order condition for optimal consumption choice is given by $E_t \Delta c_{t+1} \approx \mu + (1/\gamma) E_t r_{t+1}$, where $1/\gamma$ is the intertemporal elasticity of substitution in consumption. It is straightforward to verify that, if this elasticity is sufficiently small, income effects dominate substitution effects and cay_t will be *positively* related to expected returns, consistent with what is found.

It is important to emphasize that *excess* stock returns are forecastable; cay_t, (as with $d_t - p_t$ and other popular forecasting variables) has virtually no forecasting power for short term interest rates. Thus cay_t should be thought of a state variable that drives low frequency fluctuations in equity risk premia rather than as a driving variable for expected interest rates.

Just as with the dividend-price ratio in (9), we may explicitly link equity risk premia driven by cay_t to future movements in Δq_t by plugging (5) into (13) (again using complete markets assumption to set r_{wt} equal to r_t) to obtain:

$$cay_t = E_t \sum_{j=1}^{\infty} \rho_w^j \Big(\rho_q \Delta q_{t+1+j} + (1-\rho_q)(m_{t+1+j} - q_{t+j}) + \Phi_{t+j} - \Delta c_{t+j} \Big) \quad (14)$$

Equations (14) and (9) show that the consumption-wealth ratio and the dividend-price ratio embody rational forecasts not only of future stock returns, but also of future Δq_t. These expressions therefore motivate our investigation of whether the same variables that forecast excess stock returns (and therefore proxy for time-varying risk premia) also forecast investment growth.[12] These expressions also imply that the forecastability of investment growth should be concentrated at *long-horizons*, an implication that follows from the infinite discounted sum of Δq_{t+1+j} terms on the right-hand-side of these equations. If investment is an increasing function of q_t these equations suggest proxies for risk premia are likely to forecast long-horizon investment growth because they forecast long-horizon movements in Δq_t.

To relate cay_t explicitly to future investment, additional structure must be imposed on the problem. As one example, consider the model investigated by Abel (1983), in which firms undertake gross investment by incurring an

[12] The basic motivation remains even if one believes that only the stock return, r_{st}, should be set equal to investment returns, r_t, since the stock return is but one component of the aggregate wealth portfolio return, r_{wt}. Similarly, the relation between cay_t and expected future movements in Δq_t can be derived even if the equity return is assumed to be one component of the investment return (where, for example, leverage makes up the other component). Either of these modifications would merely require extra terms for the resulting nonstock components of returns in the summation on the right-hand-side of (14), but these extra terms would not eliminate the appearance of the term $E_t \sum_{i=1}^{\infty} \rho_w^i \rho_q \Delta q_{t+1+i}$.

increasing convex cost of adjustment, $g(I_t) = \gamma I_t^{\beta}$, where $\beta > 1$. As mentioned, in the context of a stochastic discount factor, Abel and Blanchard (1986) show that the optimality condition for investment implies the marginal cost of investment must equal the expected present value of marginal profits to capital, or $E_{t-1}(-\partial\pi/\partial I_t) = Q_t$. For the simple adjustment cost function given above, optimal investment therefore implies that $E_{t-1}(\gamma\beta I_t^{\beta-1}) = Q_t$. When investment is conditionally homoskedastic and lognormally distributed, this expression can be rewritten in log form as $q_t = \ln(\gamma\beta) + (\beta-1)E_{t-1}i_t + 1/2(\beta-1)^2\sigma^2(i_t)$, where $\sigma^2(i_t)$ is the constant conditional variance of log investment. This equation may be used to substitute out for Δq_t in (14), yielding an expression that explicitly links the consumption-wealth ratio proxy, cay_t to future investment growth:

$$cay_t = E_t \sum_{j=1}^{\infty} \rho_w^j \left(\rho_q(\beta-1)\Delta i_{t+1+j} + (1-\rho_q)(m_{t+1+j} - q_{t+j}) + \Phi_{t+j} - \Delta c_{t+j} \right). \tag{15}$$

Equation (15) shows that cay_t should be a long-horizon predictor of investment growth: cay_t forms a rational forecast of future investment growth over horizons for which expected returns vary, into the indefinite future.[13] Note that this long-horizon predictability comes, not from any long-horizon relationship between investment and Q, but from the presence of time-varying expected returns; if expected returns were constant, the framework above would predict no relation between cay_t and future investment.

What is the economic mechanism behind the relation between cay_t and future investment given in (14)? An increase in stock prices generated by a decline in equity risk premia will increase asset wealth, a_t, relative to its long-term

[13] Equation (15) does not further pin down the precise timing of the linkage from cay_t to future returns, other than to say that the consumption-wealth ratio should be systematically related to a weighted average of future returns over horizons for which expected returns vary.

trend with consumption, c_t, and labor income, y_t. Thus, a decline in the equity risk premium causes cay_t to fall since expected future returns fall. The decline in expected future returns reduces discount rates leading to an immediate increase in both stock prices and investment (see (6)). But since a decline in cay_t forecasts lower returns in the future, the increase in stock prices today is also associated with lower subsequent investment growth over long-horizons into the future (equation (15)).

3 Data and Empirical Specifications

An important task in using the left-hand-side of (15) as a forecasting variable is the estimation of the parameters in cay_t. Lettau and Ludvigson (2001a) discuss how these parameters can be estimated consistently and why the use of nondurables and services expenditure data to measure consumption is likely to imply that the coefficients on asset wealth and labor income may sum to a number less than one, as we report below. [14] Appendix A provides a complete description of the data used to measure real consumption, c_t, real asset wealth (household net worth), a_t, and real, after-tax labor income, y_t. The reader is referred to Lettau and Ludvigson (2001a) for a description of the procedure used to estimate the cointegrating parameters in (13). We simply note here

[14] The use of these expenditure categories is justified on the grounds that the theory applies to the *flow* of consumption; expenditures on durable goods are not part of this flow since they represent replacements and additions to a stock, rather than a service flow from the existing stock. But since nondurables and services expenditures are only a component of unobservable total consumption, the standard solution to this problem requires the researcher to assume that total consumption is a constant multiple of nondurable and services consumption (Blinder and Deaton (1985); Galí (1990)). This assumption in turn implies that the coefficients on asset wealth and labor income should sum to a number less than one.

that we obtain an estimated value for cay_t, which we denote $\widehat{cay}_t = c_t^* - 0.31a_t^* - 0.59y_t^* - 0.60$, where starred variables indicate measured quantities. We use this estimated value as a forecasting variable in our empirical investigation below.

Our financial data include a stock return from the Standard & Poor's (S&P) 500 Composite index. Let r_t denote the log real return of the S&P index and $r_{f,t}$ the log real return on the 30-day Treasury bill (the "risk-free" rate). The log excess return is $r_t - r_{f,t}$. Log price, p, is the natural logarithm of the S&P 500 index. Log dividends, d, are the natural logarithm of the sum of the past four quarters of dividends per share. We call the log dividend-price ratio, $d_t - p_t$, the dividend yield.

The derivation of equation (15) suggests that the the consumption-wealth ratio may forecast investment over long horizons because it forecasts stock returns over long-horizons. Thus, equity risk premia are linked to future investment growth. The logic of this derivation is not limited to the dividend yield or the consumption-wealth ratio. In principle, any variable that forecasts excess stock returns can be said to capture time-varying equity risk premia, and may also forecast long-horizon investment growth. The empirical asset pricing literature has produced a number of such variables that have been shown, in one subsample of the data or another, to contain predictive power for excess stock returns. Shiller (1981), Fama and French (1988), Campbell and Shiller (1988), Campbell (1991), and Hodrick (1992) all find that the ratios of price to dividends or earnings have predictive power for excess returns. Campbell (1991) and Hodrick (1992) find that the relative T-bill rate (the 30-day T-bill rate minus its 12-month moving average) predicts returns, and Fama and French (1989) study the forecasting power of the term spread (the 10-year Treasury bond yield minus the one-year Treasury bond yield) and the default spread (the difference between the BAA and AAA corporate bond rates). We denote these last variables $RREL_t$, TRM_t, and DEF_t respectively. Finally, as mentioned, Lettau and Ludvigson (2001a) find that the proxy for the log consumption-wealth ratio, $\widehat{cay}_t$, performs better than each of these financial indicators as a predictor of excess stock returns in both in-sample and out-of-sample test. We use all of these variables in our analysis below.

Just as the empirical finance literature has produced a variety of forecasting variables for excess returns, the empirical investment literature has identified a variety of forecasting variables for aggregate investment growth (see, for example, Barro (1990); Blanchard et al. (1993); Lamont (2000)). These are: lagged investment growth, Di_t, (measured here as either fixed, private non-residential investment, or split into the equipment and nonresidential structures components separately); lagged corporate profit growth, $Dprofit_t$, measured here as the growth rate of after-tax corporate profits; the lagged growth rate of average Q, Dq_t^A, as constructed in Bernanke et al. (1988);[15] and finally, lagged gross domestic product growth, $Dgdp_t$. Appendix A describes these data in detail. We refer to these variables as a group as our investment controls, and ask whether our proxies for equity risk premia have predictive content for future investment growth above and beyond that already contained in these variables.

