What Moves Investment?*

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Abstract

We study the determinants of aggregate corporate investment in the U.S. We use accounting identities to develop a system in which (i) news about future cash flows and news about future discount rates are directly estimated, thus avoiding measurement problems with Tobin's q, the variable that is typically used in investment regressions; and (ii) current cash flow shocks and news about the future are jointly estimated and recognizing their interdependence. We find that the lion's share of investment variation is driven by current cash flow shocks instead of news about the future. This happens because neither cash holdings nor net payout (including external financing) vary enough to break the link between earnings shocks and investment. We further show that current earnings shocks do not contain information about future news. It is thus difficult to rationalize the bulk of aggregate investment with standard models.

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Aggregate business investment is perennially important for economics: it creates current employment and leads to future growth. Large swings in investment are a primary contributor to business cycle volatility. During economic downturns, fiscal and monetary policies that aim to generate investment or reduce the cost of capital for investment are hotly debated because of their implications for the pace of economic recovery.

What drives investment then? The elegant q-theory of Tobin (1969) and Brainard and Tobin (1968), as further developed by Abel (1979) and Hayashi (1982), predicts that investment is determined by marginal q, which is the sum of expected future marginal profits generated by investment discounted by the cost of capital. Intuitively, investment is a trade-off between the present and the future. Managers should ponder in their investment decisions the prospect of future profits created by the new investment against the present cost of such profits.

If the q-theory holds, then changes in the expectation of future cash flows (i.e., cash flow news) or changes in the expectation of future discount rates (i.e., discount rate news) should drive the variation of investment. Investment, as a forward-looking decision, should not be affected by short-term fluctuations of sales and profits, which can be smoothed through payout, external financing, or cash holding management. As a result, current sales or earnings should be relevant to investment "only to the extent that they relate to expected future sales or changes in demand" (Eisner (1978)).

Overall, however, the empirical evidence on the q-theory has been unsatisfactory. Even though forward-looking variables such as returns or q have some explanatory power for investment (e.g., Barro (1990)), this power seems small (e.g., Blanchard, Rhee, and Summers (1993), Morck, Shleifer, and Vishny (1990), and Summers (1981)). In contrast, current and past cash flows play a significant role. There are, however, several possible interpretations for these findings. First, researchers usually use the observable average-q rather than marginal-q in empirical work. Even after controlling for average-q, current earnings could show up as a significant explanatory variable of investment for a host of reasons: (i) average-q contains measurement error (Erickson and Whited (2000)), (ii) average-q and marginal-q are theoretically different (e.g., Cooper and Ejarque (2003)), or (iii) the relation between investment and marginal-q is nonlinear (Gomes (2001)). Under these circumstances, current earnings could matter as long as they are correlated with marginal-q in a way that is not fully captured by average-q. A second line of interpretation is that current earnings have explanatory power in addition to q because of financial constraints (Fazzari, Hubbard, and

Petersen (1988)).

In empirical estimations it is often the case that the interdependence between current cash flows and the proxy for q is not usually recognized, therefore the results are difficult to interpret and causality is difficult to determine.[1] This motivates us to study the determinants of investment through a system that (i) estimates cash flow news and discount rate news directly through predictive regressions, thus avoiding the reliance on proxies for q, and (ii) recognizes the interdependence and simultaneity between current cash flows and cash-flow and discount-rate news. Crucially, these goals can be achieved because investment is related to returns and cash flows through accounting identities, and thus some basic relations must hold regardless of economic interpretation and modeling.

Our focus on aggregate corporate investment is similar to the focus of Abel and Blanchard (1986), Barro (1990), Blanchard, Rhee, and Summers (1993), and Gilchrist and Himmelberg (1995). A crucial difference is that they estimate a particular version of the q-theory with specific modelling assumptions. In comparison, we estimate news terms from an accounting identity, which must hold regardless of the theory under consideration. Gatchev, Pulvino, and Tarhan (2009) also adopt an accounting identity to study investment decisions, but only at the firm level. The appeal of our approach can be summarized by going back to Brainard and Tobin (1968, Page 99):

> We argue for the importance of explicit recognition of the essential interdependences of markets in theoretical and empirical specifications of financial models. Failure to respect some elementary interrelationships–for example, those enforced by balance-sheet identities–can result in inadvertent but serious errors of econometric inference and of policy. This is true equally of equilibrium relationships and of dynamic models of the behavior of the system in disequilibrium.

We start from the intertemporal budget constraint of the firm that links earnings, investment, equity values, and stock returns. We log-linearize this identity in the same style of Campbell and Shiller (1988) who work with the identity that relates dividends, equity values, and stock

[1] When critiquing the literature, Chirinko (1993) points out that "the borrowing constraint is imposed exogenously, and the endogenous variables that parameterize the multipliers—such as cash flow and net worth sensitive to the firm's decisions—are not accounted for explicitly in specifying the econometric equation, thus blurring economic interpretations of the statistical tests." (Page 1903)

returns. The log-linear present-value relationship that we obtain implies that unexpected changes in investment growth can be decomposed into surprises to current earnings, surprises to current returns, revisions of expectations about future cash flows (i.e., cash flow news), and revisions of expectations about future discount rates (i.e., discount rate news). We then study the contribution of each component to investment volatility.

We find that the lion's share of aggregate investment variation is driven by covariation with current earnings shocks, which can be expected from the almost lock-step comovement between investment growth and earnings growth in the raw data. This happens because neither net payout (including external financing) nor cash holdings respond to earnings shocks in a significant way so as to break the link between earnings shocks and investment.

Return shocks and news about the future also contribute to investment volatility, but their roles are much smaller, and, crucially, they work in ”unintuitive” ways. For example, our findings suggest that companies increase investment when expected future cash flows are low and when expected future discount rates are high. At face value, these results suggest that investment is anything but forward-looking. Firms also increase investment when returns are unexpectedly low which shows that both variables seem to be driven by different forces.

We develop a standard q-theory model in order to interpret the variance decomposition of investment. We gather the key theoretical predictions from the model and compare them with empirical evidence. This comparison enables us to examine the prevailing interpretations in the current literature. We go through these stories below.

Predictions from a standard q-model It has been argued that shocks to productivity can lead to both higher current earnings and higher investment because of their implication for future earnings; as a result, current earnings shocks and investment can be strongly related. We confirm this point in our model. However, both investment and returns are quintessentially forward-looking variables, so they must be closely related in the q-theory. In other words, a high correlation between earnings and investment has to be accompanied by a high correlation between earnings and returns. In the data investment growth has a correlation of 0.83 with earnings growth, but returns have a negative correlation of -0.15 with earnings growth (see also Kothari, Lewellen, and Warner (2006)) and -0.12 with investment (see also Lamont (2000)). The alignment with returns is crucially missing in the data, which suggests that current earnings shocks matter for investment not because of a common productivity shock as in a standard q-model.

Non-fundamental q It is possible that returns and q contain investor sentiment. As a result, managers might make investment decisions based on their own (presumably more precise) forecasts of future profitability. Therefore, investment can be weakly related to returns and q, but strongly related to current earnings, if earnings are a better proxy for future profitability.

We first note that shocks to discount rates, sentiment-related or not, lead to changes to the cost of capital and therefore they may change optimal investment in their own right (see also Chirinko and Schaller (1996), Stein (1996), Chirinko and Schaller (2001), Baker and Wurgler (2000), Baker, Stein, and Wurgler (2003), Polk and Sapienza (2009), Bakke and Whited (2009), and Campello and Graham (2009)). Given expected future cash flows, managers should adjust investment responding to such shocks because they affect the cost of financing. Empirically, we show that aggregate equity returns are also strongly and negatively correlated with both short-term and long-term costs of borrowing. Therefore, even in a q-model with non-fundamental noise, returns and investment should be highly correlated since higher returns signal low costs of equity and debt financing.

Relation between current earnings shocks and q If average-q is different from marginal-q due to measurement error, then investment can be related to current earnings shocks even after controlling for average-q. We note that, similar to Abel and Blanchard (1986) and Gilchrist and Himmelberg (1995), we directly estimate news about future cash flows and discount rates, which capture shocks to marginal-q. Therefore, we reach our conclusions without relying on measurement of average-q.

More generally, current earnings shocks could be related to investment when average-q is theoretically different from marginal-q. However, a necessary condition for current earnings shocks to matter is that they are related to marginal-q, i.e., that they signal news about the future. We find, instead, that current earnings shocks predict nothing and are not properly related to forward-looking variables. It is therefore hard to argue that earnings shocks are proxies for the future.

Investment lags Some studies (e.g., Lamont (2000) and Lettau and Ludvigson (2002)) argue that investment and returns are not properly related because investment is implemented with lags. Consistent with this argument, we find that forward-looking variables such as returns and news about future cash flows or discount rates predict *future* investment in the right way, even though the effect becomes weak after controlling for future earnings shocks. However, we note that investment lags do not explain why investment and current earnings shocks are strongly related *without* a lag. In other words, investment lags might be able to explain why investment is not contemporaneously related to forward-looking variables, but they are unlikely to explain the bulk of investment variation.

Financial constraints We show that S&P 500 firms, which are usually regarded as the least financially constrained, exhibit lower investment-cash flow sensitivity than the market as a whole. This is consistent with the presence of financial constraints. However, even for S&P 500 firms, current earnings shocks remain the dominant force of investment variation. There are two ways to interpret this finding. The first is that financial constraints do not explain the majority of investment variation because current earnings shocks are still important even in the firms with the best access to financial markets. Alternatively, one can argue that financial constraints are of first order importance even for the least constrained firms. Regardless of the interpretation, we can conclude that the cross-sectional heterogeneity in financial constraint, the focus of many studies in the current literature, plays only a secondary role in determining aggregate investment variation.

Our main conclusion, namely that the bulk of aggregate investment variation is driven by earnings shocks that do not seem to be forward looking, is a puzzling yet old issue. As Eisner (1978) points out: "Estimation of investment functions is a tricky and difficult business and the best posture for any of us in that game is one of humility." We show that it is not obvious that many prevailing stories, at least in their current forms, can explain the bulk of aggregate investment variation. Our findings put the failures and successes of current theories into perspective, emphasizing the main drivers of investment variation that need to be understood.

We also discuss several alternative interpretations. One is that managers, for the sake of empire-building (e.g., Jensen (1986), Dow, Gorton, and Krishnamurthy (2005), and Moeller, Schlingemann, and Stulz (2005)), prefer to use current earnings to invest in zero net present value (NPV) projects towards which investors are indifferent. Since the variation of zero-NPV projects does not affect q-variables or returns, and if there are many such projects, one might observe the bulk of investment that is not forward-looking and a disconnection between investment and forward-looking variables. The implication is that it is difficult to find positive-NPV projects. Other interpretations include (i) the combination of dividend smoothing and financial constraint, and (ii) managerial myopia.

The rest of the paper proceeds as follows. Section 1 develops the present value relationship that exists between investment and discounted cash flows starting from the budget constraint of the firm. We also present a log-linear q-model to have as benchmark for the empirical findings. Section 2 presents the various data sources and empirical methodology. Section 3 shows the results for aggregate investment. Section 4 discusses various alternative interpretations. Second 5 concludes.

1 Investment and the present value of cash flows

We first use accounting identities to establish the relation between investment and other terms: current returns, current earnings, future cash flows, and future returns. The variance of investment can subsequently be decomposed as covariances between investment and these terms. We then develop a simple q-model that contains the corresponding variance decompositions. The combination of a model-free estimation system and theoretical prediction will help us interpret the empirical findings.

1.1 The firm's intertemporal budget constraint

In the following derivations, capital letters are used for defining the original variables while small letters are reserved for their logs. At the firm level, the capital accumulation equation for equity is

$$E_t \times R_{t+1} + NI^E_{t+1} - DIV_{t+1} = E_{t+1}, \tag{1}$$

where E_t is total equity value at the end of period t, R_t is gross equity return in period t, NI^E_t is net equity issuance in period t, and DIV_t is total dividends during period t. The difference $DIV_{t+1} - NI^E_{t+1}$ is net equity payout as in Boudoukh, Michaely, Richardson, and Roberts (2007) or Larrain and Yogo (2008). Equation (1) says that the current period equity is equal to last period equity after growing at the realized return, plus the amount contributed by shareholders (i.e., net equity issuance), minus the dividend payout.

The flow of funds identity is:

$$Y_{t+1} + NI^{E}_{t+1} = DIV_{t+1} + I_{t+1}, \tag{2}$$

where Y_{t+1} is the firm's earnings net of working capital adjustment, and I_{t+1} is investment minus net debt issuance (i.e., equity-financed investment). Equation (2) states that the sources of the funds (net earnings plus net equity issuance) must be used to either pay dividends or invest.

