The Information Content of Dividend and Capital Structure Policies

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We reexamine signaling and agency theories and argue that the free-cash-flow hypothesis implies a stronger information effect for both over- and underinvesting firms than for value-maximizing firms. Our results indicate that dividend and capital structure policies interact to provide significant predictive information about future cash flow. We also find a U-shaped relation between the amount of information and Tobin's q. The minimum of this relation occurs near a q value of one. This outcome implies a stronger information effect for both over- and underinvesting firms than for value-maximizing firms.

■Changes in dividend and capital structure policies convey information to the stock market about the future performance of a firm. Many event studies find that dividend and pure leverage changes are associated with abnormal stock returns. However, the economic rationale for this market information effect has not been entirely resolved.

Researchers often interpret the results from many event studies as support for signaling theory. However, Jensen's (1986) free-cash-flow agency hypothesis not only predicts the same type of information effect, but also predicts that, depending upon agency considerations, different firms have different information effects. Lang and Litzenberger (1989) use Tobin's q to differentiate information effects for overinvesting firms (with Tobin's q is less than one) from all other firms. For dividend changes, Lang and Litzenberger find greater information effects for low-q firms than for high-q firms, and they interpret this result as support for the free-cash-flow hypothesis.

On the other hand, subsequent studies by Howe, He, and Kao (1992) and Denis, Denis, and Sarin (1994) examine the differential information effects of low-q and high-q firms, and find no support for the free-cash-flow hypothesis.

This paper extends the discussion along two dimensions. First, we consider a broader distinction among three types of firms: value-maximizing firms (Tobin's q close to one), overinvesting firms (q less than one), and underinvesting firms (q greater than one). By using this distinction, we can address some of the agency implications for underinvesting firms discussed by Stulz (1990). Stulz' arguments, combined with those of Jensen (1986), suggest that financing and dividend policies can reduce agency costs for both over- and underinvesting firms. Using this interpretation of the free-cash-flow hypothesis, dividend and capital structure changes should reflect a larger change in agency costs (and thus a larger information effect) for both low- and high-q firms than for firms with q values close to one.

Second, we use a time-series methodology, Geweke (1982) feedback measures (GFMs), to complement and extend the evidence provided by previous event studies. Event studies use a one-time change in dividends or leverage to construct cumulative prediction errors that can be used to measure changes in expected cash flow. In time-series methodology, a GFM is a summary statistic that measures the amount of additional information a set of variables adds to a

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time-series prediction model.

In this study, each GFM measures the extent to which dividends, capital structure, or both, predict future cash flow for a given firm over a 44-quarter sample period. A statistically significant GFM indicates that either or both of these policies provide a significant amount of information about future cash flow over time. In addition, the GFMs are cardinal measures of the amount of predictive information provided by dividend, capital structure, or both policies about future cash flow; i.e., the larger is each GFM, the more informative the policy is for that firm.

Event-study methodology is a useful way to test the free-cash-flow hypothesis, because it focuses on the market's perception of how much information major policy changes offer about future firm performance. This methodology also produces information measures that can be compared across firms. However, event-study methodology ignores any unannounced changes in a firm's dividend and capital structure policies that occur over time, and it cannot measure how the policy mix changes over time to influence agency costs and firm performance. Therefore, previous event studies have traditionally tested dividend and capital structure theories independently.

Cross-sectional studies (Gaver and Gaver, 1993, 1995; Jensen, Solberg, and Zorn, 1992; and Smith and Watts, 1992) find that dividend and capital structure policies are not independent. Their findings suggest that management might continually change the policy mix over time to influence agency costs and firm performance.

GFMs have three features that enable our analysis to complement the evidence of earlier studies. First, our time-series approach examines how the firm's mix of dividend and capital structure policies dynamically interact over time to influence firm performance. Second, we can measure the amount of predictive information for firms with different values of Tobin's q. Third, GFMs can be compared across firms to investigate cross-sectional variation in information effects for firms with different values of Tobin's q.

We use GFMs to investigate four hypotheses in a two-stage analysis. In Stage One, we examine the first three hypotheses by computing three GFMs for each firm to test whether dividends, capital structure, or both policies together provide incremental predictive information about future cash flow. A statistically significant GFM is consistent with both signaling and free-cash-flow theories. In Stage Two, we further examine the free-cash-flow hypothesis by analyzing the cross-sectional variation in the GFMs. To investigate this hypothesis, we regress the collection of feedback measures on Tobin's q and q-squared.[1]

The paper proceeds as follows. Section I discusses the previous literature on both signaling and the agency theory of free cash flow, and specifies our hypotheses. Section II develops a time-series model that relates dividend and capital structure policies to future cash flow. Section III uses this model to generate the GFMs and discusses the implications for the signaling hypothesis. Section IV examines the free-cash-flow hypothesis by relating the GFMs to firm characteristics, such as Tobin's q. The final section summarizes and concludes.

I. Signaling Theory and Agency Theory of Free Cash Flow

This section briefly describes the theory and empirical results from previous research about signaling and free-cash-flow theories for both dividend and capital structure policies. Using these theories, we generate hypotheses about the predictive information contained in dividend and capital structure policies.

A. Signaling Models

Signaling theory hypothesizes that investors can infer information about a firm's future cash flow by observing a signal, such as the amount of dividends. Firms with higher expected future cash flow wish to communicate this information to outsiders, but for signaling to work, firms with lower expected cash flow must not be able to imitate the signal, so that outsiders can rely on the signal to differentiate among firms. Therefore, firms choose signaling actions that vary systematically with the level of cash flow.