To provide background on the forecastability of excess returns, the next section begins by presenting long-horizon forecasts of excess stock returns. Once the predictive power of each risk-premia proxy for future returns has been established, we move on to investigate various predictive regressions for investment. The dependent variable in the investment regressions is the H-period investment growth rate $i_{t+H} - i_t$; the dependent variable in the excess return regressions is the H-period log excess return on the S&P Composite Index, $r_{t+1} - r_{f,t+1} + ... + r_{t+H} - r_{f,t+H}$. For each regression, the table reports the estimated coefficient on the included explanatory variable(s), the adjusted R^2

[15] The data for q_t^A are only available from the first quarter of 1960.

statistic, and two sets of t-statistics. The second t-statistic (reported in curly brackets) is computed using a procedure developed by Hodrick (1992) to address the small sample difficulties that can arise with the use of overlapping data in long-horizon regressions. We will refer to the t-statistic generated using these standard errors as Hodrick $t-$statistics. However, since the Hodrick procedure relies on a parametric correction for serial correlation, we also report t-statistics from standard errors that have been corrected for serial correlation in a nonparametric way, as recommended by Newey and West (1987). The first t-statistic (reported in parentheses) is generated from these Newey-West standard errors for the hypothesis that the coefficient is zero.

4 Empirical Results

We now turn to long-horizon forecasts. It is useful to begin with a brief overview of the long-horizon forecasting power of excess stock market returns. For the purposes of this paper, we report results from simple long-horizon regressions of the type just discussed. A more extensive analysis of the forecasting power of these variables that addresses out-of-sample stability and small-sample biases can be found in Lettau and Ludvigson (2001a).

4.1 Forecasting Excess Stock Returns

Table 1 reports the results of long-horizon forecasts of excess returns on the S&P 500 Composite Index. The regression coefficient reported gives the effect of a one unit increase in the regressor on the cumulative excess stock return over various horizons, H. The first row of Table 1 shows that the dividend-price ratio has little ability to forecast excess stock returns at horizons ranging from one to 16 quarters. This finding is attributable to including data after 1995. The last half of the 1990s saw an extraordinary surge in stock prices relative to dividends, weakening the tight link between the dividend-yield and future returns that has been documented in previous samples. The measurement concerns discussed in the introduction are clearly part of the story. It is too early to tell whether the behavior of dividends and prices in the late 1990s was merely symptomatic of a very unusual period, or representative of a larger structural change in the economy.

The second row of Table 1 shows that $\widehat{cay}_t$ forecasts the excess return on the S&P index with t-statistics that begin above 3 at a one quarter horizon and increase, and R^2 statistics that increase from 0.07 to peak at a horizon of 12 quarters at 0.26. Note that the coefficients on $\widehat{cay}_t$ are positive, indicating that a high value of this cointegrating error forecasts high returns and vice versa. The relative bill rate and the term spread also have some forecasting power for excess returns, with $RREL_t$ negatively related to future returns and TRM_t positively related. The forecasting power of both variables is concentrated at shorter horizons than is the forecasting power of $\widehat{cay}_t$. The default spread has no univariate forecasting power for excess returns in this sample.

The last row of Table 1 reports the forecasting results for excess returns when all five variables are included as dependent variables. The forecasting results are qualitatively similar to those of the univariate regressions. At short horizons, $\widehat{cay}_t$ and $RREL_t$ are marginal predictors, while the marginal predictive power of $\widehat{cay}_t$ is present at all of the horizons reported. Interestingly, their are now statistically significant negative coefficients on the default premium, but the term spread has little marginal predictive power in the multivariate regression.

Overall, these results confirm that excess returns are forecastable, but suggest that $\widehat{cay}_t$ is the only variable that forecasts excess returns at all of the horizons that we investigate. Accordingly, of these forecasting variables, $\widehat{cay}_t$ may be the most robust proxy for equity risk premia. The signs of the regression coefficients suggest that expected returns (discount rates) vary positively with $\widehat{cay}_t$ and TRM_t, and negatively with $RREL_t$. Since these variables forecast excess returns, they capture movements in risk premia. Economic instinct suggests that the sign of the regression coefficients for $d_t - p_t$ and DEF_t should be positive and negative, respectively, but this reasoning is clouded by the finding that these variables bear no statistically significant relation to future returns in our sample.

4.2 Forecasting Investment Growth

We now turn to an investigation of the predictive power of these excess return forecasting variables for long-horizon investment growth. The loglinear Q model given above implies that predictable movements in future investment should be positively related to expected returns (as in (9) and (14)), while contemporaneous movements should be negatively related to expected returns (as in 6). Thus, forecasting variables that are positively linked to future excess returns should be positively linked to future investment but negatively linked to contemporaneous investment.

As discussed above, the long-horizon forecastability of investment growth by proxies for equity-risk premia (e.g., cay_t)is attributable solely to the presence of time-varying expected returns. Nevertheless, if, as hypothesized in (Cochrane (1991)) and (Lamont (2000)), there are lags in the investment process (e.g., delivery lags, planning lags, construction lags), the *sign* of this forecasting relation may be affected at short-horizons. As we explain below, this can occur because firms may not immediately adjust investment when the discount rate changes. Lamont (2000) argues that these lags can temporally shift the negative covariance between expected returns and investment implied by (6), and he finds evidence to support this hypothesis using survey data on investment plans.

To understand the impact on the sign of the forecasting relation between cay_t and future returns of the hypothesized investment lags, consider the time-line plotted in Figure 1, which shows the dynamic relation between an expected returns (discount rate) shock and investment growth under two scenarios: instantaneous adjustment of investment, and one quarter adjustment lag. First note that, regardless of whether investment lags are present, expected returns are negatively correlated with realized returns (holding fixed dividends, lower expected returns can only be generated by future asset price depreciation from a higher current stock price–see (8)). If expected returns, $E_t r_{t+1}$, decline relative to period $t-1$, (i.e., cay_t falls in period t), stock prices, P_t, rise and stock returns, r_t, are positive. Expectations about stock returns between t and $t+1$ are lower, however, and on average we will observe lower stock prices and negative stock returns in period $t+1$, relative to period t.

Now consider the hypothesized behavior of investment growth in the case of instant adjustment to a negative expected returns shock, displayed in the top panel of Figure 1. The decline in discount rates in period t generates higher stock prices and positive stock returns in period t; therefore the level of investment rises and investment growth is positive in period t relative to period $t-1$. Since expected returns for $t+1$ are lower, however, on average we will observe lower stock prices and negative returns in period $t+1$ relative to period t, and therefore lower investment and negative investment growth in period $t+1$ relative to period t.

Compare this sequence of events with that in which there is a one quarter delay in the adjustment of investment expenditures to a decrease in expected returns. This latter scenario is depicted in the bottom panel of Figure 1. In this case, a decline in $E_t r_{t+1}$ (i.e., a decline in cay_t) affects the adjustment of investment, delaying the increase until period $t+1$. This delay also affects the adjustment of future investment: since expected returns for $t+1$ are lower, on average we will observe lower stock prices, and negative returns in period $t + 1$ relative to period t, but we will not observe lower investment and negative investment growth until period $t + 2$ relative to period $t + 1$. A one-period delayed adjustment generates the following empirical prediction: when the discount rate (cay_t) falls in period t, investment growth should *rise* one period later at time $t+1$ but *fall* at time $t+2$. Thus a decrease in cay_t predicts higher investment growth next quarter but lower investment growth two quarters hence (see Figure 1). More generally with longer adjustment lags, the correlation between risk premia proxies such as $\widehat{cay}_t$ and future investment should be negative initially, but turn positive as the horizon extends, with the length of this extension determined by the length of the investment lag. Therefore, a test of whether there are important lags in the investment process is that the sign of the predictive relationship between risk premia proxies such as $\widehat{cay}_t$ and long horizon investment growth should "flip" as the horizon increases. The point at which the sign flip occurs gives an indication of the average length of the investment lag.[16]

4.2.1 Do proxies for equity risk premia forecast investment growth?

Table 2 reports the results of long-horizon regressions of the quarterly growth rate in real fixed, private non-residential investment on the predictive variables

[16] This hypothesized investment lag is distinct from the presence of adjustment costs. If there were no adjustment costs, Q would always be equal to one. In the presence of adjustment costs, Q is not always equal to one and fluctuations in the discount rate will induce fluctuations in Q and therefore investment expenditures. But such adjustment costs would not cause a *delay* in the reaction of investment to a discount rate-generated movement in Q. With no investment lags and a simple quadratic specification for adjustment costs, for example, investment is a linear function of current Q only. By contrast, investment lags are hypothesized to produce a delay in the adjustment of investment to a discount rate-generated movement in Q.

for excess stock returns whose forecasting power is displayed in Table 1.