Combining Equations (1) and (2) yields the intertemporal budget constraint for equity:

$$E_t \times R_{t+1} = E_{t+1} + Y_{t+1} - I_{t+1}. \tag{3}$$

This equation becomes the main focus of our analysis since it contains the usual suspects in this literature, i.e., stock prices and returns, earnings, and investment. We also explore an alternative identity:

$$A_t \times R^{A}_{t+1} = A_{t+1} + Y_{t+1} - I^{A}_{t+1}, \tag{4}$$

where A_t is the value of total assets (equity plus debt), R^{A}_{t+1} is asset return, and I^{A}_{t+1} is total investment. This identity has the advantage of showcasing total investment, but the disadvantage that most of the literature is interested on the effect of equity values and equity returns alone.

1.2 Present-value relation involving earnings, investment, and discount rates

In the same style of Campbell and Shiller (1988), we log-linearize the intertemporal budget constraint in Equation (3) and get (ignoring constants),

$$v_t \approx r_{t+1} - \Delta c_{t+1} + \rho v_{t+1}, \tag{5}$$

where we define,

$$v_t = \theta y_t - (\theta - 1)\, i_t - e_t, \tag{6}$$

$$\Delta c_{t+1} = \theta \Delta y_{t+1} - (\theta - 1)\Delta i_{t+1}. \tag{7}$$

The variable v_t is the log version of the net payout yield, which in levels is $(Y_t - I_t)/E_t$. Net payout growth or Δc_{t+1} is a combination of earnings growth minus investment growth. Equation (5) is the same as equation (4) in Larrain and Yogo (2008); however, we dig deeper into the determinants of net payout growth in our specification. See the appendix for details on the log-linearization, its accuracy, and the choice of parameters ($\theta = 1.58$ and $\rho = 0.99$).

Solving Equation (5) forward, we get the present value equation for the net payout ratio as:

$$v_t = \sum_{j=1}^{\infty} \rho^{j-1} [r_{t+j} - \theta \Delta y_{t+j} + (\theta - 1) \Delta i_{t+j}]. \tag{8}$$

Therefore, the net payout ratio is higher because expected returns are higher, or expected earnings growth is lower, or expected investment growth is higher.

In a way that is analogous to the decomposition of unexpected returns of Campbell (1991), we decompose unexpected investment growth from equation (8) into four elements:

$$\begin{aligned}
\Delta i_{t+1} - E_t \Delta i_{t+1} &= \underbrace{-\frac{1}{\theta - 1} \left(r_{t+1} - E_t \left(r_{t+1} \right) \right)}_{C_{r,t+1}} + \underbrace{\frac{\theta}{\theta - 1} \left(\Delta y_{t+1} - E_t \left(\Delta y_{t+1} \right) \right)}_{C_{y,t+1}} \\
&\quad \underbrace{- \frac{1}{\theta - 1} \Delta E_{t+1} \sum_{j=2}^{\infty} \rho^{j-1} r_{t+j}}_{N_{r,t+1}} \\
&\quad \underbrace{+ \frac{\theta}{\theta - 1} \Delta E_{t+1} \sum_{j=2}^{\infty} \rho^{j-1} \Delta y_{t+j} - \Delta E_{t+1} \sum_{j=2}^{\infty} \rho^{j-1} \Delta i_{t+j}.}_{N_{cf,t+1}} \\
&= -C_{r,t+1} + C_{y,t+1} - N_{r,t+1} + N_{cf,t+1}.
\end{aligned} \tag{9}$$

The equation says that unexpected investment growth is driven by four components: (i) unexpected current return ($C_{r,t+1}$), (ii) unexpected current earnings ($C_{y,t+1}$), (iii) discount rate news ($N_{r,t+1}$), and cash flow news ($N_{cf,t+1}$). The first two components are current realizations that deviate from prior expectations. The last two are revisions of future expectations.

It is important to note that the investment decomposition holds by definition. Therefore, without resorting to any particular investment theory, it is easy to see how each item contributes to investment. For example, holding constant current earnings and expectations on future returns and cash flows, higher investment today must imply lower stock return today because of the substitution between investment and payout. This explains the negative sign before $C_{r,t+1}$. It does not mean, however, that unexpected investment and stock returns should necessarily have a negative correlation in the data, because the other three terms can move around and also affect investment. After these effects are considered, investment and returns could very well be positively related.

Similarly, holding everything else constant, investment can be financed through a positive earnings shock, which explains the positive sign before $C_{y,t+1}$. This does not mean, however, that investment should be positively related to earnings shocks. Forward-looking managers can react to a transient positive earnings shock by adjusting current payout and leaving investment intact. That is, $C_{r,t+1}$ and $C_{y,t+1}$ can change at the same time without impacting investment.

We can study the contribution of each component to investment variation by computing the covariance of $\Delta i_{t+1} - E_t\Delta i_{t+1}$ with each side of equation (9):

$$var\left(\Delta i_{t+1} - E_t\Delta i_{t+1}\right) = cov\left(\Delta i_{t+1} - E_t\Delta i_{t+1}, -C_{r,t+1}\right) + cov\left(\Delta i_{t+1} - E_t\Delta i_{t+1}, C_{y,t+1}\right) \quad (10)$$

$$+cov\left(\Delta i_{t+1} - E_t\Delta i_{t+1}, -N_{r,t+1}\right) + cov\left(\Delta i_{t+1} - E_t\Delta i_{t+1}, N_{cf,t+1}\right) \quad (11)$$

The variance of investment can be decomposed into four covariance terms. Intuitively, not all variation of the items on the right hand side of equation (9) matters for the variation of investment. What matters is the portion of variation that is related to investment, which is precisely what the covariances capture. If we divide both sides of equation (10) by $var\left(\Delta i_{t+1} - E_t\Delta i_{t+1}\right)$ we get:

$$1 = \beta_{C_r} + \beta_{C_y} + \beta_{N_r} + \beta_{N_{cf}}, \quad (12)$$

where each β is a covariance divided by the variance of investment. Each β can be interpreted as the regression coefficient from running one of the terms, say $C_{r,t+1}$, on unexpected investment growth. In other words, if investment moves unexpectedly it has to be associated with either current returns, current earnings, future returns, or future cash flows. These regression coefficients have to add up to one if the budget constraint holds.

The fact that our variance decomposition must hold by definition means that any investment theory, before claiming victory, must explain the patterns uncovered in such a decomposition. In this regard, it is interesting to see that the usual suspects –returns, current earnings, expected future discount rates, and expected cash flows– whose relative importance remains poorly understood today, are all there in our decomposition. The advantage of our approach is that their interdependence is clear through the budget constraint and this imposes discipline on the empirical implementation later on.

1.3 What Does the *q*-Theory Say Regarding the Variance Decomposition of Investment?

We develop a simple, log-linear q-model, which provides a benchmark for the variance decomposition of investment.

1.3.1 Log-Linear *q*-Theory

As in any production-based model, exogenous productivity shocks (z_{t+1}) are the drivers of the economy. We also assume the presence of exogenous shocks to the price of risk (x_{t+1}), which capture changes in investor preferences (i.e., risk aversion) or sentiment. The modeling of sentiment is interesting since it can shed light on the impact of "non-fundamental" elements on stock returns and investment.

The shocks (in logs) follow simple AR(1) processes:

$$z_{t+1} = \phi_z z_t + \varepsilon_{z,t+1} \tag{13}$$

$$x_{t+1} = \phi_x x_t + \varepsilon_{x,t+1}, \tag{14}$$

where each ε_{t+1} is a standard normal shock, with mean zero and standard deviation σ_z and σ_x respectively. The correlation between the shocks is ρ_{xz}.

The log stochastic discount factor (SDF) in this economy is assumed to be:

$$m_{t+1} = -r_f - \frac{1}{2} x_t^2 \sigma_z^2 - x_t \varepsilon_{z,t+1}. \tag{15}$$

The specification of the SDF implies that only productivity shocks are priced in this economy. This is the standard assumption in production-based models (e.g., Jermann (1998) and Lettau

(2003)).

Investment is endogenously determined as a function of productivity shocks and the price of risk in the following way. Assume that earnings, productivity, and the capital stock are related through a standard Cobb-Douglas production function with unit labor:[2]

$$Y_{t+1} = Z_{t+1} K_{t+1}^{\alpha}. \tag{16}$$

In logs this last equation is equal to $y_{t+1} = z_{t+1} + \alpha k_{t+1}$.

The standard capital accumulation equation is:

$$K_{t+1} = I_t + (1-\delta) K_t \tag{17}$$

In order to incorporate investment adjustment costs in a simple way, Abel (2003) proposes instead the following capital accumulation equation:

$$K_{t+1} = I_t^{\phi} K_t^{1-\phi}. \tag{18}$$

This is equivalent to log-linearizing the standard capital accumulation equation since it implies that $k_{t+1} = \phi i_t + (1-\phi) k_t$.[3] In this setting Abel (2003) shows that investment is proportional to equity values, as in any q-theory formulation. In particular, $I_t = \phi Q_t K_{t+1}$, where Q_t is the price of a unit of installed capital. The return on capital can then be written as:

$$R_{t+1} = \frac{(Y_{t+1} - I_{t+1}) + \frac{1}{\phi} I_{t+1}}{\frac{1}{\phi} I_t} \tag{19}$$

Intuitively, the return on capital has a cash flow piece, which corresponds to net payout $(Y_{t+1} - I_{t+1})$, and a capital gain piece.[4] Since equity values are proportional to investment, capital gains can be expressed in terms of investment growth. Log-linearizing this equation for returns we obtain

[2] We express the production function in terms of earnings and not output, but since we later on work with logs and abstracting from constants, this is irrelevant. In a Cobb-Douglas framework, earnings are simply a constant fraction of output.

[3] In the case of a first-order Taylor approximation of the capital accumulation equation, ϕ can be tied to other parameters, more specifically: $\phi = \frac{1}{1+(1-\delta)\exp(E[k_t - i_t])}$.

[4] We use the same notation for investment returns and for stock returns since they are equivalent under fairly general assumptions. See Cochrane (1991) and Restoy and Rockinger (1994).

(ignoring constants):[5]

$$
\begin{aligned}
r_{t+1} &= \log\left(R_{t+1}\right) \\
&\approx (1-\rho_r)(y_{t+1}-i_{t+1}) + \Delta i_{t+1}
\end{aligned}
\tag{20}
$$

The return on capital has to obey the following relationship (Cochrane 1991):

$$
1 = E_t\left[M_{t+1}R_{t+1}\right] = E_t\left[\exp(m_{t+1}+r_{t+1})\right],
$$

which implies that investment is of the form (again, ignoring constants):

$$
i_t = B_z z_t + B_x x_t + B_k k_t, \tag{21}
$$

We expect to find that investment responds positively to productivity ($B_z > 0$) since investment is procyclical in the data. On the other hand, we expect investment to respond negatively to a higher price of risk ($B_x < 0$). Finally, a higher capital stock implies that adjustment costs are proportionally lower, leading to higher investment ($B_k > 0$).[6] The exact expression for these parameters is given in the appendix. The log-price of capital is therefore:

$$
q_t = (1-\phi)\left[B_z z_t + B_x x_t + (B_k - 1)k_t\right] \tag{22}
$$

1.3.2 Elements in the Variance Decomposition of Investment

We can now express the items in the variance decomposition as functions of the structural shocks in this economy. Shocks to earnings, investment, capital, and returns are all caused by shocks to

[5] The log-linearization parameter is $\rho_r = \frac{1-\phi}{(1-\phi)+\phi\exp\{E[y_t-i_t]\}}$.

[6] We expect to find $B_k < 1$ since the unit price of capital should be decreasing in the stock of capital from the assumption of diminishing returns (Romer 1996).

productivity and the price of risk. Unexpected investment can be decomposed as follows:

$$\begin{aligned}
\Delta i_{t+1} - E_t \Delta i_{t+1} &= B_z \varepsilon_{z,t+1} + B_x \varepsilon_{x,t+1} && (23)\\
C_{r,t+1} &= \frac{1}{\theta - 1} \left\{ [(1-\rho_r) + \rho_r B_z] \varepsilon_{z,t+1} + \rho_r B_x \varepsilon_{x,t+1} \right\}, && (24)\\
C_{y,t+1} &= \frac{\theta}{\theta - 1} \varepsilon_{z,t+1}, && (25)\\
N_{cf,t+1} &= \left\{ \frac{\theta}{\theta-1} \left[\frac{\rho(\phi_z - 1)}{1 - \rho\phi_z} + \alpha\lambda\kappa_z \right] - (\kappa_z - B_z) \right\} \varepsilon_{z,t+1} && (26)\\
&\quad + \left\{ \frac{\theta}{\theta-1} \alpha\lambda\kappa_x - (\kappa_x - B_x) \right\} \varepsilon_{x,t+1}, \\
N_{r,t+1} &= -\left(B_z \varepsilon_{z,t+1} + B_x \varepsilon_{x,t+1} + C_{r,t+1} - C_{y,t+1} - N_{cf,t+1} \right). && (27)
\end{aligned}$$

where $\lambda = \rho\phi/[1-\rho(1-\phi)]$, $\kappa_z = \frac{1}{1-\lambda B_k} \frac{1-\rho}{1-\rho\phi_z} B_z$, and $\kappa_x = \frac{1}{1-\lambda B_k} \frac{1-\rho}{1-\rho\phi_x} B_x$.[7]

A couple of conclusions can be quickly drawn. First, the shock to current earnings $C_{y,t+1}$ in equation (25) is basically the productivity shock, while unexpected investment in equation (23) is a response to the productivity shock and the shock to the price-of-risk. As conjectured by Lamont (2000), current earnings shocks and investment shocks can be strongly positively correlated as long as the shock to the price-of-risk does not dominate. Intuitively, productivity shocks not only lead to higher current earnings, but also make managers revise their expectations on future cash flows.