Dividend signaling models suggest that managers increase dividends only when they are confident that higher dividends can be maintained with higher subsequent cash flow. Models developed by Bhattacharya (1980), John and Williams (1985), Miller and Rock (1985), and Williams (1988) predict that higher dividends will be associated with higher subsequent cash flow. Ross (1977) developed a capital structure signaling model that also predicts that higher leverage will be associated with higher cash flow. Similar capital structure signaling models include Heinkel (1982), Blazenko (1987), and John (1987).

Signaling models have been tested empirically in two ways. First, event studies examine changes in a signaling variable and observe the market reaction. Thus, such studies can investigate whether expected cash flow responds systematically. The dividend-signaling hypothesis

[1]Other studies that use GFMs in a two-stage analysis of differences in dynamic relations across different samples of multivariate time-series include those of Koch and Ragan (1986), Kawaller, Koch, and Koch (1993), and Bracker, Docking, and Koch (1999).

is supported in many event studies.[2]

The capital-structure-signaling hypothesis also receives support in several event studies of equity-for-debt and debt-for-equity exchanges. These studies of pure leverage changes often find a positive announcement effect for leverage increases and a negative reaction for leverage decreases, consistent with predictions from signaling theory. In contrast, studies of other types of leverage changing events do not consistently support the leverage-signaling hypothesis.[3]

A second set of empirical studies uses a time-series methodology to investigate the dynamic linkage between the signaling variable and earnings or cash flow. When an event study documents a contemporaneous relation between policy changes and market value, this information effect implies a concomitant relation between policy changes and expected future cash flow. To the extent that expectations are eventually realized, this information effect also implies a predictable time-series relation between the firm's policy variables and realized future cash flow.

Some empirical studies directly investigate this dynamic time-series relation. Lintner (1956), Fama and Babiak (1968), Ofer and Siegel (1987) and Dhillon, Raman, and Ramirez (1998) find support for dividend signaling by examining a time-series of dividends and earnings. However, Watts (1973), Gonedes (1978), and Benartzi, Michaely, and Thaler (1997) do not find any such relation between dividends and subsequent earnings.

Less attention has been given to the time-series relations implied by the capital-structure-signaling hypothesis. Cornett and Travlos (1989) examine changes in earnings after exchange offers, and find a subsequent positive change in earnings. Shenoy and Koch (1996) also find a positive time-series relation between leverage and subsequent cash flow. Their finding is consistent with signaling theory.

Other related time-series studies include Ely and Mande (1996), Finger (1994), Lorek and Willinger (1996), Shih (1996), and Vogt (1997). There is also a substantial related accounting literature that uses time-series methodology to address the potential determinants of earnings response coefficients. See Kallapur (1994).

B. Agency Models of Free Cash Flow

By definition, given a level of free cash flow, value-maximizing firms pursue optimal dividend and capital structure policies. Therefore, for a value-maximizing firm, changes in dividends or capital structure over time represent adjustments to realign optimal policies. Such policies do not reduce agency costs.

Lang and Litzenberger (1989) show that the free-cash-flow hypothesis implies that dividends will have a larger impact on agency costs, and thus a larger information effect, for an overinvesting firm (whose Tobin's q is less than one) than for a value-maximizing firm (whose Tobin's q is close to one).

Jensen (1986) argues that firms can mitigate managers' ability to overinvest by committing to a higher level of dividends or debt, thus reducing the free cash flow available for overinvestment. This increase in dividends or leverage reduces agency costs for overinvesting firms and leads to an increase in return on investment over time. The reduction in the agency costs provides a different rationale for increases in dividends or leverage to be perceived as good news for overinvesting firms. Thus, for overinvesting firms, event-study results that are consistent with the signaling hypothesis are also consistent with the free-cash-flow hypothesis.

The timing of the decrease in agency costs for overinvesting firms differs for dividends and capital structure. An increase in dividends immediately reduces the cash available for overinvestment. For capital structure changes, the effect is similar, although not as immediate. For example, an increase in leverage due to a debt offering will initially provide more cash for possible overinvestment, but over time the higher interest expense will decrease the cash available for overinvestment. In a cross-section of firms, those firms with higher leverage should have lower agency costs of free cash flow, ceterus paribus, because more cash is committed to interest payments.

Several studies have empirically tested these implications of the free-cash-flow theory and have had mixed results. Lang and Litzenberger (1989) partition a sample of dividend changes into two groups, those for firms with q values less than one and those for firms with q values greater than one. They find that low-q firms have larger abnormal returns than high-q firms do, and they interpret this result as consistent with the free-cash-flow hypothesis. Using an analogous methodology, Howe, He, and Kao (1992) examine a sample of share repurchases and special dividends. However, they find no significant differences across low- and high-q firms. Denis, Denis, and Sarin (1994) reexamine a sample of dividend changes, and after controlling for dividend yield, find no significant differences between low- and high-q firms.[4]

[2]These include Aharony and Swary (1980), Brook, Charlton and Hendershott (1998), Dann (1981), Dewenter and Warther (1998), Healy and Palepu (1988), Howe and Shen (1998), Koski and Scruggs (1998), Laux, Starks and Yoon (1998), Lipson, Maquiera, and Megginson (1998), Pettit (1972), and Yoon and Starks (1995).

[3]See Akhigbe, Easterwood, and Pettit (1997), Harris and Raviv (1990), Masulis (1988), Vermaelen (1981 and 1984), and Vogt (1994 and 1997).