The first row of Table 2 shows that the dividend yield has forecasting power for future investment growth over a range of horizons, but there are numerous negative coefficients in these regressions, indicating that high dividend-price ratios predict low, not high, investment. This is inconsistent with the investment lag story given above because, at least at long horizons, a low dividend-yield should predict low returns and therefore low, not high, investment growth. Again, however, this variable may have become a poor proxy for equity risk premia, as suggested by its paltry display of forecasting power for excess returns in samples that include recent data. Thus, it would not be surprising to find that any predictive power this variable may have otherwise had for investment has broken down as well. The second row of Table 2 shows the predictive power of the dividend-price ratio for investment growth using data through only 1994:Q4. Although the sign of the predictive relationship still does not eventually become positive, the coefficient estimates themselves are now statistically indistinguishable from zero as the horizon increases, suggesting that recent data (which has driven the dividend-yield to unprecedented low levels) may have generated a spurious negative relation between $d_t - p_t$ and long-horizon investment growth.

The results using $\widehat{cay}_t$ as a predictive variable are quite different from those using $d_t - p_t$. Row 3 shows that the sign pattern of the predictive relation is now consistent with the investment model discussed above when there are investment lags of the type postulated in Lamont (2000): higher values of $\widehat{cay}_t$ predict higher excess returns over long horizons (Table 1), lower investment at shorter horizons but higher investment as the horizon extends. At horizons in excess of 4 quarters, the consumption-wealth ratio has positive and strongly statistically significant coefficients for investment growth and explains a substantial fraction of the variation in investment growth. At a horizon of eight quarters, the t-statistics start above three and increase, while the R^2 statistics rise from 0.13 to 0.18 and back down to 0.16 as the horizon extends from eight to 16 quarters. These results are consistent with the view that changes in equity risk premia predict real investment growth, but that this predictive power is concentrated at longer-horizons. The result says that, when stock prices increase today as a result of a decline in equity risk premia (wealth is driven above its long-term trend with asset values and labor income), investment growth over the next 1 to 4 years is predicted decline.

The detrended short rate, $RREL_t$ follows a forecasting pattern that is similar to that of $\widehat{cay}_t$. Higher values of $RREL_t$ predict lower excess returns (Table 1), higher investment at shorter horizons and lower investment as the horizon extends. Although the R^2 statistics suggest that the fraction of variation in future investment growth that is explained by $RREL_t$ is less than that of $\widehat{cay}_t$, the sign of the predictive relationship is again consistent with the one predicted by the q_t model give above, allowing for lags in the investment process. Thus, the two variables that have the strongest forecasting power for future excess stock returns also have strong forecasting power for future investment growth over long-horizons.

The results for the term spread and the default spread do not conform to the economic interpretation given above, but there are good reasons why this might be so. Neither of these variables have much forecasting power for excess returns, suggesting that they may be relatively poor proxies for time-varying equity risk premia. Default premia may be more closely linked to investment through their influence on debt finance rather than equity finance. This could explain why the default spread shows little forecasting power for future equity returns, yet has some forecasting power for investment growth at short horizons (row 6).

The term spread has strong forecasting power for investment (Table 2, row 5), however, the economic mechanism behind this predictive power is likely to be quite different from that behind the forecasting power of the risk premia proxies $\widehat{cay}_t$ and $RREL_t$. The behavior of the yield spread is clearly affected by inflationary expectations and monetary policy, and recent theoretical work suggests that the predictive power of the term spread for economic growth may depend on the degree to which the monetary authority reacts to deviations in output from potential (Estrella (1998)). Moreover, results elsewhere (e.g., Lettau and Ludvigson (2001a)) show that $\widehat{cay}_t$ and $RREL_t$ display predictive power for excess returns that is far superior to that of TRM_t, suggesting that the former are indeed better proxies for time-varying risk premia. On the other hand, it is well known that term spreads are potent forecasters of real activity, particularly output growth (Stock and Watson (1989); Chen (1991); Estrella and Hardouvelis (1991)), thus it is not surprising to find the term spread forecasts investment growth (row 4, Table 2). A positive slope on the yield is associated with higher investment growth (comparable with the results reported in Estrella and Hardouvelis (1991)). Of all the forecasting variables considered in Table 2, TRM_t displays the strongest forecasting power (in terms of R^2) at a horizon of eight quarters, but less predictive power than the consumption-wealth ratio proxy, $\widehat{cay}_t$ at longer horizons.

The last row of Table 2 reports the results of long-horizon regressions of real investment growth in one multiple regression using $\widehat{cay}_t$, $RREL_t$, TRM_t, and DEF_t as predictive variables. All of the variables display marginal predictive power for investment growth at some horizons, with that of $\widehat{cay}_t$ concentrated at horizons in excess of four quarters, and that of the other three variables concentrated at horizons less than eight quarters. The R^2 pattern is hump-shaped. By including all four variables, the regression specification now has forecasting power for investment growth at every horizon we consider, and the adjusted R^2 statistic peaks at 0.30 at a two year horizon.

In summary, the results presented in Table 2 suggest that, when excess stock returns are forecast to decline in the future, investment growth is also forecast to decline. Variables, such as $\widehat{cay}_t$ and $RREL_t$, that are predictors of excess returns also predict future investment growth. Variables such as TRM_t and DEF_t also have forecasting power for future investment growth, but this predictive power appears to be unrelated to time-variation in the equity risk-premium, since these variables are inferior predictors of excess stock returns and are likely to be linked to future investment for reasons related to debt finance, inflation expectations, and monetary policy.

The results in Table 2 are for fixed, private, nonresidential investment as a whole. This measure of investment can be split into investment in equipment and software, and investment in nonresidential structures. This split is of some interest because it is widely believed that these components often behave differently. Thus, we now report the results of forecasting regressions for investment growth in nonresidential structures (Table 3), and equipment (Table 4).

The same difficulty with the predictive power of the dividend yield for total investment arises for investment in structures and equipment separately. By contrast, the consumption-wealth ratio proxy, $\widehat{cay}_t$ has forecasting power for both components of investment at horizons exceeding 4 quarters: it explains about 14 percent of structures investment and 12 percent of equipment investment at a horizon of 3 years. The relative bill rate, $RREL_t$, has forecasting power for structures investment at long horizons and for equipment investment at short horizons.

The predictive power of the term spread for total investment is almost entirely attributable to its predictive power for investment spending on structures. For example, TRM_t explains 31 percent of the variation in structures investment growth over an eight quarter horizon, but it explains virtually none of the variation in equipment investment over any horizon. Finally, the $\overline{R}^2$ statistics from multivariate regressions including $\widehat{cay}_t$, $RREL_t$, TRM_t, and DEF_t as predictive variables suggest that these variables as a whole explain a greater fraction of future investment spending in structures than in equipment and do so at longer horizons: the $\overline{R}^2$ statistics for investment in structures (Table 3) peak at 34 percent over an eight quarter horizon, whereas they peak at 22 percent for investment growth in equipment over a 2 quarter horizon.

4.2.2 Do risk premia proxies forecast relative to traditional predictive variables?

So far we have investigated the degree to which investment growth is forecastable by a set of variables shown elsewhere, at one time or another, to have had predictive power for excess stock returns. Yet there is a long list of alternative forecasting variables for investment that have been studied in the empirical literature on aggregate investment. We refer to these variables as a group as 'traditional' forecasting variables and call them our investment control variables. A remaining question is whether our proxies for equity risk premia contain any information about future investment that is not already contained in these traditional forecasting variables. These traditional variables are: lagged investment growth, Di_t, lagged profit growth, $Dprofit_t$, lagged growth in the market's valuation of capital relative to its replacement cost (average Q_t growth), Dq_t^A, and lagged GDP growth, $Dgdp_t$. Table 5 gives an idea of how well these traditional variables forecast total investment growth (structures plus equipment) in our sample.

Rows one through four of Table 5 shows that all these variables have forecasting power for investment growth in a univariate setting. Not surprisingly, lags of investment growth are strong predictive variables at horizons up to one year; a similar result occurs using the lagged value of $Dgdp_t$ as the predictive variable. There are several statistically significant coefficients on lagged Dq_t^A at horizons ranging from two quarters and beyond, but the R^2 statistics indicate that this variable explains very little of the variation in future investment.

Consistent with what has been reported elsewhere, profit growth has strong predictive power for investment growth, with t-statistics around four and an R^2 statistic that peaks at 16 percent at a two quarter horizon. $Dprofit_t$ is the only variable that appears to have forecasting power for investment at horizons beyond one year (row 2).

The last row of Table 5 reports the results of a multivariate regressions of long-horizon investment growth on Di_t, $Dprofit_t$, Dq_t^A and $Dgdp_t$. We call this our *benchmark investment regression*. The results suggest that these traditional investment forecasting variables have joint predictive power that is more concentrated at short horizons relative to the equity-premium proxies in Table 2. For example, the $\overline{R}^2$ statistic from a multivariate regression using Di_t, $Dprofit_t$, Dq_t^A and $Dgdp_t$ as predictive variables peaks at 0.37 at a two quarter horizon, but declines to 0.08 at a 12 quarter horizon. By contrast, the $\overline{R}^2$ statistic from a multivariate regression using $\widehat{cay}_t$, $RREL_t$, TRM_t, and DEF_t as predictive variables (Table 2) peaks at 0.29 eight quarters quarters out, but is still 0.26 at a 12 quarter horizon. Thus, risk premia proxies tell us something about the path of investment growth over longer horizons into the future than do the traditional forecasting variables for investment. The long-horizon nature of this forecasting ability is precisely what is predicted by the log-linear q framework with time-varying expected returns (see 15).