Second, from (23) and (24) it is easy to see that unexpected returns behave essentially like unexpected investment growth, particularly since $\rho_r \approx 1$ (see also Cochrane (1991)). Intuitively, unexpected investment responds to the same shocks that affect stock prices, therefore they must be highly correlated.

It follows immediately that whatever correlation there is between earnings growth and investment growth, the model predicts a similar correlation between earnings growth and returns. If investment growth and earnings growth are highly correlated, then it has to be the case that earnings growth and returns are highly correlated too. These two correlations must go hand in hand in the standard q-theory, which becomes important when we evaluate the empirical evidence.

[7] We define discount rate news in (27) as the residual from the budget constraint to ensure that the variance decomposition holds. There is an alternative way to define discount rate news directly from the definition of returns. However, the partial equilibrium nature of the model does not enforce the aggregate budget constraint on which our decomposition is based.

1.3.3 Discussion of Calibration Results

We calibrate most parameters by taking standard values used in the literature.[8] Table 1 shows the variance decomposition using the model for various parameter choices of σ_x and ρ_{xz}. In the benchmark case, $\sigma_x = 0.12$ and $\rho_{xz} = -1$.

The calibration results show that the covariance between shocks to earnings and investment growth is about twice the variance of investment growth, and it corresponds to the largest element in the variance decomposition. Therefore, the q-theory is capable of producing large investment-cash flow sensitivities. The second largest element is the positive covariance between investment growth and returns. Earnings, investment, and returns are all highly and positively correlated across the different cases in Table 1. If the q-theory produces a large investment-cash flow sensitivity it is together with a high correlation between earnings and returns, and between investment and returns. In fact, this trinity of correlations is at the heart of the standard q-theory.

Investment shocks can be negatively correlated with news about future cash flows, however a positive correlation is also observed under certain parameter combinations. On the other hand, discount rate news are always strongly and negatively correlated with investment in Table 1. This shows that any shock that affects the discount factor in this economy, sentiment related or not, has a large impact on investment.

[8] The share of capital α is set at 0.30. From Cochrane (1991) we take a value of 0.10 for the depreciation rate δ, and an average capital-investment ratio of 7.29, ($E[K_t/I_t] \simeq \exp(E[k_t - i_t])$), which together give $\phi = 0.13$. The implied λ is 0.93. Using $\phi = 0.13$ and an average earnings-investment ratio ($E[Y_t/I_t] \simeq \exp(E[y_t - i_t])$) of 1.377 from our quarterly data, we get that $\rho_r = 0.82$. Following Lettau and Wachter (2007) we set $\sigma_x = 0.12$ and $\phi_x = 0.95$ in order to match the autocorrelation of the dividend yield. The persistence of productivity is $\phi_z = 0.99$, therefore, as is standard in the macro literature, productivity is close to a random walk (see, for example, Campbell (1994) and Lettau (2003)). In the benchmark case, productivity shocks and shocks to the price of risk are assumed to be perfectly and negatively correlated ($\rho_{xz} = -1$) as in Campbell and Cochrane (1999). We calibrate the volatility of productivity shocks from the volatility of unexpected earnings, which according to equation (25) are the same once the factor $\theta/(\theta - 1)$ is removed. This implies that $\sigma_z = 0.1375$ using as benchmark our main quarterly results. This number is quite high when compared to the typical assumption of 0.0072 for the standard deviation of technology shocks used in the macro literature (see, for example, King and Rebelo (1999)). However, one needs to recognize that earnings in our data are levered cash flows since debt-related payments are subtracted. This choice for σ_z allows us to match the level, although not the composition, of investment variance seen in the data.

2 Data and Empirical Estimation

2.1 Flow of Funds Data

Our primary source for aggregate data is the seasonally-adjusted quarterly data from the Flow of Funds Accounts of the United States, 1952:01-2008:02. The annual data from the Flow of Funds starts in 1947. We construct the variables for the nonfarm, nonfinancial corporate sector. In particular, we obtain market value of equity (E_t, Line 35) from Table B.102. We obtain dividends (DIV_t, Line 3), net equity issues (NI_t^E, Line 39), net debt issues (Lines 41 plus 43), and capital expenditure (Line 11) from Table F.102. For our main results, investment (I_t) is defined as capital expenditure minus net debt issuance, i.e. equity-financed investment. Total investment refers to capital expenditures alone. Stock returns (R_t) are computed with these elements from Equation (1); and earnings net of working capital adjustment (Y_t) are backed out from Equation (2). In the rest of the paper, earnings refer to earnings backed out from these identities. When we measure earnings directly we use profits (Line 1) from Table F.102 and we note it explicitly. When we compute asset (debt + equity) returns we follow the methodology described in Larrain and Yogo (2008). All data are deflated using the end-of-quarter CPI from the *Bureau of Labor Statistics.*

2.2 Compustat Data

Our secondary data source is a merge of the Compustat Annual Industrial File and the Center for Research in Security Prices (CRSP) Database. When constructing the variables, we follow the variable definitions and procedures in Larrain and Yogo (2008) and Gatchev, Pulvino, and Tarhan (2009) closely. Due to the requirement for the statement of cash flows, the data are available at annual frequency only since 1971. We exclude the SIC codes 6000-6799 to focus on the nonfinancial firms.

We gather firm-level information. Investment (I) is defined as the capital expenditure (data128) minus the change in inventory (data303) minus net debt issuance. The net debt issuance is in turn defined as the issuance of long-term debt (data111) minus the reduction in long-term debt (data114) plus the change in current debt (data301). We also collect the dividend (data127), share repurchase (data115) and share issuance (data108) from the Compustat database. Cash holding is generally defined to also include net working capital, or, cash holding is equal to total current assets (data4)minus total current liabilities (data5) plus debt in current liabilities (data34). The market capitalization at the end of each year and the annual stock return are computed using the CRSP database. Firm-level variables are then aggregated to the portfolio or the market levels. The annual data cover 1972-2006.

2.3 Descriptive Analysis

Figure 1 plots the aggregate dividend growth, earnings growth, and investment growth at the quarterly frequency.[9] For visual clarity, we first calculate the average numbers for each year, and then plot the time series at annual frequency. In Panel A, earnings growth and investment growth are much more volatile than dividend growth throughout the 1952-2008 period. More important, investment growth tends to follow earnings growth closely in most years. For example, both investment growth and earnings growth reach their lowest points during the 2001 recession. There are, however, interesting exceptions in particular in the later part of the sample. Overall, investment growth and earnings growth behave like close cousins (if not twins), going wildly up and down together; in contrast, dividend growth is smooth, and does not appear to be related to either earnings growth or investment growth.

Panel B in Figure 1 replaces the earnings growth in Panel A by the direct earnings growth (see Section 3.1 on the difference between earnings and direct earnings). We note that earnings, after adjusting for cash holding and net payout, are equal to investment by definition. Therefore, investment growth should follow earnings growth (which already adjust for cash holding) more closely than follows direct earnings growth (which is before cash holding adjustment). What we can observe in Panel B is that investment growth and direct earnings growth still follow very similar patterns. This suggests that earnings shocks are usually channeled into investment: neither cash holding adjustment nor net payout is important enough to separate them.

What we have just observed can be verified in Table 2, which reports the summary statistics of the main variables using the quarterly sample. Earnings growth and investment growth are more volatile than stock returns; and direct earnings growth and total investment growth are about as volatile as equity growth. However, all earnings growth and investment growth measures are much

[9]Dividend growth and dividend yield in Figures 1 and 2, and in Table 1, are taken from CRSP to allow a straightforward comparison with the previous asset pricing literature.

more volatile than dividend growth. Put differently, managers do not seem to use corporate policy tools enough to break the relation between earnings shocks and investment. In particular, they seem to adopt a policy of smooth dividends and volatile investment.

Even though different measures of investment growth and earnings growth are all very volatile, they track each other well. Earnings growth has a correlation of 0.81 with investment growth (which excludes debt-financed investment) and 0.65 with total investment growth; direct earnings growth has a correlation of 0.52 with investment growth and 0.51 with total investment growth. In comparison, dividend growth is essentially not related to either earnings growth or direct earnings growth (both correlations at 0.03). Therefore, earnings growth and investment growth are strongly related even after adjusting for cash holding and net payout (external financing considered).

The summary statistics are broadly consistent with what has been found in the literature, but they are puzzling on several fronts. Stock returns are negatively related to investment growth (-0.13) and total investment growth (-0.07). Lamont (2000) argues that this result is counter-intuitive, since investment and returns supposedly reflect news about future discount rates and cash flows. Lamont (2000) further argues that the lack of a proper correlation between investment and returns is caused by lags in the implementation of investment plans. Indeed, he finds that investment plans are significantly and positively related to stock returns. Stock returns are also negatively correlated to earnings growth (-0.14) and direct earnings growth (-0.09). This seems to suggest that discount rates go up precisely when there are positive shocks to earnings. As Kothari, Lewellen, and Warner (2006) point out, this would be against the predictions of standard asset pricing models.

Figure 2 shows the time series of the net payout ratio. This ratio captures the slow-moving and predictable component of discount rates and cash flows. It looks more stationary than the dividend yield, a variable that is commonly used to predict returns. The autocorrelation of net payout yield is 0.87, while the autocorrelation of the dividend yield is 0.96. In fact the dividend yield exhibits a downward trend during the 1952-2008 period.

Throughout the paper, except for robustness checks, we study equity-financed investment, i.e., capital expenditure minus net debt issuance. Our results are virtually unchanged if we use total investment. This can be expected because the two investment growth series track each other closely as seen in Figure 3. Their correlation is 0.73 at the quarterly frequency and 0.89 at the annual frequency (Flow of Funds data).

2.4 VAR Estimation of the Variance Decomposition

It has been widely documented that long-horizon regressions have poor finite-sample properties (e.g., Boudoukh, Michaely, Richardson, and Roberts (2007), Hodrick (1992), and Valkanov (2003)). Therefore we estimate the news terms through a VAR model (e.g., Campbell (1991)). Consider a vector $x_t = (r_t, \Delta y_t, \Delta i_t, v_t)'$ such that:

$$x_{t+1} = \Phi x_t + \varepsilon_{t+1}, \tag{28}$$

where $E[\varepsilon_{t+1}] = 0$ and $E[\varepsilon_{t+1}\varepsilon'_{t+1}] = \Sigma$. The first three equations of this VAR can be interpreted as a vector error-correction model where the payout ratio v_t is the cointegrating vector. This is perhaps the best way to justify our VAR specification and therefore the information set we use to estimate long-run news. As shown by Chen and Zhao (2009), changes in the VAR specification can lead to different conclusions about the importance of cash flow and return news when the information set is arbitrarily chosen. In any case, the forecasting variables typically used in investment regressions (e.g., Barro (1990)) are precisely the ones we are considering: own lags, earnings or profitability growth, returns, and scaled stock prices (the payout ratio in our case).