[4]Other studies that test the free-cash-flow hypothesis either directly or indirectly include Chen and Ho (1997); McLaughlin, Safieddine, and Vasudevan (1996, 1998); Szewczyk, Tsetsekos, and Zantout (1996); and Vogt (1994, 1997). Studies that address other agency issues related to capital structure include Chenchuramaiah, Moon, and Rao (1994); Dyl and Weigand (1998); Gaver and Gaver (1993, 1995); and Holder, Langrehr, and Hexter (1998).

We expand the discussion to include underinvesting firms. An underinvesting firm whose Tobin's q is greater than one has unexploited positive-NPV investment opportunities, which could, if undertaken, increase firm value. Stulz (1990) demonstrates how capital structure policy can reduce the agency costs of underinvestment. He argues that firms with limited expected free cash flow and good investment opportunities could want management to raise more equity. Although this action would decrease leverage, it would increase the likelihood that all good investment opportunities would be undertaken. Using equity rather than debt also increases managerial flexibility, so that managers and shareholders might prefer to increase equity financing so as to take full advantage of all attractive projects.

Similarly, a reduction in dividends enhances an underinvesting firm's capacity to undertake all attractive investment opportunities. Thus, for underinvesting firms, a decrease in dividends or leverage reduces agency costs and increases future cash flow.

Our discussion of agency considerations describes a dynamic predictive relation between dividends or leverage and future cash flow that differs in sign and in magnitude across overinvesting, underinvesting, and value-maximizing firms. For overinvesting firms, an *increase* in dividends or leverage, or both, reduces agency costs, subsequently increasing return on investment and operating cash flow (assuming the scale of investments does not decrease). In contrast, for underinvesting firms a *decrease* in dividends or leverage, or both, allows additional investment in positive-NPV projects, which should ultimately increase operating cash flow. Finally, for value-maximizing firms, changes in dividends or capital structure over time do not reduce agency costs. Therefore, these changes provide less predictive information about firm performance. Our observations suggest that in an empirical test, the free-cash-flow hypothesis implies a positive relation between the policy variables and future cash flow for overinvesting firms, a negative relation for underinvesting firms, and little or no relation for value-maximizing firms.

The possibility of a systematic association between the signs of the predictive relations (between dividend or capital structure policies and future cash flow) and the firm's tendency to over- or underinvest (Tobin's q) is not amenable to empirical testing. In this paper, we emphasize the related implication that the amount of incremental predictive information provided by the policy variables should also vary systematically across overinvesting, underinvesting, and value-maximizing firms. That is, dividend or capital structure policies, or both, should have a greater effect on agency costs (and therefore a greater information effect) for both over- and underinvesting firms than they do for value-maximizing firms.

The rationale for this premise is that value-maximizing firms (those firms with q values close to one) are more likely to adjust dividend and capital structure decisions to optimize financial structure, and consequently less likely to use dividend commitments and debt promises to control agency costs. Thus, under the free-cash-flow hypothesis, we expect a stronger predictive relation for firms with q values greater than or less than one and a weaker predictive relation for firms with q values close to one. As a result, if the arguments of both Jensen (1986) and Stulz (1990) apply, we should observe a U-shaped relation between Tobin's q and the absolute magnitude of the information content of a firm's policies.

A possible confounding aspect of our analysis regards firms that earn monopoly rents. Although a value-maximizing firm in a competitive industry should have a q value close to one, a value-maximizing firm that enjoys monopoly rents will have a q value greater than one. In the context of monopolistic competition, such a firm could be minimizing agency costs and maximizing profits. Dividend and capital structure policies for a value-maximizing, high-q firm should not affect agency costs. The presence of this type of firm in our sample should dilute the average information effect for all high-q firms, and therefore bias the results against finding a larger information effect for high-q firms.

Over the sample period, some firms substitute share repurchases for dividends. However, we exclude repurchases from this analysis. This exclusion could be justified, as repurchases do not commit management to further payouts and therefore might represent an inferior means to control agency costs. Still, repurchases do either remove free cash flow from managers' discretion, or they can signal management's belief that shares are undervalued. Therefore, the exclusion of repurchases could bias the results against finding an information effect for low-q firms through dividends. Since this phenomenon would make it less likely for our approach to detect a U-shaped relation, the exclusion of repurchases represents a conservative approach.

C. Implications and Hypotheses

Signaling models do not address the agency costs of free cash flow, which we proxy with Tobin's q, and therefore do not predict any association between the information content of a firm's policies and Tobin's q. On the other hand, the free-cash-flow model does address agency costs. Thus, although both the signaling and free-cash-flow models imply that dividends or capital structure, or both, should provide information about future cash flow, the free-cash-flow model predicts a U-shaped relation between Tobin's q and the information content of a firm's policies. The least amount of information is provided by value-maximizing firms with q values close to one.

To test these issues, we state four hypotheses. The first three hypotheses address whether any predictive information is provided by the two policies, both individually and interactively.

H_1: Dividend policy provides incremental predictive information about future cash flow.

H_2: Capital structure policy provides incremental predictive information about future cash flow.

H_3: Both dividend and capital structure policies interact to provide incremental predictive information about future cash flow.

Support for H_1, H_2, or H_3 is consistent with both the signaling and free-cash-flow agency theories.

The fourth hypothesis distinguishes the free-cash-flow hypothesis from the signaling hypothesis:

H_4: Either dividend or capital structure policies (or both) provide more predictive information about future cash flow for firms with values of Tobin's q greater than or less than one, and less predictive information for firms with q values close to one.