Do proxies for equity risk premia contain any information for future investment growth that is not already contained in the investment controls? To address this question, Table 6 assesses the marginal predictive power of each risk-premium proxy relative to four benchmark investment controls, Di_t, $Dprofit_t$, Dq_t^A and $Dgdp_t$. Rows one through four present the results of forecasting investment growth over various horizons, adding $\widehat{cay}_t$, $RREL_t$, TRM_t, and DEF_t, one at a time, to this set of four regressors. Row 5 reports the results of including all eight indicators, Di_t, $Dprofit_t$, Dq_t^A, $Dgdp_t$, $\widehat{cay}_t$, $RREL_t$, TRM_t, DEF_t as predictive variables for Di_{t+1+h}.

Row 1 of Table 6 shows that when the consumption-wealth ratio proxy, $\widehat{cay}_t$, is added to the benchmark investment regression, lagged investment growth, average Q_t growth and GDP growth all have marginal predictive power at some horizons less than one year, but very little beyond one year. By contrast, both profit growth and $\widehat{cay}_t$ have strong marginal predictive power for investment growth at horizons in excess of one year, but none before hand. Nevertheless, a comparison of $\overline{R}^2$ statistics in Tables 2 (row 3) and 5 (row 2) shows that $\widehat{cay}_t$ explains a larger fraction of the variation in future investment growth at long horizons than does $Dprofit_t$. The regression coefficients on $\widehat{cay}_t$ in Table 6 are uniformly positive beyond two quarters and statistically significant beyond four horizons, suggesting that $\widehat{cay}_t$ contains information for future investment growth not already captured by traditional predictive variables for investment. Furthermore, the incremental predictive impact of $\widehat{cay}_t$ on future investment growth is economically large: adding $\widehat{cay}_t$ to the benchmark predictive variables allows the regression to predict an additional 15 percent of the variation in investment growth 4 years ahead. This result reinforces the notion that proxies for equity risk premia are likely to have their strongest predictive power for investment growth over longer horizons.

Turning to the marginal predictive power of the other variables, there are no statistically significant coefficients on the relative bill rate, $RREL_t$ in row 2 of Table 6, indicating that it contains little information about future investment growth that is not already contained in the four benchmark control variables. On the other hand, both the term and default spreads are found to have marginal predictive power at one horizon or another, and the increment to the adjusted R^2 from adding TRM_t to the benchmark regression is sometimes in excess of 10 percent (compare Tables 5 and 6).

Finally, when all eight variables, Di_t, $Dprofit_t$, Dq_t^A, $Dgdp_t$, $\widehat{cay}_t$, $RREL_t$, TRM_t, DEF_t, are included as regressors for future investment growth, the regression explains a much larger fraction of the variation in future investment growth at long horizons than does the benchmark model using only investment controls, whereas it explains only a very modest additional fraction of the variation at short horizons. For example, using just the investment controls, the regression explains just 11 percent of investment growth over an eight quarter horizon, compared to 32 percent when the equity risk premia controls and the term spread are included. Only $\widehat{cay}_t$ and $Dprofit_t$ have marginal predictive power at very long horizons, while Di_t, Dq_t^A, TRM_t, and DEF_t have marginal predictive power at shorter horizons. But, more significantly, with the inclusion of the equity risk premium controls, the empirical specification now has forecasting power for investment growth at horizons both long and short, and that the total fraction of variation in long horizon returns that is predicted remains substantial even after three years.

Overall, these results suggest that a new model of investment predictability is warranted. The standard empirical model accounts for variation in lagged investment, output growth and profit growth, but ignores important variation in proxies for equity risk premia, which can pull the predictive power up on the long-end. $\widehat{cay}_t$ is a strong predictor of both excess stock returns and investment growth over long horizons. Thus, where excess stock returns are predicted to go, so goes expected investment growth. The term spread is also an important predictor of investment growth, but the interpretation of this result seems to have little to do with its role as a proxy for equity risk premia. $RREL_t$, in turn, has predictive power for investment growth relative to the other variables that have been shown elsewhere to forecast returns, but contains little information that is not already captured by the traditional investment controls. It follows that by far the strongest evidence that equity risk premia are related to future investment comes from the log consumption-aggregate wealth ratio proxy, a variable that has marginal predictive power for long-horizon investment growth controlling for both macroeconomic and financial variables.

We conclude this section by briefly comparing the long-horizon forecasting results in Table 6 with results from an alternative approach, which computes long-horizon statistics without actually measuring data over a long-horizon. We do this as a robustness check. This alternative approach uses vector autoregressions (VARs) to impute long-horizon statistics rather than estimating them directly; in particular, an implied long–horizon R^2 statistic may be computed giving the fraction of variation in the long-horizon investment growth that is explained by the regressors. The advantage of this approach is that it avoids small sample biases that may occur in single equation techniques that can be especially pronounced when the horizon is large relative to the sample size. Hodrick (1992) investigates the small sample properties of the VAR methodology and finds that it has correct size and supplies long-horizon statistics that are unbiased measurements. The methodology for measuring long-horizon statistics by estimating a VAR has been covered by Campbell (1991), Hodrick (1992), and Kandel and Stambaugh (1989), and we refer the reader to those articles for a description of the approach.

Table 7 gives the results from estimating two VARs. The first system is a four variable VAR that includes the benchmark investment controls Di_t, $Dprofit_t$, Dq_t^A, $Dgdp_t$; the second adds the consumption-wealth proxy $\widehat{cay}_t$ to this set of variables. For each horizon we consider, we calculate an implied R^2 using the coefficient estimates of the VAR and the estimated covariance matrix of the VAR residuals. The numbers reported in Table 7 for each specification are the implied R^2 statistics from regressions of long-horizon investment growth on the other variables in the system.

The pattern of the implied R^2 statistics is very similar to that from the single equation regressions presented in Tables 5 and 6, indicating that those results are robust to the vector autoregression approach. Comparing Rows 1 and 2 of Table 7 gives an idea of how much additional predictive power is added to to the benchmark regression by including the equity risk-premium variable,

$\widehat{cay}_t$. Including this variable in the forecasting regression improves the fit only marginally at short horizons, but improves it quite a lot at long horizons. For example, adding observations on $\widehat{cay}_t$ to the empirical specification allows the regression to predict an additional two percent of the variation in next quarter's investment growth, but an additional nine percent of the variation in investment growth over a 12 quarter horizon. Interestingly, the VAR coefficient estimates (not reported) indicate that the first lag of $\widehat{cay}_t$ in the investment growth equation is negative and now statistically significant, while lags two through four are all positive and significant. This finding is consistent with the investment lag story given above: an increase in stock prices driven by a decline in discount rates, drives down $\widehat{cay}_t$, and should be associated with an increase in investment immediately, but because of investment lags is instead associated with an increase investment after about one quarter; hence the negative coefficient on the first lag of $\widehat{cay}_t$. On the other hand, values of $\widehat{cay}_t$ lagged at least two quarters have a positive impact on investment growth, as would be expected from the long-horizon relation in (14) once short-run adjustment problems have been overcome.

5 Concluding Remarks

At least since the work of Tobin (1969), economists have understood that the stock market is likely to be linked to the real economy through investment. Tobin argued that optimal investment should be an increasing function of average Q–the ratio of the market valuation of capital to the replacement cost of capital. Since the market valuation of capital depends on the current stock price, the theory implies a positive contemporaneous covariance between stock prices and investment. Yet the literature's focus on how stock prices and investment should be theoretically related often ends there. This may be because many macroeconomists are accustomed to thinking in terms of constant discount rates, implying that stock returns are approximately i.i.d. If changes in stock returns today imply nothing about the future path of the stock market, they also imply nothing about the future path of investment.

In this paper, we focus on the covariance between stock returns and future investment. If discount rates are not constant, movements in the stock market today will not be independent of future movements. A large body of research in financial economics suggests that discount rates do fluctuate, and that their movements may be revealed by (for example) fluctuations in stock prices relative to dividends or earnings, asset values relative to their common trend with consumption and labor income, or short term real interest rates. Moreover, this research finds that it is the expected excess return component of discount rates, or the equity risk premium, that varies the most over time. Under these circumstances, the implication for investment of higher stock prices today does not end with its contemporaneous relation to investment. Instead, classic models of investment imply that higher stock prices, generated by a decline in discount rates, should be associated with an increase in investment growth today, but a *decrease* in investment growth in the future.

We present empirical results that are consistent with this hypothesis: the log consumption-wealth ratio, a predictor of excess stock market returns, also predicts long-horizon investment growth, both relative to traditional investment forecasting variables, and relative to other variables shown elsewhere to predict excess stock returns. Further, the sign of this predictive relationship is consistent with the simple Q model outlined in this paper, when investment lags of about one to two quarters are present.