The intertemporal budget constraint in equation (5) implies the following restriction on the coefficients:

$$[e'_1 - \theta e'_2 + (\theta - 1)e'_3 + \rho e'_4]\Phi = e'_4, \tag{29}$$

where e_i is the ith column of the 4×4 identity matrix I. The VAR model implies that the dynamics of unexpected investment in Equation (9) can be written as:

$$
\begin{aligned}
e_3'\varepsilon_{t+1} \quad = \quad & \underbrace{-\frac{1}{\theta-1}e_1'\varepsilon_{t+1}}_{C_{r,t+1}} + \underbrace{\frac{\theta}{\theta-1}e_2'\varepsilon_{t+1}}_{C_{y,t+1}} \\
& \underbrace{-\frac{1}{\theta-1}e_1'\rho\Phi(I-\rho\Phi)^{-1}\varepsilon_{t+1}}_{N_{r,t+1}} \\
& \underbrace{+\left(\frac{\theta}{\theta-1}e_2' - e_3'\right)\rho\Phi(I-\rho\Phi)^{-1}\varepsilon_{t+1}}_{N_{cf,t+1}}.
\end{aligned} \tag{30}
$$

Define:

$$
A = \rho\Phi(I-\rho\Phi)^{-1}. \tag{31}
$$

The variance decomposition of unexpected investment becomes:

$$
\begin{aligned}
e_3'\Sigma e_3 \quad = \quad & -\frac{1}{\theta-1}e_1'\Sigma e_3 + \frac{\theta}{\theta-1}e_2'\Sigma e_3 \\
& -\frac{1}{\theta-1}e_1'A\Sigma e_3 + \left(\frac{\theta}{\theta-1}e_2' - e_3'\right)A\Sigma e_3
\end{aligned} \tag{32}
$$

We estimate the VAR using OLS equation-by-equation for the first three equations of the system. The coefficients of the fourth (net payout) equation are obtained by imposing the constraints in equation (29). This is similar to the methodology described by Campbell and Shiller (1988). The unrestricted OLS regression for net payout gives almost identical coefficients, which only attests to the accuracy of the log-linear approximation. We report Newey-West corrected standard errors for the coefficients.

3 Results

3.1 Baseline case

Table 3 reports the VAR results using the quarterly sample for 1952:02-2008:02. In Table 3, consistent with the current literature (see Boudoukh, Michaely, Richardson, and Roberts (2007) and Larrain and Yogo (2008)), the payout yield significantly predicts returns (0.03, t-statistic 2.02). The payout yield also predicts earnings growth (-0.092, t-statistic 4.04) and investment growth (-

0.092, t-statistic 3.77). Importantly, the ability of the payout yield to predict earnings growth and investment growth is stronger than its ability to predict returns; this is clear from both the coefficients and the t-statistics. In addition, and not surprisingly, the lagged payout ratio strongly predicts the current payout ratio (0.887, t-statistic 28.02).

Both earnings growth and investment growth have negative autocorrelation in the quarterly data (see Table 2). As such, their lags have significant predictive power. In addition, earnings growth significantly predicts investment growth (0.176, t-statistic 2.20), but not the other way around. This evidence is consistent with the finding in the literature that lagged output and sales can predict investment (e.g., Eisner (1978)).

As the cointegration vector, the ability of the payout yield to predict each variable largely determines the variability of the expectation of that variable. Since the payout yield is the key variable, one common practice in the literature is to estimate a reduced-form VAR, in which the only independent variable is the payout yield (see, among others, Ang (2002), Chen (2009), and Cochrane (2008)). When we do so, the coefficient on the return equation becomes insignificant (t-statistic 1.62), but the coefficient on the earnings equation (-0.110, t-statistic 5.24) and the investment equation (-0.095, t-statistic 4.19) become slightly larger and more significant.

In the language of cointegration the results of the VAR can be summarized as follows. When the net payout ratio is high, and in order for the payout ratio to go back to its mean, it has to be the case that either future returns are high or future payout growth is low. The VAR shows that part of the adjustment is achieved through future returns, but more importantly through future payout growth.

The effects on earnings growth and returns assure the mean reversion in the payout ratio. The effect on future investment growth is also strong, but the negative sign on the payout ratio is puzzling from the point of view of cointegration. Lower investment growth in the future means higher payout growth (ceteris paribus), therefore the negative effect of the payout ratio on investment works against the mean reversion of the ratio. Since we observe mean reversion in the payout ratio, the effects on returns and earnings more than compensate for the divergence seen in investment. The negative coefficient is also puzzling from the perspective of the standard q-theory. As Lettau and Ludvigson (2002) point out, the same variables that predict returns should predict investment growth, and with the same sign, if there is a discount rate channel.[10] If discount rates go up, then investment today should go down and expected investment growth should go up. However, the opposite happens in the data. The simplest possible explanation is that investment follows earnings, therefore the same variables that predict earnings growth simultaneously predict investment growth.

Table 4 reports the variance decomposition. We present the results for both the full VAR and the reduced-form VAR. For the full VAR, the variance of unexpected investment is 0.022 per quarter (a standard deviation of 14.8% per quarter). The covariance between unexpected investment and current earnings shock is 0.046 or 208% of investment variance. In comparison with the benchmark q-model, at least two covariances have the "wrong" sign: the covariance of investment with current returns is negative, and the covariance of investment with discount rate news is positive. These signs are "wrong" because they suggest that firms increase investment when they expect higher discount rates. We obtain very similar results using the reduced-form VAR, suggesting that they are not driven by potentially strange combinations of VAR coefficients or the autocorrelation of the variables.

The "wrong" sign in the covariance of investment and future news is driven by the strong positive relation between current earnings shocks and investment (0.825 in Table 4) and the negative relation between current earnings shocks and returns (-0.144). Since earnings and returns are negatively related, a positive shock to current earnings implies (ceteris paribus) a positive shock to the payout yield. A higher payout yield in turn implies lower future earnings growth or higher future discount rates. Therefore, investment appears to go up at a time when there is lower expected future payout growth or higher future discount rates.

3.2 Other cases

Direct earnings growth and total investment In Table 5 we report the results for the case in which direct earnings growth and total investment are used. Such a case allows for cash holding adjustment and external debt financing to break the relation between earnings shocks and investment. The downside is that the identity is not perfectly satisfied within the set of variables considered in the VAR. As a result, the components of the investment variance do not add up to

[10]See, in particular, Figure 1 of Lettau and Ludvigson (2002) for a clear illustration of this point.

100%, but only to 86% in Table 5. Despite this problem, we observe the same salient patterns as in Table 4. Current earnings shocks remain the dominant determinant of investment. The forward-looking components – unexpected returns, cash flow news, and discount rate news – are related to investment with unintuitive signs.

Asset return, earnings growth, and total investment In this case the identity holds again as shown in equation (4), which is confirmed since the elements of the variance decomposition in Table 6 add up to 101%. Again, we observe similar patterns: current earnings shocks explain more than 200% of investment variation. Total investment and earnings have a correlation of 0.676.

Asset return, direct earnings growth, and total investment The identify is not satisfied perfectly in this case, at least in principle. However, the variance decompositions turns out to be extremely accurate, with the components adding up to a perfect 100% (Table 7). This exercise confirms the previous conclusions drawn from different data definitions.

Direct earnings growth and total investment with COMPUSTAT data We define Y_{t+1} as earnings minus cash holding adjustment, which can be further decomposed as:

$$Y_{t+1} = ERN_{t+1} - CH_{t+1} \tag{33}$$

$$= ERN_{t+1} \times \left(1 - \frac{CH_{t+1}}{ERN_{t+1}}\right), \tag{34}$$

where ERN_{t+1} is direct earnings and CH_{t+1} is cash holding adjustment. This implies that, in log form,

$$y_{t+1} = ern_{t+1} + cr_{t+1},$$

where ern_{t+1} is log direct earnings and $cr_{t+1} = \ln(1 - CH_{t+1}/ERN_{t+1})$ is approximately the log of cash *reduction*. Current earnings shocks in Equation (9) can be decomposed into direct earnings shocks and cash reduction shocks:

$$C_{y,t+1} = C_{ern,t+1} + C_{cr,t+1}. \tag{35}$$

We report in Table 8 the variance decomposition, now with five components, using the data from Compustat 1972-2006. Since Compustat covers a shorter sample period at annual (rather than quarterly) frequency, they provide an interesting robustness check. We observe the same patterns as before. Direct earnings shocks and investment growth are strongly and positively correlated (0.587). In addition, investment is high when cash holdings increase (i.e., investment is negatively correlated with cash reductions), which suggests that physical investment and investment in working capital are complements. The correlation between direct earnings shocks and cash reduction is -0.78. Therefore, in years when direct earnings shocks are high, both investment and cash holdings increase.

In summary, we have examined various scenarios from Table 4 to 8, and the results are very robust. Direct earnings shocks lead to investment shocks because the tools that managers can use to smooth investment, i.e., cash holding, payout, or external financing, are relatively unimportant. As a result, investment absorbs the bulk of earnings shocks. Accordingly, forward-looking financial variables seem to play a secondary role.

4 Interpretations

A strong relation between investment and earnings, together with a weak relation between investment and forward-looking variables, is puzzling. In this section we review attempts to rationalize these results within the q-theory itself or with other theories.

4.1 Can Productivity Shocks in a Q-model Explain the Empirical Evidence?

Our calibration results in Table 1 shows that productivity shocks can generate a strong positive relation between current earnings shocks and investment. However, in the model the correlation between investment growth and earnings growth goes hand in hand with the correlation between returns and earnings growth. In the data, investment has a high correlation with earnings (0.82). In contrast, earnings and investment have negative correlations with returns (-0.14 and -0.12 respectively).

Therefore, productivity shocks in a standard q-theory model are unlikely to account for the simultaneous correlations between these three variables. The reason is that theoretically investment is usually highly correlated with returns, both of which are driven by news about future. In the data, however, investment is not properly related to returns.

4.2 Can "Non-fundamental-q" Explain the Empirical Evidence?

Is it possible that investment and returns are not positively correlated because investment only responds to "fundamental-q" and returns are dominated by sentiment? We believe this is unlikely to be the case. In the model discount rate shocks do not affect current earnings, but still drive investment and return together. Therefore, even if sentiment-driven discount rate shocks reduce the correlation between earnings and returns, the correlation between investment and returns should still be high (see, for example, last column on the right in Table 1). Imagine that a positive earnings shock causes investors to be overly optimistic about future cash flows and pushes stock prices above their intrinsic values, and that managers are aware of this sentiment. Such an overly-priced market suggests that the cost of capital is low. Therefore, even though managers harbour correct visions about future cash flows, they must optimally invest more due to cheaper borrowing costs (e.g., Chirinko and Schaller (1996), Stein (1996), Chirinko and Schaller (2001), Baker and Wurgler (2000), Baker, Stein, and Wurgler (2003), Polk and Sapienza (2009), Bakke and Whited (2009), and Campello and Graham (2009)).[11]

Figure 4 plots the time series relation between the aggregate Baa over Aaa yield spread and the value-weighted market return, at annual frequency, between 1917 and 2008. The yield spread can be regarded as the long-term cost of borrowing of an average firm. For both the level and change of the yield spread, the clear pattern in Figure 4 is that the yield spread tends to increase when stock returns go down. The pattern is particularly dramatic during the Great Depression and the current financial crisis. The correlation between the change of yield spread and return is a highly significant -0.588.

Figure 5 plots the relation between the Ted spread –the three-month Eurodollar rate over the three-month T-bill rate– and the market return between 1971-2008. The Ted spread can be regarded as the short-term cost of borrowing over the benchmark rate. Similar to Figure 4, for both the level and the change of the Ted spread, the clear pattern is that the Ted spread tends to

[11]It is hard to argue that rational managers can adopt their own discount rates, which are potentially different from the prevailing discount rates on the market. Expected marginal profits and the present costs of such profits should determine investment, irrespective of whether the manager thinks that the cost of funds is rational or not.

jump up when returns go down. Again, the pattern is more dramatic during the Great Depression and the current financial crisis. The correlation between the change of the Ted spread and returns is a highly significant -0.521.

Therefore, aggregate market returns, related to sentiment or not, are strongly and negatively related to the cost of funds. Whether the driver of stock price movement is "fundamental" or not seems irrelevant. We note that Eberly, Rebelo, and Vincent (2009) discuss the issue of "non-fundamental-q" using firm-level data, which seem more relevant in their context. At the aggregate level, however, market sentiment must affect the cost of capital, causing a positive relation between investment and return.

4.3 Can Investment Lags Explain the Empirical Evidence?

It has been argued that investment and contemporaneous returns are not properly related because the response of investment to forward-looking information is implemented with lags, while the same information is reflected in prices instantaneously. Consistent with this argument, Lamont (2000) show that investment plans (rather than actual investment) are positively correlated to returns. Similarly, Lettau and Ludvigson (2002) show that some financial variables that predict returns also predict investment in the long run, although not in the short run.

Can investment lags explain (i) the strong relation between investment and current earnings shocks, and (ii) the wrong relation between investment and current returns and news about the future? The answer to the first question is likely no. This is because, contrary to the existence of lags, the response of investment to current earnings shocks is not delayed. The fact that current earnings shocks are the dominant determinant of investment suggests that the majority of investment variation has nothing to do with investment lags.

Investment lags could have more promise to explain the second question. To explore this issue, we regress future investment growth on lagged return shocks, lagged cash flow news, and lagged discount rate news, and report the results in Table 9. Consistent with investment lags, returns predict two- and three-quarter ahead investment growth with the correct (positive) sign. After three quarters the predictive power disappears. Interestingly, both cash flow news and discount rate news predict investment growth for the three-quarter horizon with the correct signs.