II. Joint Determination of Cash Flow, Dividends, and Leverage

Operating cash flow is a function of a firm's cumulative past investment decisions. In turn, past investment decisions depend on the amount of cash available in prior periods, plus the relative amounts of debt and equity issued in previous periods, minus any dividend disbursements in those periods. Outsiders do not know the exact functional form of the relation between current cash flow and prior levels of cash, leverage, and dividends, nor can they observe the investment made by managers in any period. But outsiders can observe dividends and leverage in any period and, according to signaling theory, they can infer managerial expectations of future operating cash flow from their observations. Outside investors can also observe the effect of past investment decisions, that is, operating cash flow in the current period.

Our discussion suggests that a firm's current cash flow depends in part on past cash flow and past movements in the two policy variables, dividends (D_t) and leverage (L_t). Signaling theory and the free-cash-flow hypothesis focus on how changes in the policy variables affect subsequent changes in cash flow. Thus, we build a predictive model of cash flow based on historical values of cash flow, dividends, and leverage:

$$CF_t = \sum_{k=1}^{m} \alpha_{1k} CF_{t-k} + \sum_{k=1}^{m} \alpha_{2k} D_{t-k} + \sum_{k=1}^{m} \alpha_{3k} L_{t-k} + u_t \qquad (1)$$

where

CF_t = earnings before interest, taxes, and depreciation, scaled by total assets,

L_t = book value of long-term debt divided by the sum of the book value of long-term debt and the market value of equity,

D_t = dividends per share, adjusted for stock splits and stock dividends (from CRSP distributions tape), and

u_t = a disturbance term with variance σ^{2}.

Dividends and leverage can also depend on their own past values, the past values of the other policy variable, and past cash flow, as follows:

$$D_t = \sum_{k=1}^{m} \beta_{1k} CF_{t-k} + \sum_{k=1}^{m} \beta_{2k} D_{t-k} + \sum_{k=1}^{m} \beta_{3k} L_{t-k} + v_t \qquad (2)$$

$$L_t = \sum_{k=1}^{m} \gamma_{1k} CF_{t-k} + \sum_{k=1}^{m} \gamma_{2k} D_{t-k} + \sum_{k=1}^{m} \gamma_{3k} L_{t-k} + w_t \qquad (3)$$

Taken together, Equations (1), (2), and (3) can be considered as a system of seemingly unrelated regressions in which each disturbance term is assumed to be not autocorrelated. However, the three disturbances can be contemporaneously correlated with each other. We include lag lengths of m equals four quarters on all distributed lags, ensuring that the firm's policy changes from the previous year can influence cash flows in the next year. We include quarterly indicator variables in all three equations to account for any seasonality in CF_t, D_t, or L_t.[5]

We also perform the analysis using a book value definition of leverage that uses total assets as the denominator.[6] Both variables have a potential confounding effect with cash flow. A market value definition of equity contains expectations of all future cash flows, and a book value definition contains past cash flows. This potential confounding relation does not appear to be driving our results since the results are generally robust with respect to the definition of leverage. Furthermore, with either leverage definition,

[5]We have also applied the analysis using longer lag lengths of eight quarters on all distributed lags, with robust results (available on request). Analysis of lag lengths longer than eight quarters is not possible given the available degrees of freedom. We investigate the null hypothesis that each disturbance term is not autocorrelated for every firm in the sample, by conducting the Ljung-Box test on the autocorrelation function of the residuals, using 12 quarterly lags. Results generally support the white-noise hypothesis.

[6]For comparison, we can provide a report on request that shows the estimation results using both definitions of leverage for six sample firms.

the association between leverage and cash flows is the weakest of the three relations investigated.

III. Measuring the Information Content of Dividend and Capital Structure Policies

In this section, we show the details of calculating GFMs, and we discuss how these measures differ from the more traditional Wald F statistic. We present the Stage One results of our analysis.

A. Calculating Geweke Feedback Measures (GFMs)

We investigate our first three hypotheses by examining the coefficients on lagged dividends and lagged leverage in Equation (1). We estimate the predictive relation between dividends and future cash flow by the coefficients α_{2k}, the relation between leverage and future cash flow by α_{3k}, and the joint relation between both dividends and leverage and future cash flow by α_{2k} and α_{3k}. We investigate these predictive relations by conducting tests for absence of Granger causality (Granger, 1969; Geweke, 1982). Since all three predictive relations involve the cash flow Equation (1), we compare the residual variance of this equation, σ^2, with and without appropriate restrictions imposed.

We examine the predictive relation between dividends and future cash flow by relating the first null hypothesis to restrictions on the appropriate coefficients in Equation (1):

H_1: Dividend policy provides no predictive information about future cash flow (α_{2k} equals zero).

Under the null hypothesis of no Granger causality between dividends and cash flow in either direction, we impose the joint restriction that a_{2k}equals zero in Equation (1) and β_{1k}equals zero in Equation (2). Thus, we derive the first restricted model:

$$CF_t = \Sigma\alpha'_{1k}CF_{t-k} + \Sigma\alpha'_{3k}L_{t-k} + u_{Rlt} \quad (4)$$

$$D_t = \Sigma\beta'_{2k}D_{t-k} + \Sigma\beta'_{3k}L_{t-k} + v_{Rlt} \quad (5)$$

$$L_t = \Sigma\gamma'_{1k}CF_{t-k} + \Sigma\gamma'_{2k}D_{t-k} + \Sigma\gamma'_{3k}L_{t-k} + w_{Rlt} \quad (6)$$

The residual variance of the cash flow equation for this restricted model is denoted as σ^2_{R1}.