In previous work, we have found that large swings in financial assets need not be associated with large subsequent movements in aggregate consumption (Ludvigson and Steindel (1999); Lettau and Ludvigson (2001a); Lettau and Ludvigson (2001b)). The results in this paper offer strikingly different conclusions for aggregate investment spending, suggesting an important connection between transitory fluctuations in asset prices and the real economy. A decline in the equity risk premium is likely to increase investment within a few quarters time, via the usual cost-of-capital effects. But because such movements also forecast a decline in future stock returns, the analysis presented here suggests that these favorable cost of capital effects will eventually deteriorate, foretelling a reduction in future long-horizon investment growth. An implication of this finding is that fluctuations in market risk premia can create temporary investment opportunities as stock returns rise and fall predictably over long horizons.

Among the most salient aspects of the U.S. economy in the last half of the 1990s was the extraordinary growth in stock prices, coupled with strong growth in investment spending. The stock market surge also led asset wealth to soar away from its long-term trend with consumption and labor income, causing $\widehat{cay}_t$ to fall well below its sample mean, suggesting a sharp decline in discount rates and a bearish stock market in the year 2000 and beyond. As of this writing, returns on broad stock market indexes have fallen roughly 26 percent since their highs a little over a year ago, as anticipated by the low values reached by $\widehat{cay}_t$ in the last part of the 1990s. The analysis conducted here suggests that these low values were not merely bearish for the future of stocks, but also for the future of investment growth. Only time will tell whether such foreboding movements in $\widehat{cay}_t$ for the stock market have also foretold a future with significantly slower aggregate investment spending.

Appendix A: Data Description

This Appendix describes the data used in our study.

AFTER-TAX LABOR INCOME

Labor income is defined as wages and salaries + transfer payments + other labor income - personal contributions for social insurance - taxes. Taxes are defined as [wages and salaries/(wages and salaries + proprietors' income with IVA and Ccadj + rental income + personal dividends + personal interest income)] times personal tax and nontax payments, where IVA is inventory valuation and Ccadj is capital consumption adjustments. The quarterly data are in current dollars. We obtain a real, per capita measure by dividing this current dollar value by the deflator and the population measure listed in this appendix. Our source is the Bureau of Economic Analysis.

CONSUMPTION

Consumption is measured expenditures on nondurables and services, excluding shoes and clothing. The quarterly data are per capita, seasonally adjusted at annual rates, in billions of chain- weighted 1996 dollars. The components are chain-weighted together, and this series is scaled up so that the sample mean matches the sample mean of total personal consumption expenditures. Our source is the U.S. Department of Commerce, Bureau of Economic Analysis.

DEFAULT SPREAD

The default spread is the difference between the BAA corporate bond rate and the AAA corporate bond rate. Our source is the Moody's Corporate Bond Indices.

GROSS DOMESTIC PRODUCT

Gross Domestic Product is seasonally adjusted and measured in chain-weighted 1996 dollars. Our source is the Bureau of Economic Analysis.

INVESTMENT

Investment is fixed private non-residential investment, seasonally adjusted in chain-weighted 1996 dollars. Our source is the Bureau of Economic Analysis.

INVESTMENT- EQUIPMENT AND SOFTWARE

Investment in equipment and software is fixed private non-residential investment in equipment and software, seasonally adjusted in chain-weighted 1996 dollars. Our source is the Bureau of Economic Analysis.

INVESTMENT - STRUCTURES

Investment in structures is fixed private non-residential investment in structures, seasonally adjusted in chain-weighted 1996 dollars. Our source is the Bureau of Economic Analysis.

PRICE DEFLATOR

The nominal after-tax labor income and wealth data are deflated by the personal consumption expenditure chain-type deflator (1996=100), seasonally adjusted. Our source is the Bureau of Economic Analysis.

POPULATION

A measure of population is created by dividing real total disposable income by real per capita disposable income. Our source is the Bureau of Economic

Analysis.

PROFITS

Profits are after-tax corporate profits with inventory valuation and capital consumption adjustments, seasonally adjusted in current dollars. Our source is the Bureau of Economic Analysis.

AVERAGE Q: q^A

Average Q is computed from the tax-adjusted formula in Bernanke et al. (1988) as follows:

$$q_t^A = \left(\frac{1}{1-\tau_t}\right)\left[\frac{(V_t - B_t) + D_t}{A_t} + ITC_t + \tau_t z_t - 1\right]$$

V_t is the market value of equity in nonfarm, nonfinancial corporate business; D_t is the value of total liabilities in nonfarm, nonfinancial corporate business; A_t is the value, in current dollars, of the stock of equipment, nonresidential structures, and inventories for nonfarm, nonfinancial corporate businesses; the source for these series was the Federal Reserve Board's Flow of Funds accounts. τ_t is the maximum corporate tax rate in effect during quarter t, and is taken from the Federal Reserve Board's Quarterly Econometric Model (see Brayton and Mauskopf (1985) for the construction of variables in the Quarterly Model). z_t is a weighted average of the present value of \$1 of depreciation allowances for equipment and for non-residential structures, with the weights equal to the shares of equipment and nonresidential structures in total current-dollar business fixed investment. Depreciation allowances were calculated by discounting the stream of future tax depreciation allowances using the discount rate $(1-\tau)\, RB_t$, where RB_t is the interest rate on ten-year treasury bonds, from the Federal Reserve. ITC_t is the average rate of investment tax credit for equipment, taken from the Federal Reserve Board's Quarterly Econometric Model, multiplied by the share of equipment in total current-dollar business fixed investment. Finally, B_t measures the present value of the depreciation allowances still to be taken on the existing capital stock:

$$B_t = KTAX_t \tau_t \left(\int_0^\infty \delta_t^T \cdot e^{-\left[\delta_t^T + RB_t(1-\tau)s\right]} ds \right) = KTAX_t \tau_t \left\{ \delta_t^T / \left[\delta_t^T + RB_t \left(1 - \right.\right.\right.$$

$KTAX_t$ measures the current-dollar stock of equipment and nonresidential structures in nonfarm, nonfinancial corporate business yet to be depreciated for tax purposes, and was generated through the perpetual inventory method. Because no initial value of $KTAX_t$ is observed, it is simply set in 1929 equal to the Bureau of Economic Analysis' (BEA) current dollar net stock of equipment and nonresidential structures in nonfarm, nonfinancial corporate business (by starting the calculation well before the beginning of our sample period, we reduce the effect of errors in the initial value of $KTAX_t$). $KTAX_t$ is then calculated through 2000:3 based on the relation $KTAX_t = KTAX_{t-1} - CCA_t + IN_t$, where CCA_t is capital consumption allowances on existing equipment and nonresidential structures from the NIPAs (excluding the adjustment from tax depreciation to economic depreciation) and IN_t is current-dollar investment these assets, also from the NIPAs. Given the estimated series for $KTAX_t$, we then compute the rate of tax depreciation, δ_t^T, as $CCA_t/KTAX_t$.

RELATIVE BILL RATE

The relative bill rate is the 3-month treasury bill yield less its four-quarter moving average. Our source is the Federal Reserve Board.

RETURNS

Returns are the return on the Standard and Poor Index of 500 stocks.. Quarterly data are converted from monthly data. Our source is Standard and Poor.

S&P 500 DIVIDEND-PRICE RATIO

The S&P 500 dividend-price ratio is the dividend yield for the S&P Composite 500 Index, with four-quarter trailing dividends. Our source is Standard and Poor.

TERM SPREAD

The term spread is the difference between the 10-year treasury bond yield and the 3-month treasury bill yield. Our source is the Board of Governors of the Federal Reserve System.

WEALTH

Total wealth is household net wealth in billions of current dollars, measured at the end of the period. We lag this series one period to produce a measure of beginning of period wealth. Stock market wealth includes direct household holdings, mutual fund holdings, holdings of private and public pension plans, personal trusts, and insurance companies. Nonstock wealth is the residual of total wealth minus stock market wealth. Our source is the Board of Governors of the Federal Reserve System. We obtain a real, per capita measure by dividing this current dollar value by the deflator and the population measure listed in this appendix.