The predictive power is, however, quite small. The R-squared (the fraction of future investment variance explained by the variable) is at best 5% in these regressions. Therefore, even if investment lags can salvage the role of returns, cash flow news, and discount rate news as investment determinants, they still do not explain the bulk of investment variation. This is because the bulk of investment variation corresponds to a simultaneous response – without a lag – to earnings shocks. In particular, the right-hand side panel in Table 9 shows that the R-squared increases up to about 67% when contemporaneous earnings shocks are included in each regression. Contemporaneous earnings shocks also seem to reduce the predictive power that was found before for past returns, and past news.

4.4 Can Measurement Error in q or Nonlinearity Explain the Empirical Evidence?

Our results do not rely on measures of average-q. Instead, we estimate cash flow news and discount rate news directly, i.e., the elements in marginal-q. However, it can be argued that news about the future can never be perfectly estimated due to data constraints, choice of variables, time lags, etc. However, for current earnings shocks to matter, they must be related to marginal-q. That is, they must have predictive power for future cash flows or discount rates. Table 10 shows that earnings shocks have essentially no such power. They do not predict themselves: the autocorrelation oscillates around zero at all horizons. They do not predict future investment or return at any horizon. Regressing future cash flow news or discount rate news on current earnings also yields no predictive power at any horizon when using the Flow of Fund data in Panel A. In the case of Compustat data in Panel B, a higher direct earnings shock seems to predict a higher discount rate news – discount rate goes up – at the three-year horizon. Current earnings shocks then predict negatively the discount rate at the six-year horizon and thus cancel the effect at the three-year horizon. Overall, Table 10 suggests that current earnings shocks are not forward-looking. It it thus difficult to rationalize the role of current earnings shocks through their alleged forecasting power for future conditions.

4.5 Can Financial Constraints Explain the Empirical Evidence?

Another important explanation for the strong relation between earnings shock and investment growth is the presence of financial constraint. Fazzari, Hubbard, and Petersen (1988) argue that different firms face different levels of financial constraints in the credit market (see also Livdan, Sapriza, and Zhang (2009)). More financially constrained firms are forced to cutback investment due to costly external financing. As such, these firms' investment growth responds more positively to earnings shocks in an effort to pull investment back to optimal levels. Such cross-sectional heterogeneity of investment sensitivity to earnings shocks can potentially be added up to the aggregate level, leading to the sensitivity of aggregate investment to aggregate earnings shocks.

An easy way to test this hypothesis is to study the investment variance decomposition of S&P 500 firms. These firms are the most liquid ones in the corporate universe and are the least financially constrained, if constrained at all. If the financial constraint hypothesis is true, then the relation between investment growth and earnings growth could disappear for these firms.

Table 11 reports the investment variance decomposition for S&P 500 firms during 1972-2006. The covariance between investment growth and earnings shocks is 0.023, which accounts for 127% of investment variance. In comparison, for all the Compustat firms during the same period, the covariance between investment growth and earnings shocks is 0.03, which accounts for 173% of investment variance. Therefore, the investment sensitivity to earnings shock appears to be smaller for the S&P firms, consistent with the financial constraint story. However, earnings growth remains to be the dominant determinant of investment variance.

There are two ways to interpret this evidence. The first is that financial constraints do not explain the majority of investment variation, because current earnings shocks are important even for the firms that have the best access to credit markets. Alternatively, one can argue that financial constraints are important even for the least constrained. Such an argument is consistent with the observation that during economic downturns equity and debt issuance are much reduced. Regardless of the interpretation, we can conclude that the cross-sectional heterogeneity in financial constraint, the focus of many studies in the current literature, plays a secondary role in determining aggregate investment variation. If one believes that financial constraints are a first-order concern, one has to go beyond the cross-sectional heterogeneity and explain why it is such a concern for the most liquid firms.

4.6 Lumpy Investment?

It is possible that investment is lumpy: managers make investment plans for the next five years and use current earnings, whenever available, to fulfill the investment planned earlier. Such a strategy, while causes a strong relation between earnings and investment, can also lead to a weak relation between investment and market conditions (as reflected by q-variables and returns).

One way to examine this story is to check the cumulative relation between investment growth and returns. Presumably for longer horizons investment can catch up with forward-looking variables. We find that the correlation between long-horizon cumulative returns and cumulative investment growth is surprisingly stable. The correlation is -0.11 at the one-year horizon, -0.12 at the five-year horizon, and -0.12 at the ten-year horizon. In addition, it is unclear why lumpy investment at the firm level will play a significant role at the aggregate level. For these reasons we believe lumpy investment is unlikely the interpretation of our results.

4.7 Other Potential Interpretations

We have gone through the major interpretations in the current literature. None seems to be able to fully explain the prominent role of current earnings shocks as an investment determinant. We discuss below several alternative interpretations. We leave for future research to test the validity of these stories.

4.7.1 Zero NPV projects

While investors are indifferent toward zero NPV projects, managers, for the desire of empire-building (e.g., Jensen (1986), Dow, Gorton, and Krishnamurthy (2005), and Moeller, Schlingemann, and Stulz (2005)), might use current earnings to pursue such projects in addition to positive NPV projects.[12] Since the variation of zero NPV projects do not necessarily affect q-variables or returns, and if there are many zero NPV projects, one might observe a strong relation between current earnings and investment, and a weak relation between investment and forward-looking variables.[13]

This hypothesis does not suggest that most investments are wasted. Investors are actually

[12] Another story that is consistent with a strong relation between earnings shocks and investment is CEO overconfidence (e.g., Malmendier and Tate (2005)).

[13] It can be argued that managers might find it easier to use earnings rather external financing to expand their companies. External financing thus plays a secondary role for this purpose.

indifferent if they cannot find positive NPV projects. Therefore, a natural implication is that it is difficult to find positive NPV projects (due to, for example, competition).[14]

4.7.2 Growth options

As we have shown, a major problem that challenges the q-theory is that investment and returns are delinked: while investment responds strongly to current earnings shocks, return has little relation with either investment or earnings. A potential interpretation is that stock returns are mainly driven by growth options that will be based on future technology, but investment and earnings are driven by current technology that is not closely related to future technology. In such a way, investment and current earnings shocks can be closely related, but returns could be driven by very different information. See Abel and Eberly (2005) for a similar story.

4.7.3 Dividend smoothing and financial constraints

If managers (investors) prefer smoothed payout, then external financing and cash holding management are the tools the managers can use to ensure investment is driven by forward-looking decisions. In the presence of financial constraint, however, investment will be largely affected by retained earnings. Therefore, the combination of smoothed payout policy and financial constraint can potentially explain why investment and current earnings shocks are so highly related.

Since Lintner (1956)'s seminal work, it is well known that corporations smooth dividends and, importantly, that they set the dividend policy ahead of other corporate policies. While in the early years of the last century dividend payout still varies according to earnings shocks, in the postwar period aggregate dividends have no correlation to earnings shocks (see Chen (2009), and Chen, Da, and Priestley (2009)). In fact, survey data indicates that dividend payers are simply content with maintaining past levels of dividends per share (Brav, Graham, Harvey, and Michaely (2005)). If payout is smoothed and delinked from earnings shocks, and if firms face financial constraints, then investment becomes the "volatile step child" (Lettau and Ludvigson (2002)) that absorbs most variation in earnings shocks.

[14] We also note that the part of the capital expenditure meant to replace depreciation and amortization does not need to be related to forward-looking variables. In untabulated results, we use Compustat data to exclude this part from capital expenditure and find very similar results as before. Therefore, replacement of depreciation and amortization is not the main driver of our results.

4.7.4 Managerial Myopia

Another possible explanation is proposed by Eisner (1978) after extensive examination of investment data. He finds that firms are "conspicuously inaccurate in predicting the timing of long-run changes in sales", which are a crucial input for investment decisions. This finding echoes well with the original insight of Keynes (1936) who said, "The average person thinks that business owners and managers know what they are doing and, in particular, know a great deal about the future return of a factory, a mine, a product, or a service. But this is not so. All human beings, even so-called experts, are mostly in the dark about the future. Their knowledge of the future amounts to little and sometimes to nothing, and their ability to make accurate, especially pinpoint, forecasts is usually nil. People in general and business investors in particular cope with their ignorance of (and anxiety about) the future by falling back on a simple convention. They assume that what has happened in the recent past will continue to happen. Unfortunately this device is arbitrary, weak and precarious. It often fails, and failure brings with it a psychological shock." If firms myopically follow current cash flow shocks to make investment decisions, we will find a strong relation between both of them in the data, regardless of news about the future that more sophisticated statistical techniques may detect.

5 Conclusions

The importance of aggregate investment is unquestionable. A long literature has made efforts to study its determinants. Yet, there is still a heated debate about what really determines investment. From an accounting identity, we show that unexpected investment, controlling for cash holding, must be driven by four components: unexpected current earnings, unexpected current returns, revisions to expectations of future cash flows, and revisions to expectations of future discount rates.

We find that current earnings shocks are the dominant driver of investment variation. This happens because neither cash holding adjustment nor net payout (external financing included), the two tools managers can use to smooth investment, vary enough to break the strong relation between earnings shocks and investment. Accordingly, the forward-looking variables, which are predicted by the q-theory to determine investment, seem to play a secondary role.

We develop a standard production-based model and compare the model predictions with empirical evidence. The combination of theory and empirical evidence enables us to examine the prevailing stories that meant to explain why current earnings shocks, rather than returns or q-variables, are major determinants of investment. We conclude that none of these stories appear to stand out as a plausible interpretation on the majority of investment variation. Crucially, we show that current earnings shocks, which explain the lion's share of investment variation, is not forward-looking. It is thus difficult to rationalize the bulk of investment variation using the standard q-theory. We provide several alternative interpretations and leave for future work to test the validity of these stories.

A Log-linear approximation

Assume that $y_t - e_t$ and $i_t - e_t$ are stationary. The parameters used in the log-linearization are:

$$
\begin{aligned}
\rho &= \frac{1}{1 + \exp\{E[y_t - e_t]\} - \exp\{E[i_t - e_t]\}} \\
\theta &= \frac{\exp\{E[y_t - e_t]\}}{\exp\{E[y_t - e_t]\} - \exp\{E[i_t - e_t]\}}
\end{aligned}
$$

A first-order Taylor approximation of the log of both sides of equation (3) around $E[y_t - e_t]$ and $E[i_t - e_t]$ give equation (5) in the text.

Empirically, $E[y_t - e_t] > E[i_t - e_t]$ so that $\rho < 1$ and $\theta > 1$ are the relevant cases. As is standard in the literature on present-value relationships we set $\rho = 0.99$. In order to obtain a consistent estimate of θ we note that the stationarity of returns, earnings growth, and investment growth imply that earnings, investment, and equity values are cointegrated. The parameter θ is part of the cointegrating vector between these variables. The ratio v_t is basically the cointegrating relationship. We run the DLS regression of Stock and Watson (1993) to estimate θ.

$$
e_t = \alpha + \beta y_t + \gamma i_t + \sum_{j=-k}^{k} [\delta_j \Delta y_{t+j} + \lambda_j \Delta i_{t+j}] + \epsilon_t
$$

Our analysis implies that $\beta = \theta$ and $\gamma = -(\theta - 1)$. In the sample period 1952:01-2008:02 and with $k = 4$ (i.e., one year), we obtain $\beta = 1.58$ and $\gamma = -0.73$. The coefficient β is estimated with slightly higher precision since its standard error is 0.17, while the standard error of γ is 0.20. We set $\theta = 1.58$ for our analysis. Our results are virtually unchanged for similar values of θ.

In order to assess the accuracy of the loglinear approximation we compare investment growth with its log-linear equivalent, i.e., we compare both sides of the following equation that is derived from equation (5) in the main text:

$$
\Delta i_{t+1} = \underbrace{\frac{1}{\theta - 1} \left(v_t - r_{t+1} + \theta \Delta y_{t+1} - \rho v_{t+1} \right)}_{\text{approximate investment growth}} \tag{36}
$$

The correlation between investment growth and its approximate version is 0.999 in the main quarterly sample. The approximation error is only 0.0019 on average and with a standard deviation of 0.0067. The correlation between investment growth and the approximation error is −0.13. See Table A1 for more details.

B Model solution

The coefficients on the investment equation are defined by:

$$
\begin{aligned}
0 &= \rho_r \phi B_k^2 + \left[(1-\rho_r)\,\phi\alpha - 1 + \rho_r(1-\phi)\right] B_k + (1-\rho_r)(1-\phi)\alpha \qquad (37)\\
B_z &= \frac{(1-\rho_r)\,\phi_z}{1-(1-\rho_r)\,\phi\alpha - \rho_r\phi_z - \rho_r\phi B_k},\\
B_x &= -\frac{[(1-\rho_r)+\rho_r B_z]\sigma_z^2}{1-(1-\rho_r)\,\phi\alpha - \rho_r\phi_x - \rho_r\phi B_k + \rho_r\sigma_{xz}}.
\end{aligned}
$$

Out of the two roots for B_k that follow from equation (37) we pick the root that implies a positive B_z.