Next, we consider the predictive relation between leverage and future cash flow. This relation can be investigated by relating the second null hypothesis to restrictions on the appropriate coefficients in Equation (1):

H_2: Capital structure policy provides no predictive information about future cash flow (α_{3k} equals zero).

To test the leverage relation, we construct a second restricted model. This model is analogous to the first restricted model above, except that now we impose the joint restriction of no interaction between leverage and cash flow in either direction (α_{3k}equals zero in Equation (1) and γ_{1k}equals zero in Equation (3)). The residual variance of the cash flow equation for this second restricted model is denoted as σ^2_{R2}.

Last, we examine how both policy variables interact to predict cash flow. We investigate the information provided by dividends and leverage together by re-specifying the third null hypothesis:

H_3: H_1 and H_2, neither dividend nor capital structure policies predict future cash flow (α_{2k} equals α_{3k} equals zero).

We investigate this joint hypothesis by specifying a third restricted model with no interaction between dividends and cash flow or between leverage and cash flow, in either direction (α_{2k} equals α_{3k} equals zero in Equation (1); β_{1k} equals zero in Equation (2); and γ_{1k} equals zero in Equation (3)). The residual variance of the cash flow equation for the third restricted model is denoted as σ^2_{R3}.

We estimate the unrestricted system in Equations (1), (2), and (3), and each restricted model as a set of seemingly unrelated regressions. We then investigate H_1, H_2, and H_3 using the estimated residual variance from the cash flow equation in the unrestricted model ($\hat{\sigma}^2$) along with the analogous residual variances from the three restricted models ($\hat{\sigma}^2_{R1}$, $\hat{\sigma}^2_{R2}$, and $\hat{\sigma}^2_{R3}$), to compute the Geweke (1982) feedback measures:

$$(n)(GFM_D) = \ln(\hat{\sigma}^2_{R1}/\hat{\sigma}^2) \overset{a}{\sim} \chi^2_m$$
under H_1 (no dividend feedback)

$$(n)(GFM_L) = \ln(\hat{\sigma}^2_{R2}/\hat{\sigma}^2) \overset{a}{\sim} \chi^2_m$$
under H_2 (no leverage feedback)

$$(n)(GFM_{DL}) = \ln(\hat{\sigma}^2_{R3}/\hat{\sigma}^2) \overset{a}{\sim} \chi^2_{2m}$$
under H_3 (no dividend or leverage feedback)

where

n = the number of observations in the time-series for each firm

m = the lag length on all distributed lags

Each feedback measure has an asymptotic χ^2 distribution under each respective null hypothesis. In our analysis, n equals 40 quarters and m equals four quarterly lags. (Four lags means the loss of four quarterly observations.)

The GFMs are the log-likelihood ratio statistics for testing H_1, H_2, and H_3. As with other methodologies used to test for absence of Granger causality (such as the Wald F test), we can compute the appropriate marginal significance level for each feedback measure and either reject or fail to reject the null hypothesis in question. A rejection of H_1, H_2, or H_3 (a larger GFM) would result from coefficients, α_{2k} and α_{3k}, that are larger in absolute value, or that have smaller standard errors, or both. A rejection implies that dividend or capital structure policies, or both, offer significant predictive information about future cash flow. This finding would be consistent with both signaling and free-cash-flow agency theories.

To address the further implications of the free-cash-flow hypothesis specified in H_4, we exploit the distributional theory for each GFM. Since the asymptotic distribution of each GFM is known under the alternative hypothesis that feedback is present,[7] each GFM represents a cardinal measure of the amount of incremental predictive information provided by dividends, leverage, or both about future cash flow. Therefore, we can compare the feedback measures across firms to investigate how and why different firms have dividend or capital structure policies with different amounts of predictive information. This additional analysis is not possible with other methodologies, such as the Wald F test.[8]

We analyze cross-sectional variation in the GFMs to investigate the implications of the free-cash-flow hypothesis specified in H_4. Under the free-cash-flow hypothesis, we expect a stronger predictive relation (greater GFMs) for firms with q values greater or less than one, and a weaker predictive relation for firms with q values close to one. Therefore, we anticipate a U-shaped relation between Tobin's q and the amount of information contained in a firm's policies (the GFMs).

Although this methodology enables a novel investigation of the free-cash-flow hypothesis as specified in H_4, the methodology has its limitations. For example, under the free-cash-flow hypothesis, in addition to expecting different amounts of information for overinvesting, value-maximizing, and underinvesting firms, we also expect different signs for the coefficients (α_{2k} and α_{3k}) that describe the predictive relations for overinvesting and underinvesting firms. However, like other time-series tests, such as the Wald F test, GFMs are nonnegative. By examining the size of the reduction in the residual variance for the cash flow equation when the coefficients, α_{2k} or α_{3k} appear in the model, the GFMs indicate the magnitude of the relevant predictive relation for each firm. The GFMs do not show the signs of these coefficients. Therefore, the GFMs do not distinguish the expected positive relation from dividends, capital structure (or both) to future cash flow for overinvesting firms, nor the expected negative relation for underinvesting firms.

We could examine all the individual dividend and leverage coefficients from the cash flow Equation (1), and compare the signs of coefficients across firms with different values of Tobin's q. However, such an examination would be cumbersome and beyond the scope of this study. Instead, we focus on the GFMs as appropriate measures of the magnitude of the predictive relations that are the focus of our four hypotheses.[9]

B. Estimated Geweke Feedback Measures and the Information Content of Dividends and Leverage

We estimate the three feedback measures for each firm, using quarterly data from 1979 through 1989. Our sample comprises 249 firms with a complete set of 44 quarters of Compustat and CRSP data. Our analysis results in three sets of 249 feedback measures.[10] Each set measures the amount of predictive information conveyed by one or both policy variables for all sample firms.