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Table 1: Forecasting Stock Returns

row	Regressors	Forecast Horizon H					
		1	2	4	8	12	16
1	$d_t - p_t$	0.58	1.55	3.11	3.72	3.27	3.25
		(0.88)	(1.43)	(1.32)	(0.82)	(0.60)	(0.55)
		{0.93}	{1.26}	{1.33}	{0.87}	{0.54}	{0.43}
		[0.00]	[0.01]	[0.03]	[0.02]	[0.01]	[0.01]
2	$\widehat{cay}_t$	1.77	3.34	5.95	9.65	11.10	11.02
		(3.26)	(4.29)	(3.23)	(4.50)	(3.85)	(3.52)
		{3.08}	{2.98}	{2.85}	{2.67}	{2.49}	{2.33}
		[0.07]	[0.10]	[0.17]	[0.24]	[0.26]	[0.22]
3	$RREL_t$	-0.02	-0.04	-0.07	-0.04	-0.03	-0.04
		(-3.90)	(-3.35)	(-2.92)	(-1.68)	(-1.21)	(-1.00)
		{-2.95}	{-2.83}	{-3.09}	{-1.15}	{-0.71}	{-0.77}
		[0.05]	[0.06]	[0.11]	[0.02]	[0.01]	[0.01]
4	TRM_t	0.01	0.02	0.03	0.02	0.04	0.06
		(2.35)	(2.02)	(1.99)	(1.47)	(1.89)	(2.52)
		{2.24}	{1.92}	{1.63}	{0.66}	{0.84}	{1.18}
		[0.03]	[0.04]	[0.06]	[0.01]	[0.03]	[0.08]
5	DEF_t	0.01	0.02	0.00	-0.06	-0.06	-0.05
		(0.90)	(0.65)	(0.11)	(-1.10)	(-0.94)	(-0.54)
		{0.89}	{0.58}	{0.07}	{-0.58}	{-0.46}	{-0.28}
		[0.00]	[0.00]	[0.01]	[0.01]	[0.01]	[0.00]
6	$d_t - p_t$	-0.05	0.94	3.50	5.36	5.20	5.82
		(-0.07)	(0.74)	(1.82)	(1.33)	(1.05)	(0.96)
		{-0.08}	{0.75}	{1.47}	{1.23}	{0.85}	{0.73}
	$\widehat{cay}_t$	1.61	2.83	4.77	9.05	10.15	8.83
		(2.80)	(3.07)	(3.37)	(3.85)	(3.03)	(2.48)
		{2.69}	{2.59}	{2.56}	{2.61}	{2.18}	{1.68}
	$RREL_t$	-0.02	-0.04	-0.07	-0.05	-0.02	0.01
		(-3.11)	(-2.66)	(-3.49)	(-1.73)	(-0.50)	(0.26)
		{-2.30}	{-2.19}	{-3.04}	{-1.38}	{-0.36}	{0.22}
	TRM_t	0.00	0.00	0.00	-0.01	0.01	0.05
		(-0.15)	(-0.02)	(-0.05)	(-0.33)	(0.59)	(1.65)
		{-0.12}	{-0.01}	{-0.03}	{-0.23}	{0.30}	{0.94}
	DEF_t	0.00	-0.02	-0.09	-0.16	-0.15	-0.14
		(-0.19)	(-0.93)	(-2.66)	(-3.33)	(-2.37)	(-1.70)
		{-0.18}	{-0.76}	{-1.60}	{-1.58}	{-1.19}	{-0.93}
		[0.08]	[0.14]	[0.27]	[0.31]	[0.30]	[0.27]

Notes: The table reports results from long-horizon regressions of excess returns on lagged variables. H denotes the return horizon in quarters. The dependent variable is the sum of H log excess returns on the S&P composite index, $r_{t+1} - r_{f,t+1} + ... + r_{t+H} - r_{f,t+H}$. The regressors are one-period lagged values of the deviations from trend $\widehat{cay}_t$, the log dividend yield $d_t - p_t$, the detrended short-term interest rate $RREL_t$, the term-spread TRM, the default spread DEF, and combinations thereof. For each regression, the first number associated with each regressor is the OLS estimate of the coefficients for that regressor; the second number, in parentheses, is the Newey-West corrected t-statistic; the third number, in curly brackets, is the Hodrick (1992)-corrected t-statistic; and the fourth number, in square brackets is the adjusted R^2 statistic for the regression. The sample period is fourth quarter of 1952 to third quarter 1999.

Table 2: Forecasting Investment Growth

row	Regressors	Forecast Horizon H					
		1	2	4	8	12	16
1	$d_t - p_t$	-0.77	-1.50	-2.40	-2.69	-3.35	-4.74
		(-3.21)	(-3.36)	(-3.16)	(-1.85)	(-1.63)	(-2.00)
		{-4.57}	{-4.67}	{-4.10}	{-2.48}	{-2.24}	{-2.35}
		[0.10]	[0.13]	[0.11]	[0.05]	[0.06]	[0.09]
2	$d_t - p_t$	-0.78	-1.45	-1.91	-0.84	-0.71	-1.96
	to Q4 94	(-2.38)	(-2.41)	(-1.95)	(-0.55)	(-0.36)	(-0.90)
		{-3.42}	{-3.34}	{-2.46}	{-0.58}	{-0.35}	{-0.72}
		[0.07]	[0.08]	[0.05]	[0.00]	[0.00]	[0.01]
3	$\widehat{cay}_t$	-0.19	-0.05	0.89	3.54	4.83	4.86
		(-1.14)	(-0.17)	(1.35)	(3.20)	(4.34)	(3.46)
		{-1.44}	{-0.24}	{2.15}	{4.11}	{4.33}	{3.86}
		[0.00]	[-0.01]	[0.02]	[0.13]	[0.18]	[0.16]
5	$RREL_t$	0.01	0.01	0.00	-0.03	-0.04	-0.03
		(2.40)	(2.08)	(0.40)	(-3.12)	(-2.87)	(-1.61)
		{3.26}	{2.56}	{0.42}	{-2.99}	{-3.23}	{-2.15}
		[0.06]	[0.04]	[0.00]	[0.06]	[0.07]	[0.02]
5	TRM_t	0.00	0.01	0.02	0.04	0.04	0.03
		(1.83)	(2.34)	(3.28)	(3.78)	(3.25)	(1.99)
		{2.12}	{2.82}	{4.01}	{4.32}	{3.21}	{2.31}
		[0.01]	[0.04]	[0.12]	[0.23]	[0.15]	[0.09]
6	DEF_t	-0.02	-0.03	-0.03	-0.02	-0.01	-0.02
		(-3.59)	(-2.72)	(-1.64)	(-0.51)	(-0.18)	(-0.33)
		{-4.67}	{-3.69}	{-2.10}	{-0.61}	{-0.19}	{-0.29}
		[0.09]	[0.07]	[0.03]	[0.00]	[0.00]	[0.00]
7	$\widehat{cay}_t$	-0.33	-0.38	0.15	2.25	3.78	4.14
		(-2.56)	(-1.45)	(0.27)	(2.36)	(3.56)	(3.00)
		{-2.65}	{-1.73}	{0.37}	{3.10}	{4.07}	{3.98}
	$RREL_t$	0.01	0.02	0.02	0.00	-0.02	-0.01
		(4.08)	(3.94)	(2.63)	(-0.40)	(-0.92)	(-0.32)
		{5.17}	{4.89}	{3.61}	{-0.51}	{-1.33}	{-0.44}
	TRM_t	0.01	0.02	0.03	0.04	0.02	0.02
		(3.92)	(4.09)	(3.92)	(3.31)	(1.76)	(1.11)
		{5.54}	{5.56}	{5.23}	{3.91}	{2.16}	{1.54}
	DEF_t	-0.01	-0.02	-0.03	-0.04	-0.04	-0.04
		(-2.73)	(-2.18)	(-1.71)	(-1.32)	(-0.84)	(-0.76)
		{-3.57}	{-2.85}	{-2.28}	{-1.57}	{-0.92}	{-0.76}
		[0.26]	[0.25]	[0.22]	[0.29]	[0.26]	[0.19]

Notes: See Table 1. The table reports results from long-horizon regressions of investment growth on lagged variables. The dependent variable is the H-period growth of fixed, private non-residential investment, $i_{t+h} - i_t$.

Table 3: Forecasting Investment Growth (Structures)

row	Regressors	Forecast Horizon H					
		1	2	4	8	12	16
1	$d_t - p_t$	-1.02	-1.96	-3.03	-3.67	-4.93	-6.54
		(-4.02)	(-4.28)	(-3.88)	(-2.18)	(-2.01)	(-2.29)
		{-5.24}	{-5.28}	{-4.42}	{-2.89}	{-2.88}	{-2.84}
		[0.12]	[0.15]	[0.13]	[0.08]	[0.1]	[0.14]
2	$d_t - p_t$	-1.10	-2.00	-2.62	-1.86	-2.34	-3.64
	to Q4 94	(-3.24)	(-3.28)	(-2.58)	(-0.98)	(-0.93)	(-1.31)
		{-4.24}	{-4.03}	{-2.85}	{-1.08}	{-1.01}	{-1.17}
		[0.09]	[0.11]	[0.07]	[0.01]	[0.02]	[0.05]
3	$\widehat{cay}_t$	-0.22	-0.04	1.00	3.68	4.84	4.67
		(-1.16)	(-0.11)	(1.28)	(2.93)	(3.75)	(2.62)
		{-1.43}	{-0.16}	{1.99}	{3.61}	{3.69}	{3.22}
		[0.00]	[-0.01]	[0.01]	[0.11]	[0.14]	[0.11]
4	$RREL_t$	0.01	0.01	-0.01	-0.06	-0.06	-0.04
		(1.74)	(0.89)	(-2.50)	(-5.16)	(-3.47)	(-2.33)
		{2.19}	{0.92}	{-1.59}	{-4.01}	{-3.94}	{-3.13}
		[0.02]	[0.00]	[0.01]	[0.14]	[0.12]	[0.05]
5	TRM_t	0.01	0.01	0.03	0.05	0.05	0.04
		(3.02)	(3.88)	(4.83)	(5.05)	(3.92)	(2.38)
		{3.15}	{4.10}	{5.14}	{4.98}	{3.63}	{2.54}
		[0.04]	[0.09]	[0.21]	[0.31]	[0.18]	[0.09]
6	DEF_t	-0.02	-0.02	-0.02	0.00	0.02	0.02
		(-3.01)	(-1.98)	(-0.87)	(0.11)	(0.47)	(0.39)
		{-3.67}	{-2.48}	{-1.04}	{0.13}	{0.44}	{0.32}
		[0.05]	[0.03]	[0.01]	[-0.01]	[0.00]	[0.00]
7	$\widehat{cay}_t$	-0.46	-0.57	-0.14	1.90	3.40	3.64
		(-2.86)	(-1.80)	(-0.20)	(1.80)	(2.56)	(1.95)
		{-2.96}	{-2.09}	{-0.27}	{2.19}	{3.14}	{3.11}
	$RREL_t$	0.01	0.02	0.01	-0.02	-0.03	-0.02
		(3.83)	(3.18)	(1.47)	(-1.50)	(-1.47)	(-0.85)
		{4.44}	{3.59}	{1.91}	{-1.82}	{-2.20}	{-1.21}
	TRM_t	0.01	0.02	0.04	0.04	0.03	0.02
		(5.01)	(5.07)	(4.80)	(4.06)	(1.87)	(1.11)
		{6.04}	{6.02}	{5.64}	{4.09}	{2.19}	{1.29}
	DEF_t	-0.01	-0.02	-0.03	-0.03	-0.01	-0.01
		(-2.25)	(-1.75)	(-1.39)	(-0.81)	(-0.26)	(-0.13)
		{-2.75}	{-2.15}	{-1.60}	{-0.86}	{-0.25}	{-0.12}
		[0.21]	[0.21]	[0.24]	[0.34]	[0.25]	[0.15]