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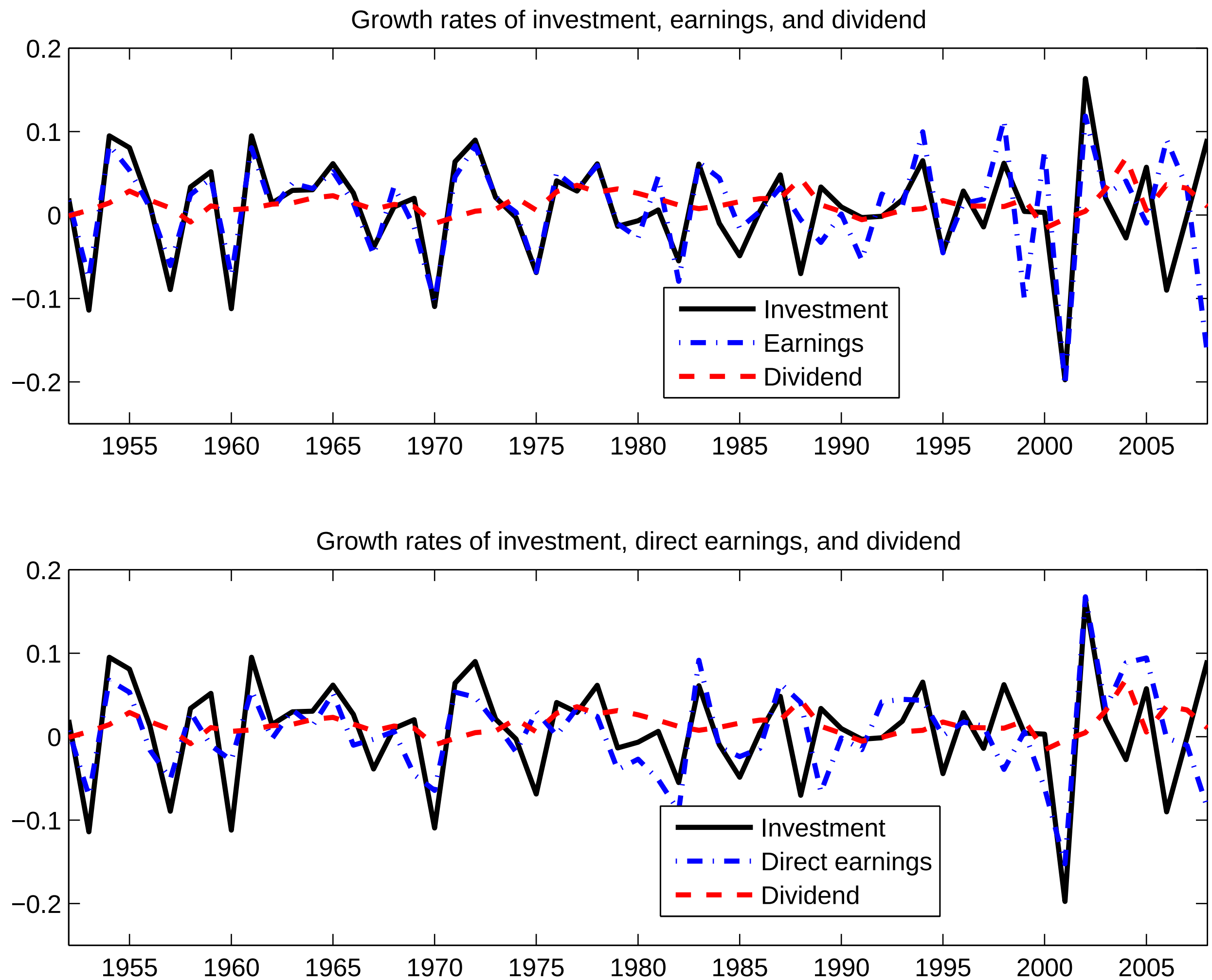

Figure 1. Earnings, Investment (equity-financed), and Dividend Growth The growth rates at quarterly frequency are constructed using data from Flow of Funds for the Non-financial Non-farm Corporate Sector. We first calculate the average numbers for year and then plot the time series at annual frequency from 1952 to 2008. Panel A uses earnings backed out from flow of fund identity while Panel B uses earnings directly reported.

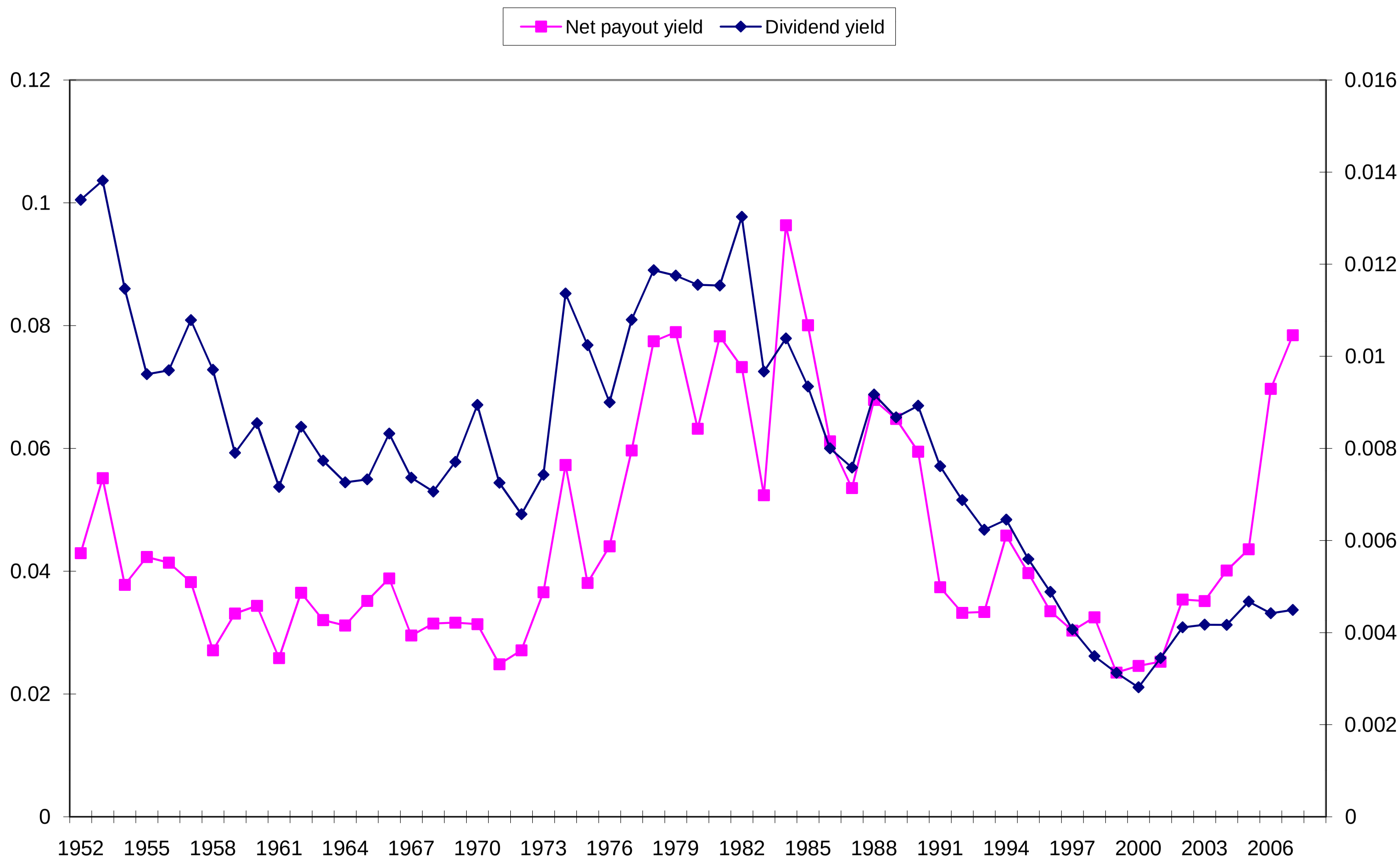

Figure 2. Net Payout Yield (left scale) and Dividend Yield (right scale) Quarterly net payout yield is constructed using data from Flow of Funds for the Non-financial Non-farm Corporate Sector. Quarterly dividend yield is taken from CRSP. We first calculate the average numbers for year and then plot the time series at annual frequency from 1952 to 2008.

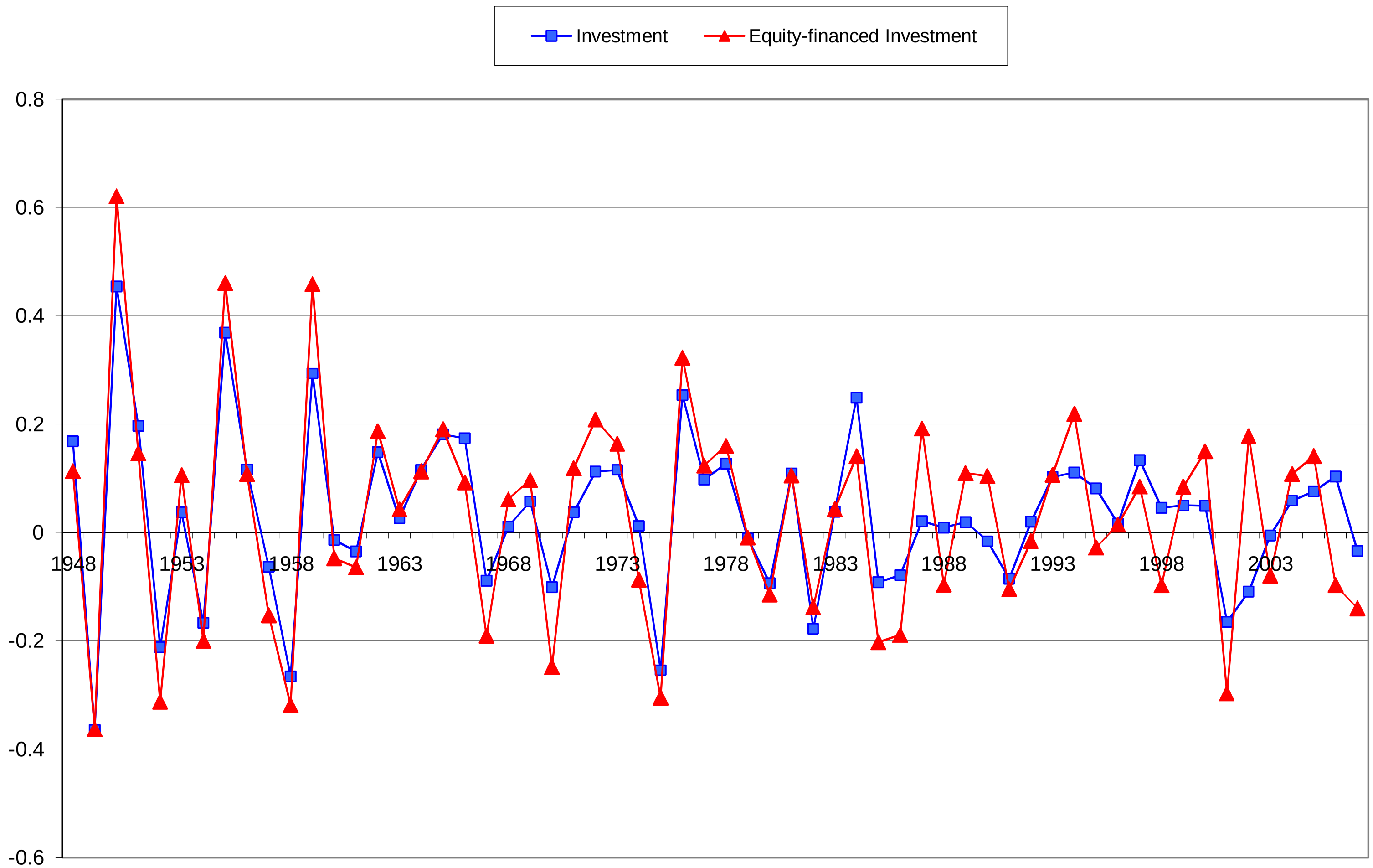

Figure 3. Investment Growth and Equity-financed Investment Growth Investment is constructed using data from Flow of Funds for the Non-financial Non-farm Corporate Sector at annual frequency from 1947 to 2008. Equity-financed investment is investment minus net debt issuance.