There can be potential limitations associated with quarterly data. Quarterly data are voluntarily provided and unaudited. Some firms provide quarterly statements for several years and then stop for several years. There are relatively few firms that have consistently provided quarterly data since 1979. Because firms that choose to have consistent quarterly statements may be different from other firms, our results may be sample-specific.

The results of our analysis are summarized in Table 1 and in Figures 1-3. Table 1 illustrates the frequency of rejections for each respective null hypothesis at various levels of significance. Figures 1 through 3 plot the frequency distribution histograms for each set of feedback measures.

Table 1, Panel A and Figure 1 summarize the results for the first set of feedback measures, that describe the predictive information provided by dividends (GFM_D) for all sample firms. Panel A indicates that 22 of these 249 firms paid no dividends during the sample

[7]Under each alternative hypothesis to H_1, H_2, or H_3, the relevant Geweke feedback measure has an asymptotic noncentral χ^2 distribution. See Geweke (1982) for details.

[8]As Geweke states (1981), "For tests used in time series … only an asymptotic distribution theory is available, and then often only under the null hypothesis."

[9]For the interested reader, we can provide a report that lists the coefficient estimates of the cash flow equation for six sample firms with different values of Tobin's q. This report supports the above intuition regarding the expected signs and magnitudes of the predictive relations examined in this paper for firms with different values of Tobin's q, along with providing additional details regarding the construction of the GFMs.

[10]A complete listing of all three sets of the 249 GFMs is available on request.

Table 1. Distribution of Estimated Geweke Feedback Measures

This table lists the frequency of Geweke feedback measures for different levels of significance. The GFMs are the log-likelihood ratio statistics for testing the hypotheses H_1, H_2, and H_3 that dividends, leverage, or both provide incremental information about future cash flow. GFM_D measures information from dividends, GFM_L measures information from leverage, and GFM_{DL} information from both dividends and leverage. The p-values are based on χ^2 distributions. GFM_L and GFM_D have an asymptotic χ^2 distribution with four degrees of freedom. GFM_{DL} has an asymptotic χ^2 distribution with eight degrees of freedom.

Panel A. H_2: Distribution of Geweke Feedback Measures for Dividends

Values of GFM_D	p-Values for GFM_D	Frequency
$18.5 < GFM_D$	$p < 0.001$	17
$13.3 < GFM_D < 18.5$	$0.001 < p < 0.01$	28
$9.5 < GFM_D < 13.3$	$0.01 < p < 0.05$	30
$7.8 < GFM_D < 9.5$	$0.05 < p < 0.10$	25
$0 < GFM_D < 7.8$	$0.10 < p < 1.00$	127
No Dividends: $GFM_D = 0$	$p = 1.00$	22
Average Value	7.56	249

Panel B. H_2: Distribution of Geweke Feedback Measures for Leverage

Values of GFM_L	p-Values for GFM_D	Frequency
$18.5 < GFM_L$	$p < 0.001$	12
$13.3 < GFM_L < 18.5$	$0.001 < p < 0.01$	34
$9.5 < GFM_L < 13.3$	$0.01 < p < 0.05$	31
$7.8 < GFM_L < 9.5$	$0.05 < p < 0.10$	22
$0 < GFM_L < 7.8$	$0.10 < p < 1.00$	150
Average Value	7.50	249

Panel C. H_3: Distribution of Geweke Feedback Measures for Both Dividends and Leverage

Values of GFM_{DL}	p-Values for GFM_D	Frequency
$26.1 < GFM_{DL}$	$p < 0.001$	47
$20.1 < GFM_{DL} < 26.1$	$0.001 < p < 0.01$	52
$15.5 < GFM_{DL} < 20.1$	$0.01 < p < 0.05$	42
$13.4 < GFM_{DL} < 15.5$	$0.05 < p < 0.10$	25
$0 < GFM_{DL} < 13.4$	$0.10 < p < 1.00$	83
Average Value	17.85	249

Figure 1. Histogram of GFM_D

This figure shows the distribution of Geweke feedback measures for dividends, GFMD. The shaded area indicates that the feedback measures are statistically significant at the 0.05 level. The feedback measures have an asymptotic χ^2 distribution with four degrees of freedom. This distribution is superimposed on the histogram.

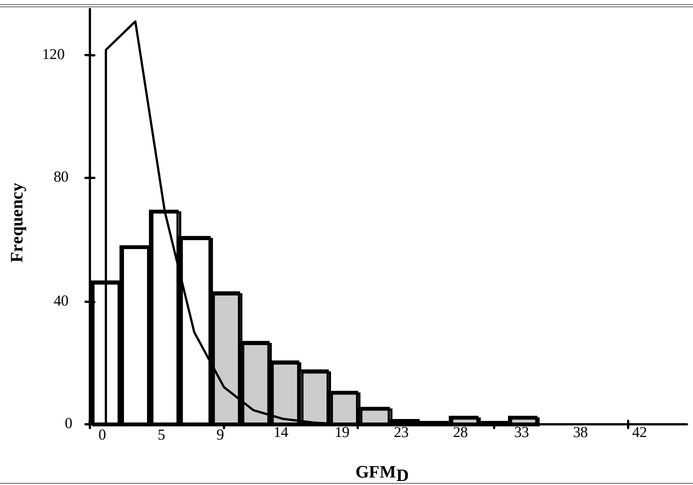


Figure 2. Histogram of GFM_L

This figure shows the distribution of Geweke feedback measures for leverage, GFM_L. The shaded area indicates that the feedback measures are statistically significant at the 0.05 level. The feedback measures have an asymptotic χ^2 distribution with four degrees of freedom. This distribution is superimposed on the histogram.