Notes: See Table 1. The table reports results from long-horizon regressions of investment growth on lagged variables. The dependent variable is the H-period growth of fixed, private non-residential investment in structures, $i^s_{t+h} - i^s_t$.

Table 4: Forecasting Investment Growth (Equipment)

row	Regressors	Forecast Horizon H					
		1	2	4	8	12	16
1	$d_t - p_t$	-0.19	-0.40	-0.71	-0.02	0.52	-0.35
		(-0.65)	(-0.67)	(-0.64)	(-0.01)	(0.23)	(-0.13)
		{-0.92}	{-0.99}	{-0.92}	{-0.02}	{0.25}	{-0.12}
		[0.00]	[0.00]	[0.00]	[-0.01]	[0.00]	[-0.01]
2	$d_t - p_t$	-0.15	-0.35	-0.41	1.35	2.44	1.26
	to Q4 94	(-0.39)	(-0.45)	(-0.29)	(0.65)	(1.01)	(0.44)
		{-0.55}	{-0.65}	{-0.40}	{0.71}	{0.90}	{0.34}
		[0.00]	[0.00]	[0.00]	[0.00]	[0.02]	[0.00]
3	$\widehat{cay}_t$	-0.10	-0.01	0.75	2.95	4.09	4.30
		(-0.57)	(-0.04)	(1.20)	(2.52)	(3.07)	(3.05)
		{-0.68}	{-0.04}	{1.54}	{3.23}	{3.45}	{3.18}
		[0.00]	[-0.01]	[0.01]	[0.08]	[0.12]	[0.10]
4	$RREL_t$	0.01	0.02	0.03	0.01	0.00	0.01
		(3.34)	(3.84)	(3.35)	(0.74)	(-0.09)	(0.48)
		{4.59}	{4.94}	{3.70}	{0.69}	{-0.11}	{0.51}
		[0.10]	[0.16]	[0.10]	[0.00]	[-0.01]	[0.00]
5	TRM_t	0.00	0.00	0.00	0.02	0.02	0.01
		(-0.83)	(-0.66)	(0.15)	(1.19)	(1.18)	(0.74)
		{-1.01}	{-0.82}	{0.17}	{1.31}	{1.04}	{0.70}
		[0.00]	[0.00]	[-0.01]	[0.03]	[0.02]	[0.01]
6	DEF_t	-0.02	-0.03	-0.05	-0.05	-0.06	-0.08
		(-3.05)	(-2.64)	(-2.20)	(-1.76)	(-1.44)	(-1.55)
		{-3.84}	{-3.34}	{-2.43}	{-1.45}	{-1.12}	{-1.09}
		[0.08]	[0.09]	[0.07]	[0.04]	[0.04]	[0.05]
7	$\widehat{cay}_t$	-0.06	0.05	0.77	2.70	3.94	4.39
		(-0.41)	(0.18)	(1.42)	(2.39)	(3.16)	(3.52)
		{-0.43}	{0.18}	{1.65}	{3.14}	{3.44}	{3.39}
	$RREL_t$	0.01	0.03	0.04	0.02	0.01	0.01
		(3.35)	(3.90)	(3.66)	(1.38)	(0.33)	(0.60)
		{4.28}	{4.74}	{3.98}	{1.67}	{0.44}	{0.81}
	TRM_t	0.00	0.01	0.01	0.02	0.01	0.01
		(1.30)	(1.54)	(1.64)	(1.32)	(0.73)	(0.50)
		{1.83}	{1.98}	{1.96}	{1.41}	{0.69}	{0.57}
	DEF_t	-0.01	-0.02	-0.04	-0.06	-0.07	-0.08
		(-2.69)	(-2.20)	(-1.85)	(-1.93)	(-1.77)	(-1.73)
		{-2.92}	{-2.26}	{-1.79}	{-1.56}	{-1.32}	{-1.22}
		[0.15]	[0.22]	[0.19]	[0.15]	[0.16]	[0.17]

Notes: See Table 1. The table reports results from long-horizon regressions of investment growth on lagged variables. The dependent variable is the H-period growth of fixed, private non-residential investment in equipment and software, $i^e_{t+h} - i^e_t$.

Table 5: Forecasting Investment Growth

row	Regressors	Forecast Horizon H					
		1	2	4	8	12	16
1	Di_t	0.49	0.82	1.00	0.42	0.02	-0.05
		(7.78)	(7.22)	(5.17)	(1.24)	(0.05)	(-0.11)
		{8.16}	{8.44}	{5.76}	{1.65}	{0.08}	{-0.16}
		[0.24]	[0.22]	[0.11]	[0.00]	[-0.01]	[-0.01]
2	$Dprofit_t$	2.02	3.85	6.27	7.44	7.54	5.50
		(4.67)	(4.97)	(5.47)	(4.51)	(4.19)	(2.35)
		{5.24}	{6.15}	{7.41}	{6.44}	{6.14}	{4.34}
		[0.13]	[0.16]	[0.15]	[0.09]	[0.07]	[0.03]
3	Dq_t^A	0.01	0.04	0.08	0.10	0.08	0.07
		(0.79)	(3.15)	(3.27)	(2.81)	(4.45)	(3.71)
		{0.37}	{1.83}	{3.19}	{3.10}	{2.85}	{2.40}
		[0.00]	[0.03]	[0.05]	[0.03]	[0.01]	[0.01]
4	$Dgdp_t$	1.33	2.33	3.44	2.34	1.37	0.75
		(7.33)	(6.66)	(6.72)	(3.45)	(1.59)	(0.86)
		{8.71}	{9.34}	{8.77}	{4.65}	{2.27}	{1.09}
		[0.29]	[0.30]	[0.23]	[0.04]	[0.01]	[0.00]
5	Di_t	0.35	0.64	0.68	0.10	-0.13	-0.08
		(4.43)	(5.30)	(2.66)	(0.21)	(-0.22)	(-0.12)
		{4.43}	{5.33}	{3.56}	{0.33}	{-0.39}	{-0.19}
	$Dprofit_t$	0.26	0.55	1.46	6.52	9.91	9.54
		(0.65)	(0.80)	(1.18)	(3.06)	(3.88)	(3.15)
		{0.65}	{0.85}	{1.66}	{4.70}	{5.47}	{4.53}
	Dq_t^A	0.01	0.05	0.09	0.08	0.05	0.03
		(1.24)	(4.06)	(4.53)	(2.81)	(2.06)	(1.36)
		{1.24}	{3.43}	{5.31}	{3.92}	{2.52}	{1.54}
	$Dgdp_t$	0.59	1.11	2.27	1.13	-0.65	-1.66
		(2.68)	(2.42)	(2.57)	(0.96)	(-0.44)	(-0.99)
		{2.68}	{3.33}	{4.42}	{1.51}	{-0.67}	{-1.37}
		[0.28]	[0.37]	[0.32]	[0.11]	[0.08]	[0.04]

Notes: See Table 1. The table reports results from long-horizon regressions of investment growth on lagged variables. The dependent variable is the H-period growth of fixed, private non-residential investment, $i_{t+h} - i_t$. The regressors are one-period lagged investment growth, Di_t one-period lagged profit growth, $Dprofit_t$, the one-period lagged value of average Q, Dq_t^A, and the one-period lagged value of GDP, $Dgdp_t$. Regressions that include average q start in the second quarter of 1960.