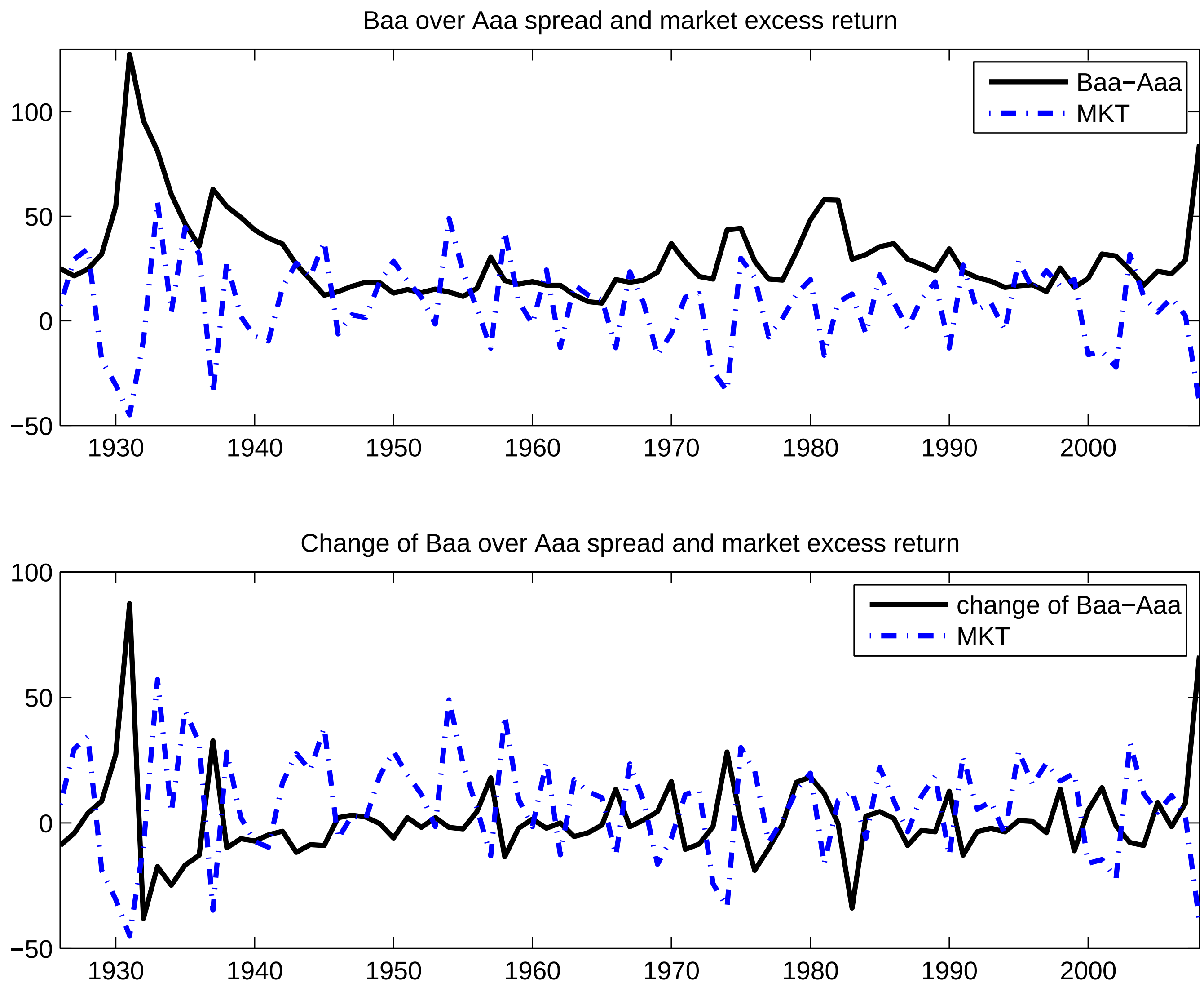

Figure 4. Credit Spread and Stock Market Return Time series relation between the aggregate Baa over Aaa yield spread and the value-weighted market return, at annual frequency, between 1917 and 2008.

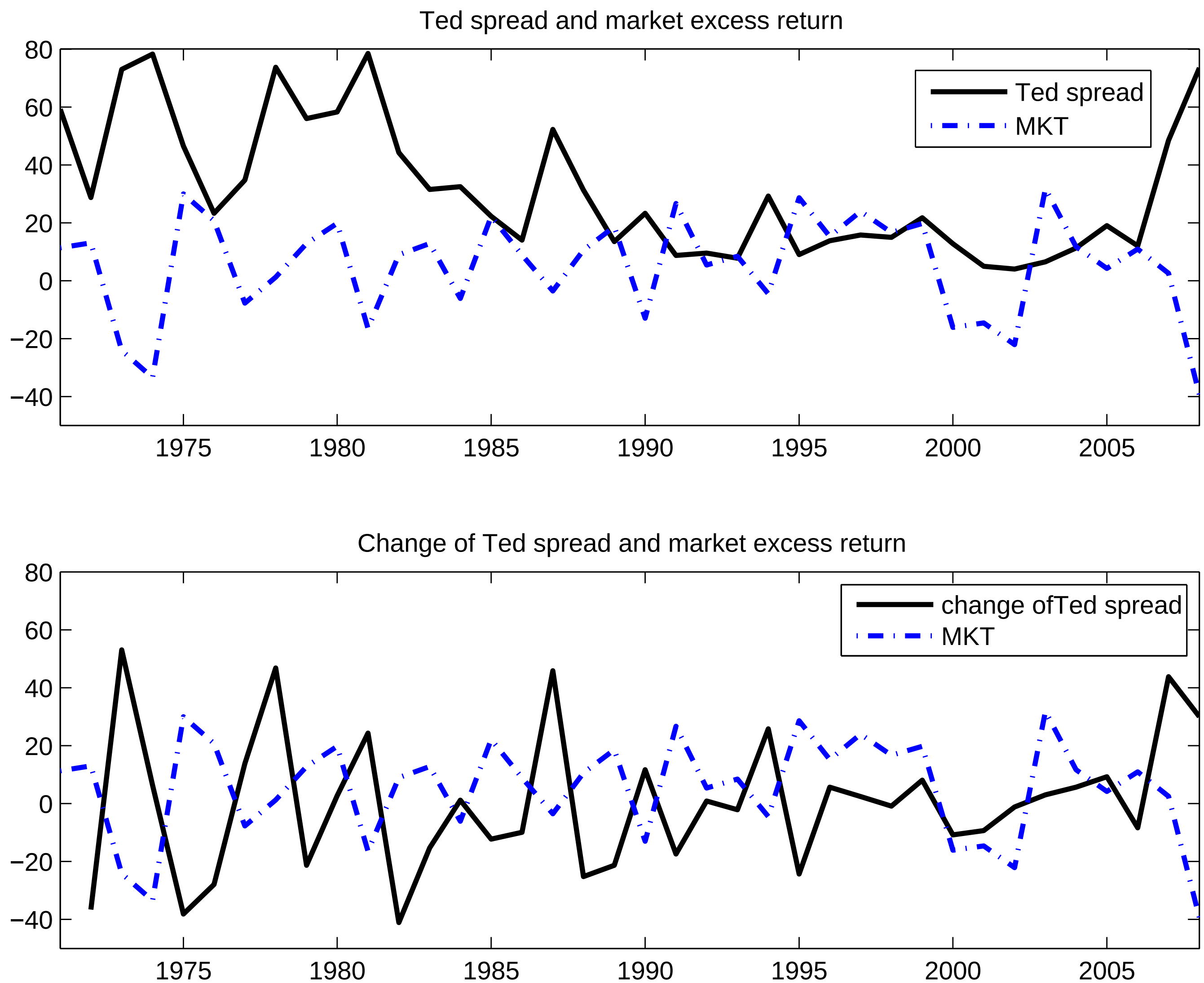

Figure 5. Ted Spread and Stock Market Return Time series relation between the Ted spread–the three-month Eurodollar rate over the three-month T-bill rate–and the market return, at annual frequency, between 1971-2008.

Table 1: Variance Decomposition: Model Implied, Quarterly

This table shows the variance decomposition results using the simple log-linear q-theory model for various parameter choices of σ_x (standard deviation of the x shock) and ρ_{xz} (correlation between x and z shocks). We decompose the variance in the unexpected investment growth rate (i) into covariances between the unexpected investment growth rate and each of its four components: ((1) Cy: current earnings news; (2)Ncf: future cashflow news; (3) Cr: current return news; and (4)Nr: future discount rate news. For easy comparison, we reproduce the variance decomposition results using the quarterly flow-of-fund data.

	MODEL							
	(1)		(2)		(3)		(4)	
σ_x	0.12		0.12		0.8		0.8	
ρ_{xz}	-1		0		-1		0	
B_k	0.1805		0.18045		0.1805		0.18045	
B_z	1.1004		1.10038		1.1004		1.10038	
B_x	-0.1129		-0.10507		-0.1957		-0.10507	
	level	**ratio**	**level**	**ratio**	**level**	**ratio**	**level**	**ratio**
Cov(i,Cy)	0.0617	227%	0.0567	246%	0.1153	122%	0.0567	189%
-Cov(i, Cr)	-0.0455	-167%	-0.0390	-169%	-0.1472	-155%	-0.0488	-163%
Cov(i,Ncf)	-0.0073	-27%	-0.0085	-37%	0.0283	30%	-0.0019	-6%
-Cov(i, Nr)	0.0181	67%	0.0139	60%	0.0983	104%	0.0240	80%
Var(i)	0.0270	100%	0.0231	100%	1.3908	100%	0.0300	100%
Corr(i, Cy)	1.00		1.00		1.00		0.87	
Corr(y, Cr)	1.00		1.00		1.00		0.91	
Corr(i,Cr)	1.00		1.00		1.00		1.00	

Table 2: Summary statistics

Quarterly data 1952:02-2008:02. All variables are expressed in real terms using the Consumer Price Index from the BLS. All data is taken from the Flow of Funds for the Non-financial Non-farm Corporate Sector, except for dividend growth and dividend yield which are taken from CRSP. Growth rates are computed as log differences and returns are in log form. The net payout yield and the dividend yield are in levels (not logs) to ease comparisons with the dividend yield.

A) Summary Stats

	Obs	Mean	Std. Dev.	Min	Max	1st Autocorr
Returns	225	0.019	0.086	-0.313	0.220	0.063
Earnings (fof) growth	225	0.009	0.153	-0.620	0.369	-0.327
Earnings (direct) growth	225	0.005	0.086	-0.410	0.228	0.186
Investment (equity-financed) growth	225	0.007	0.166	-0.750	0.438	-0.327
Investment (capx) growth	225	0.007	0.084	-0.425	0.204	-0.061
Dividend growth	225	0.014	0.019	-0.072	0.150	0.380
Net payout yield	225	0.010	0.006	0.001	0.034	0.863
Dividend yield	225	0.008	0.003	0.003	0.014	0.968

B) Correlation matrix

	Ret	Earn. fof	Earn. direct	Inv. EF	Inv. Capx	Div. Growth	NP Yield	Div. Yield
Returns	1.00							
Earnings (fof) growth	-0.14	1.00						
Earnings (direct) growth	-0.09	0.47	1.00					
Investment (equity-financed) growth	-0.13	0.81	0.52	1.00				
Investment (capx) growth	-0.07	0.65	0.51	0.73	1.00			
Dividend growth	0.09	0.03	0.03	-0.07	-0.02	1.00		
Net payout yield	-0.04	0.09	-0.12	-0.05	-0.07	0.31	1.00	
Dividend yield	-0.11	-0.06	-0.14	-0.06	-0.10	0.04	0.47	1.00

Table 3: VAR Results

The Flow of Funds data corresponds to the Non-financial Non-farm Corporate Sector. The quarterly sample covers the period 1952:02-2008:02. Investment (I) is defined as capital expenditures (CAPX) minus net debt issuance (NDI). Growth rates are computed as log differences and returns and the net payout yield are in log form. All variables are expressed in real terms using the Consumer Price Index from the BLS. Newey-West t-statistics with 4 lags are reported in parenthesis below the coefficients. The log-linearization parameters are $\theta = 1.58$ and $\rho = 0.99$.

	FLOW OF FUNDS QUARTERLY 1952-2008			
	Dependent Variable			
Lagged regressor	Return	Earnings growth	Investment growth	Net payout yield
Full VAR:				
Return	0.077	-0.038	0.074	-0.182
	(1.26)	(-0.23)	(0.46)	(-0.95)
Earnings growth	-0.075	-0.312	0.176	-0.525
	(-1.35)	(-3.76)	(2.20)	(-4.73)
Investment growth	0.041	0.029	-0.435	0.259
	(0.79)	(0.36)	(-4.77)	(2.33)
Net payout yield	0.030	-0.092	-0.092	0.887
	(2.02)	(-4.04)	(-3.77)	(28.02)
Obs	224	224	224	224
R-squared	2%	16%	16%	77%
Reduced VAR:				
Net payout yield	0.023	-0.110	-0.095	0.866
	(1.62)	(-5.24)	(-4.19)	(26.39)
Obs	224	224	224	224
R-squared	1%	8%	5%	75%

Table 4: Variance Decomposition: Quarterly FOF, Case I, 1952:02-2008:02

The Flow of Funds data corresponds to the Non-financial Non-farm Corporate Sector. The quarterly sample covers the period 1952:02-2008:02. We decompose the variance in the unexpected investment growth rate (i) into covariances between the unexpected investment growth rate and each of its four components: (1) Cy: current earnings news; (2)Ncf: future cashflow news; (3) Cr: current return news; and (4)Nr: future discount rate news. The log-linearization parameters are $\theta = 1.58$ and $\rho = 0.99$.