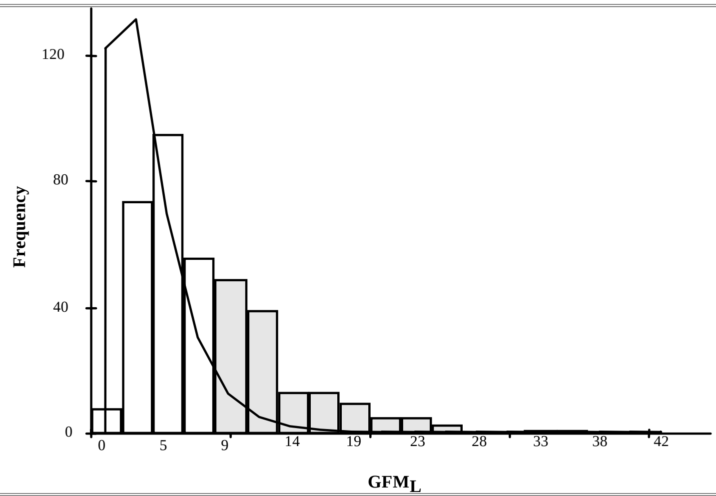
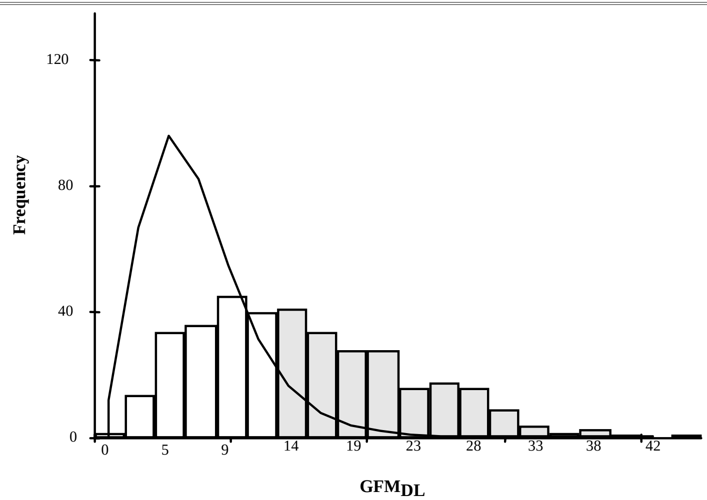


Figure 3. Histogram of GFM_{DL}

This figure shows the distribution of Geweke feedback measures for dividends and leverage together, GFM_{DL}. The shaded area indicates that the feedback measures are statistically significant at the 0.05 level. The feedback measures have an asymptotic χ^2 distribution with eight degrees of freedom. This distribution is superimposed on the histogram.



period. These non-dividend-paying firms have a GFM_D equal to zero, since dividends provide no incremental information about cash flow. Of the 227 remaining dividend-paying firms, Panel A indicates a rejection of H_1 for 100 firms at the 0.10 level of significance or higher, and for 45 firms at the 0.01 level of significance. Although there is substantial variation across firms, the average GFM_D for all 249 firms is 7.56, which is not statistically significant at the 0.10 level The average GFM_D for the subsample of 227 dividend-paying firms is 8.3, which is statistically significant at the 0.10 level.

Table 1, Panel B and Figure 2 show that for 99 of the 249 sample firms, leverage provides significant predictive information about future cash flow at the 0.10 level or better. Again, although there is substantial variation across these feedback measures, the average GFM_L in this collection is 7.5, which is not statistically significant.

Table 1, Panel C and Figure 3 present a contrasting picture regarding the amount of predictive information provided by the interaction of both policies (GFM_{DL}). Panel C shows that H_3 is rejected for 166 of the 249 firms at the 0.10 level or higher. Furthermore, the average GFM_{DL} in this panel is 17.85, which is statistically significant at the 0.05 level. We conclude that dividends and capital structure interact to provide significant information regarding future cash flow for most firms, and their joint influence is significant for the average firm.

We wish to see if firms that have a significant dividend information effect are the same firms that have a significant leverage information effect. Therefore, we compare the number of GFMs with approximate marginal significance levels (p-values) in each row of Panel C (Table 1) with the analogous numbers from Panels A and B combined. For example, if firms with significant information effects from dividends were entirely different from the firms with significant information effects from leverage, the number of rejections of H_3 (in Panel C) would approximately equal the sum of rejections of H_1 and H_2 (Panels A and B).[11] Instead, Panel C shows more p-values below 0.001 than we see in Panels A and B combined (47 > 17+12). Panel C also shows fewer p-values between 0.001 and 0.10 than appear in Panels A and B combined. This observation confirms the information conveyed by Figure 3 relative to Figures 1 and 2, indicating that the distribution of the estimated GFM_{DL} measures moves further into the right tail of the χ^2 distribution. These results imply that the interaction of dividends and leverage conveys new predictive information beyond that provided by dividends or leverage separately.