Table 6: Investment Growth Regressions

row	Regressors	Forecast Horizon H					
		1	2	4	8	12	16
1	Di_t	0.34	0.64	0.68	0.06	-0.21	-0.13
		(4.62)	(5.31)	(2.63)	(0.14)	(-0.48)	(-0.23)
		{4.44}	{5.30}	{3.55}	{0.20}	{-0.59}	{-0.30}
	$Dprofit_t$	0.29	0.56	1.12	5.45	8.18	7.72
		(0.71)	(0.77)	(0.86)	(2.56)	(3.16)	(2.65)
		{0.70}	{0.84}	{1.26}	{3.83}	{4.77}	{3.93}
	Dq_t^A	0.01	0.05	0.08	0.04	-0.01	-0.03
		(1.55)	(4.20)	(4.50)	(1.71)	(-0.31)	(-0.92)
		{1.29}	{3.35}	{4.80}	{2.27}	{-0.37}	{-0.99}
	$Dgdp$	0.58	1.11	2.45	1.85	0.55	-0.39
		(2.41)	(2.34)	(2.59)	(1.50)	(0.40)	(-0.27)
		{2.58}	{3.37}	{4.77}	{2.44}	{0.57}	{-0.34}
	$\widehat{cay}_t$	-0.07	-0.03	0.62	2.71	4.40	4.78
		(-0.58)	(-0.13)	(1.06)	(2.23)	(3.70)	(3.21)
		{-0.54}	{-0.14}	{1.72}	{3.93}	{4.80}	{4.09}
		[0.28]	[0.37]	[0.32]	[0.18]	[0.22]	[0.19]
2	Di_t	0.32	0.61	0.79	0.69	0.51	0.29
		(4.06)	(4.76)	(2.97)	(1.39)	(0.97)	(0.46)
		{3.82}	{4.76}	{4.40}	{2.39}	{1.61}	{0.71}
	$Dprofit_t$	0.31	0.60	1.30	5.43	8.77	8.94
		(0.75)	(0.89)	(1.04)	(2.51)	(3.25)	(2.75)
		{0.77}	{0.97}	{1.51}	{4.13}	{5.05}	{4.42}
	Dq_t^A	0.01	0.05	0.08	0.06	0.03	0.02
		(1.68)	(4.11)	(4.70)	(2.93)	(0.91)	(0.86)
		{1.38}	{3.56}	{5.17}	{3.10}	{1.56}	{1.09}
	$Dgdp$	0.58	1.10	2.31	1.36	-0.43	-1.56
		(2.54)	(2.47)	(2.50)	(0.99)	(-0.29)	(-0.89)
		{2.71}	{3.34}	{4.48}	{1.81}	{-0.44}	{-1.28}
	$RREL_t$	0.00	0.00	-0.01	-0.04	-0.04	-0.02
		(0.76)	(0.46)	(-1.22)	(-3.02)	(-2.67)	(-1.27)
		{0.91}	{0.53}	{-1.24}	{-3.83}	{-3.48}	{-1.93}
		[0.28]	[0.37]	[0.32]	[0.18]	[0.14]	[0.05]
3	Di_t	0.35	0.66	0.73	0.22	-0.03	0.00
		(4.62)	(5.32)	(2.76)	(0.43)	(-0.05)	(-0.01)
		{4.45}	{5.38}	{3.84}	{0.70}	{-0.09}	{-0.01}
	$Dprofit_t$	0.14	0.25	0.33	3.84	7.40	7.50
		(0.33)	(0.31)	(0.23)	(1.55)	(2.56)	(2.39)
		{0.37}	{0.39}	{0.41}	{2.98}	{4.73}	{4.30}
	Dq_t^A	0.01	0.04	0.08	0.05	0.03	0.02
		(1.41)	(4.27)	(4.82)	(2.48)	(0.91)	(0.53)
		{1.15}	{3.31}	{4.86}	{2.73}	{1.25}	{0.66}
	$Dgdp$	0.58	1.09	2.18	0.88	-0.88	-1.82
		(2.48)	(2.36)	(2.48)	(0.79)	(-0.62)	(-1.11)
		{2.59}	{3.24}	{4.29}	{1.18}	{-0.90}	{-1.49}
	TRM_t	0.00	0.00	0.01	0.03	0.03	0.02
		(1.23)	(1.52)	(2.51)	(2.77)	(2.22)	(1.42)
		{1.14}	{1.48}	{2.85}	{3.85}	{2.84}	{2.05}
		[0.28]	[0.38]	[0.37]	[0.25]	[0.17]	[0.09]

Table 6, continued

row	Regressors	Forecast Horizon H					
		1	2	4	8	12	16
4	Di_t	0.25	0.50	0.47	-0.28	-0.63	-0.78
		(3.09)	(3.89)	(1.90)	(-0.61)	(-1.17)	(-1.17)
		{3.27}	{4.26}	{2.47}	{-0.84}	{-1.57}	{-1.52}
	$Dprofit_t$	0.39	0.74	1.75	7.04	10.61	10.61
		(0.98)	(1.11)	(1.46)	(3.31)	(3.96)	(3.66)
		{0.97}	{1.18}	{2.01}	{5.18}	{6.14}	{5.32}
	Dq_t^A	0.01	0.05	0.09	0.09	0.06	0.05
		(1.63)	(4.01)	(4.46)	(3.08)	(2.15)	(1.84)
		{1.43}	{3.77}	{5.92}	{4.43}	{2.90}	{1.98}
	$Dgdp$	0.57	1.08	2.22	1.02	-0.80	-1.92
		(2.31)	(2.41)	(2.62)	(0.84)	(-0.52)	(-1.16)
		{2.62}	{3.44}	{4.68}	{1.47}	{-0.91}	{-1.73}
	DEF_t	-0.01	-0.02	-0.02	-0.04	-0.06	-0.09
		(-2.66)	(-1.95)	(-1.26)	(-1.19)	(-1.29)	(-1.76)
		{-3.00}	{-2.43}	{-1.83}	{-1.75}	{-1.56}	{-1.76}
		[0.32]	[0.39]	[0.33]	[0.14]	[0.11]	[0.11]
5	Di_t	0.17	0.37	0.37	-0.10	-0.26	-0.61
		(2.20)	(3.32)	(1.55)	(-0.26)	(-0.60)	(-1.06)
		{2.34}	{3.59}	{2.20}	{-0.31}	{-0.67}	{-1.22}
	$Dprofit_t$	0.24	0.38	0.46	4.04	7.39	7.70
		(0.57)	(0.50)	(0.33)	(1.77)	(2.75)	(2.68)
		{0.59}	{0.61}	{0.59}	{3.21}	{4.83}	{4.60}
	Dq_t^A	0.01	0.05	0.08	0.04	-0.01	-0.02
		(2.27)	(5.25)	(4.69)	(1.71)	(-0.51)	(-0.81)
		{1.91}	{4.55}	{6.14}	{2.39}	{-0.69}	{-0.82}
	$Dgdp$	0.44	0.87	2.05	1.34	0.25	-0.84
		(1.82)	(1.98)	(2.37)	(1.12)	(0.19)	(-0.58)
		{2.03}	{2.91}	{4.60}	{2.00}	{0.28}	{-0.77}
	$\widehat{cay}_t$	-0.22	-0.33	0.03	1.70	3.72	4.19
		(-2.04)	(-1.53)	(0.06)	(1.57)	(3.40)	(2.90)
		{-1.75}	{-1.47}	{0.08}	{2.48}	{4.12}	{3.76}
	$RREL_t$	0.01	0.01	0.01	-0.02	-0.03	-0.01
		(2.37)	(2.13)	(0.88)	(-1.00)	(-1.59)	(-0.64)
		{2.54}	{2.35}	{1.33}	{-1.62}	{-2.48}	{-1.07}
	TRM_t	0.01	0.01	0.02	0.02	0.01	0.01
		(2.89)	(3.04)	(2.64)	(2.13)	(0.88)	(0.60)
		{3.14}	{3.14}	{3.07}	{2.57}	{1.05}	{0.91}
	DEF_t	-0.01	-0.02	-0.03	-0.06	-0.07	-0.09
		(-2.76)	(-2.33)	(-1.84)	(-1.94)	(-1.62)	(-1.87)
		{-3.15}	{-2.55}	{-2.22}	{-2.30}	{-1.83}	{-1.92}
		[0.34]	[0.43]	[0.40]	[0.32]	[0.31]	[0.27]

Notes: See Tables 1 and 2.

Table 7: VAR Investment Growth Regressions

row	Variables	Implied R^2 for Forecast Horizon H					
		1	2	4	8	12	16
1	$Di_t, Dq_t^A, Dprofit_t, Dgdp_t$	0.43	0.42	0.30	0.11	0.06	0.05
2	$Di_t, Dq_t^A, Dprofit_t, Dgdp_t, \widehat{cay}_t$	0.45	0.45	0.35	0.20	0.15	0.12

Note: The table reports implied R^2 statistics for H-period investment growth from vector autoregressions (VARs) with 4 lags. The column denoted "Variables" lists the variables included in the VAR. The implied R^2 statistics for investment growth for horizon H are calculated from the estimated parameters of the VAR and the estimated covariance matrix of VAR residuals. The sample period is second quarter of 1960 to third quarter 1999.