	Full VAR		**Reduced VAR**	
	Levels	**As fraction of Var(i)**	**Levels**	**as fraction of Var(i)**
Var(i)	0.022	1.00	0.025	1.00
Variance Decomposition:				
Cov(i,Cy)	0.046	2.08	0.050	1.98
Cov(i,Ncf)	-0.020	-0.90	-0.022	-0.90
-Cov(i, Cr)	0.003	0.12	0.002	0.10
-Cov(i, Nr)	-0.007	-0.30	-0.004	-0.18
Sum	0.022	1.01	0.025	1.00
Correlations:				
Correlation(i,Cy)	0.825		0.797	
Correlation(i,Cr)	-0.121		-0.105	
Correlation(Cy,Cr)	-0.144		-0.115	

Table 5: Variance Decomposition: Quarterly FOF, Case II, 1952:02-2008:02

The Flow of Funds data corresponds to the Non-financial Non-farm Corporate Sector. The quarterly sample covers the period 1952:02-2008:02. We use total investment and direct earnings from FOF. We decompose the variance in the unexpected investment growth rate (i) into covariances between the unexpected investment growth rate and each of its four components: (1) Cy: current earnings news; (2)Ncf: future cashflow news; (3) Cr: current return news; and (4)Nr: future discount rate news. The log-linearization parameters are $\theta = 1.58$ and $\rho = 0.99$.

	Levels	**As fraction of Var(i)**
Var(i)	0.006	1.00
Variance Decomposition:		
Cov(i,Cy)	0.009	1.42
Cov(i,Ncf)	-0.003	-0.53
-Cov(i, Cr)	0.001	0.15
-Cov(i, Nr)	-0.001	-0.17
Sum	0.005	0.86
Correlations:		
Correlation(i,Cy)	0.499	
Correlation(i,Cr)	-0.077	
Correlation(Cy,Cr)	-0.085	

Table 6: Variance Decomposition: Quarterly FOF, Case III, 1952:02-2008:02

The Flow of Funds data corresponds to the Non-financial Non-farm Corporate Sector. The quarterly sample covers the period 1952:02-2008:02. We use total investment, earnings backed out from flow of fund identity and asset return from FOF. We decompose the variance in the unexpected investment growth rate (i) into covariances between the unexpected investment growth rate and each of its four components: (1) Cy: current earnings news; (2)Ncf: future cashflow news; (3) Cr: current return news; and (4)Nr: future discount rate news. The log-linearization parameters are $\theta = 1.58$ and $\rho = 0.99$.

Var(i)	0.006	1.00
Variance Decomposition:		
Cov(i,Cy)	0.017	2.66
Cov(i,Ncf)	-0.010	-1.60
-Cov(i, Cr)	0.001	0.10
-Cov(i, Nr)	-0.001	-0.15
Sum	0.006	1.01
Correlations:		
Correlation(i,Cy)	0.676	
Correlation(i,Cr)	-0.100	
Correlation(Cy,Cr)	-0.127	

Table 7: Variance Decomposition: Quarterly FOF, Case IV, 1952:02-2008:02

The Flow of Funds data corresponds to the Non-financial Non-farm Corporate Sector. The quarterly sample covers the period 1952:02-2008:02. We use total investment, direct earnings and asset return from FOF. We decompose the variance in the unexpected investment growth rate (i) into covariances between the unexpected investment growth rate and each of its four components: (1) Cy: current earnings news; (2)Ncf: future cashflow news; (3) Cr: current return news; and (4)Nr: future discount rate news. The log-linearization parameters are $\theta = 1.58$ and $\rho = 0.99$.

Var(i)	0.006	1.00
Variance Decomposition:		
Cov(i,Cy)	0.009	1.42
Cov(i,Ncf)	-0.002	-0.35
-Cov(i, Cr)	0.001	0.11
-Cov(i, Nr)	-0.001	-0.17
Sum	0.006	1.00
Correlations:		
Correlation(i,Cy)	0.497	
Correlation(i,Cr)	-0.101	
Correlation(Cy, Cr)	-0.054	

Table 8: Variance Decomposition: Annual Compustat, 1972-2006

Annual data is obtained from COMPUSTAT/CRSP merged database. The sample covers the period 1972-2006 and excludes financial firms. We decompose the variance in the unexpected investment growth rate (i) into covariances between the unexpected investment growth rate and each of its five components: (1) Cern: current direct earnings news; (1) Ccr: current news about cash holding reduction; (3)Ncf: future cashflow news; (4) Cr: current return news; and (5)Nr: future discount rate news. The log-linearization parameters are $\theta = 1.58$ and $\rho = 0.96$.

	Full VAR		**Reduced VAR**	
	Levels	**as fraction of Var(i)**	**Levels**	**as fraction of Var(i)**
Var(i)	0.018	1.00	0.018	1.00
Variance Decomposition:				
Cov(i,Cern)	0.036	1.93	0.031	1.55
cov(i,Ccr)	-0.005	-0.25	0.004	0.18
Cov(i,Ncf)	-0.013	-0.68	-0.011	-0.57
-Cov(i, Cr)	0.016	0.84	0.016	0.78
-Cov(i, Nr)	-0.016	-0.85	-0.019	-0.94
Correlations:				
Corr(i,Cern)	0.587		0.467	
Corr(i,Ccr)	-0.105		0.028	
Corr(i,Cr)	-0.381		-0.327	
Corr(Cern,Cr)	-0.150		-0.010	
Corr(Ccr,Cr)	-0.195		-0.242	

Table 9: Regressions of Future Unexpected Investment Growth

We regress the future unexpected investment growth (F.i) on the current Cr (current return news), Nr (future discount rate news) and Ncf (future cashflow news). The LHS variables are unexpected investment growth led by 1 quarter up to 5 quarters and by 8 quarters. In the right panel, we also control for the Cy (current earnings news) during the same quarter as the unexpected investment growth (F.Cy). The quarterly sample covers the period 1952:02-2008:02. t-statistics are reported below the coefficients.

F.i	Cr	Nr	Ncf	R2/AR2	Cr	Nr	Ncf	F.Cy	R2/AR2
1	-0.022			0.1%	-0.004			0.326	67.9%
	-0.33			-0.4%	-0.09			21.55	67.6%
		0.055		0.1%		0.002		0.326	67.9%
		0.43		-0.4%		0.03		21.55	67.6%
			-0.018	0.1%			-0.001	0.326	67.9%
			-0.43	-0.4%			-0.04	21.55	67.6%
2	0.227			5.1%	0.031			0.322	67.7%
	3.43			4.7%	0.78			20.62	67.4%
		-0.233		1.5%		-0.059		0.323	67.7%
		-1.86		1.1%		-0.81		21.2	67.4%
			0.059	0.9%			0.017	0.324	67.7%
			1.44	0.5%			0.71	21.28	67.4%
3	0.218			4.7%	0.028			0.322	67.7%
	3.28			4.2%	0.69			20.62	67.4%
		-0.327		3.0%		-0.078		0.322	67.8%
		-2.6		2.6%		-1.06		20.94	67.5%
			0.094	2.3%			0.026	0.322	67.8%
			2.29	1.9%			1.08	21.05	67.5%
4	0.037			0.1%	0.018			0.324	67.6%
	0.54			-0.3%	0.46			21.28	67.4%
		-0.004		0.0%		-0.065		0.325	67.7%
		-0.03		-0.5%		-0.89		21.34	67.4%
			-0.004	0.0%			0.020	0.325	67.7%
			-0.09	-0.5%			0.83	21.33	67.4%
5	-0.088			0.8%	-0.075			0.324	68.2%
	-1.3			0.3%	-1.93			21.38	67.9%
		0.114		0.4%		0.186		0.326	68.6%
		0.89		-0.1%		2.58		21.66	68.3%
			-0.040	0.4%			-0.062	0.326	68.6%
			-0.97	0.0%			-2.63	21.66	68.3%

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8	-0.060			0.4%	-0.036			0.320	66.8%
	-0.89			-0.1%	-0.93			20.66	66.5%
		0.133		0.5%		0.063		0.319	66.8%
		1.06		0.1%		0.86		20.62	66.5%
			-0.049	0.7%			-0.023	0.319	66.8%
			-1.2	0.2%			-0.95	20.61	66.5%

Table 10: Predictive Power of the Current Earnings Shock

We regress the future investment growth and its components on the current earnings shock. Panel A uses the Flow of Fund Data at quarterly frequency from 1952:02 to 2008:02. Panel B uses the Compustat data at annual frequency from 1972 to 2006. The components of investment growth (i) are (1) Cy: current earnings news; (2)Ncf: future cashflow news; (3) Cr: current return news; and (4)Nr: future discount rate news. For compustat data, we use direct earnings news (Cern). t-statistics are reported below the coefficients.

A) The case of earnings growth and investment growth for FOF data

Future Horizon (quarter)	1	2	3	4	8	12
Cy	0.03	0.03	-0.05	0.07	0.02	-0.02
	0.40	0.38	-0.75	0.97	0.23	-0.24
i	0.01	0.00	-0.03	0.00	0.00	-0.01
	0.26	-0.16	-0.97	0.15	0.11	-0.38
Cr	0.00	0.02	0.05	0.00	0.00	-0.02
	0.13	0.74	1.70	-0.15	-0.03	-0.79
Ncf	-0.02	-0.04	-0.02	-0.05	-0.01	0.02
	-0.40	-0.91	-0.36	-1.18	-0.25	0.40
Nr	0.01	0.01	0.01	0.01	0.00	-0.01
	-0.40	-0.91	-0.52	-0.97	-0.22	0.49

B) The case of Compustat data

Future horizon (year)	1	2	3	4	5	6
Cern	-0.15	-0.17	0.08	-0.19	0.18	-0.40
	-0.73	-1.23	0.36	-0.94	0.75	-1.80
i	-0.03	-0.03	-0.03	-0.04	0.03	-0.02
	-0.55	-0.39	-0.42	-0.59	0.68	-0.34
Cr	0.02	-0.02	0.10	-0.05	0.04	-0.05
	0.24	-0.20	1.15	-0.40	0.41	-0.77
Ncf	0.00	0.02	0.02	0.00	-0.02	-0.05
	-0.08	0.26	0.32	0.01	-0.32	-1.09
Nr	0.02	-0.01	0.18	-0.12	0.03	-0.17
	-0.27	0.10	-2.69	0.99	-0.29	2.38

Table 11: Variance Decomposition: S&P500 firms, 1972-2006

Annual data is obtained from COMPUSTAT/CRSP merged database. The sample covers the period 1972-2006 and only firms in the S&P500 index. We decompose the variance in the unexpected investment growth rate (i) into covariances between the unexpected investment growth rate and each of its five components: (1) Cern: current direct earnings news; (1) Ccr: current news about cash holding reduction; (3)Ncf: future cashflow news; (4) Cr: current return news; and (5)Nr: future discount rate news. The log-linearization parameters are $\theta = 1.58$ and $\rho = 0.96$.

	Full VAR		**Reduced VAR**	
	Levels	**As fraction of Var(i)**	**Levels**	**as fraction of Var(i)**
Var(i)	0.019	1.00	0.019	1.00
Variance Decomposition:				
Cov(i,Cern)	0.034	1.59	0.030	1.44
cov(i,Ccr)	-0.006	-0.27	-0.003	-0.16
Cov(i,Ncf)	-0.015	-0.71	-0.007	-0.34
-Cov(i, Cr)	0.013	0.61	0.015	0.72
-Cov(i, Nr)	-0.004	-0.21	-0.014	-0.65
Correlations:				
Corr(i,Cern)	0.460		0.382	
Corr(i,Ccr)	-0.104		-0.087	
Corr(i,Cr)	-0.260		-0.247	
Corr(Cern,Cr)	-0.128		0.070	
Corr(Ccr,Cr)	-0.017		-0.169	

Table A1: Approximation error in log-linearization

Comparison of actual investment growth and log-linear approximation using net payout yield, earnings growth, and returns. The data comes from the Flow of Funds, quarterly 1952:01–2008:02. Investment is defined as capital expenditures minus net debt issuance.

	Exact investment growth (1)	Approximate investment growth (2)	Approximation error (1)-(2)
Mean	0.0071	0.0051	0.0020
Std. deviation	0.1655	0.1637	0.0068
Correlation with (1)	1.0000	0.9992	-0.1397