IV. Firm Characteristics and the Free-Cash-Flow Hypothesis

This section is Stage Two of our analysis. By using the GFMs in three different regression models, we investigate the association between different firm characteristics and the amount of predictive information. With these regression models, we test H_4 to distinguish between the signaling and free-cash-flow hypotheses.

A. A Quadratic Regression Analysis of the Free-Cash-Flow Hypothesis

As specified in H_4, under the free-cash-flow hypothesis dividends or capital structure, or both, should provide greater predictive information for over- and underinvesting firms than for value-maximizing firms. This hypothesis is consistent with a nonlinear U-shaped relation between each set of feedback measures and Tobin's q. The estimated minimum q value of the quadratic relation should occur at q value equal to one. We investigate H_4 by regressing each collection of feedback measures on Tobin's q and q^2:

$$GFM_{ij} = b_0 + b_1 q_j + b_2 q_j^2 + \varepsilon_{ij} \quad i = D, L, \text{ or } DL; \quad j = 1 \text{ to } 249 \text{ firms} \qquad (7)$$

To calculate the q values, we follow Lindenberg and Ross (1981), with the modifications suggested by Perfect and Wiles (1994).[12] For each firm, we compute an average annual q value over the 11-year sample period, 1979 through 1989, which corresponds to the period used to compute the GFMs.

Our results appear in Table 2. The coefficient of q_j^2 is positive in all three regressions, and is significantly greater than zero in the two regressions on GFM_D and GFM_{DL}. The implied U-shaped parabolic function has a minimum at a q value near one in all three cases, which is consistent with the free-cash-flow hypothesis (the minimum for GFM_D is at a Tobin's q value of 1.16; for GFM_L at a q of 1.06; and for GFM_{DL} at a q of 1.14).[13]

B. An Expanded Analysis of the Free-Cash-Flow Hypothesis

Although the regression results in Table 2 are consistent with the free-cash-flow hypothesis, these results should be interpreted with some caution. The r^2 values in Table 2 indicate substantial unexplained variation in the GFMs around these fitted parabolic relations. This unexplained variation may be partially attributable to firm characteristics other than Tobin's q. For example, Harris and Raviv (1990) summarize several firm-specific factors that should affect a firm's capital structure policy, and which may also affect its dividend policy. Such factors include firm risk, proportion of tangible assets, proportion of non-debt tax shields, R&D expenditures, dividend yield, and size. This leads us to investigate the robustness of the U-shaped relations in Table 2 by expanding the regression model in Equation (7) to account for these other potential determinants of the feedback measures:

$$\begin{aligned} GFM_{ij} = {} & b_0 + b_1 q_j + b_2 q_j^2 + b_3 VAR(r)_j + b_4 VAR(CF)_j \\ & + b_5 TGAST_j + b_6 TAX_j + b_7 R\&D_j + b_8 DIVYLD_j \\ & + b_9 SIZE_j + b_{10} MFG_j + b_{11} NODIV_j + \varepsilon_{ij} \qquad (8) \end{aligned}$$

where

q_j = the average Tobin's q value for the jth

[11]When only one type of feedback is present (when either H_1 or H_2 is rejected), tests of the joint hypothesis, H_3, will generally have lower power than tests of the individual hypotheses, H_1 or H_2. Hence, a more accurate statement is that we expect the number of rejections of H_3 (in Panel C) to be slightly less than the sum of the numbers of rejections of H_1 and H_2 (in Panels A and B).

[12]Lewellyn and Badrinath (1997), Lee and Tompkins (1998), and Chung and Pruitt (1994) suggest other modifications for computing Tobin's q, which are not applied in this analysis.

[13]We have also estimated piecewise linear regressions with similar results that are available on request. The fact that the GFMs have asymptotic non-central χ^2 distributions under each alternative hypothesis (Geweke,1982) leads us to examine the distribution of the regression error term in Equation (7). We find that the regression residuals have no major deviations from the ideal conditions. We also estimate the regressions using the transformation suggested by Geweke (1982), which converts each GFM to a random variable with an asymptotic normal distribution. Results are robust and available on request.

Table 2. Quadratic Regression Model Estimates

This table presents the estimated regression coefficients of the Geweke feedback measures on Tobin's q and Tobin's q squared. Coefficient t-statistics are in parentheses. The estimated minimum value of the quadratic form is given in the last row of the table.

	Dependent Variable		
	GFM_D	GFM_L	GFM_{DL}
Intercept	16.32***	10.38***	29.28***
	(6.28)	(4.15)	(7.83)
q	-18.13***	-6.38	-23.93***
	(-3.48)	(-1.27)	(-3.19)
q^2	7.80***	3.00	10.45***
	(3.43)	(1.37)	(3.19)
F-Value	6.08***	0.98	5.16***
(p-Value)	(0.00)	(0.38)	(0.01)
r^2	0.05	0.01	0.04
Parabola has minimum at q value of	1.16	1.06	1.14

***Significant at the 0.01 level.

firm over the 11-year sample period,

$VAR(r)_j$ = standard deviation of monthly stock returns for the jth firm over the 11-year sample period,

$VAR(CF)_j$ = standard deviation of quarterly cash flow movements for the jth firm over the sample period,

$TGAST_j$ = jth firm's average ratio of net property, plant, and equipment to total assets over the sample period,

TAX_j = jth firm's average depreciation and noncash expenses divided by total assets over the sample period,

$R\&D_j$ = jth firm's average research and development expense divided by total assets over the sample period,

$DIVYLD_j$ = jth firm's dividend for Year t divided by the stock price at the end of Year t, averaged over the sample period,

$SIZE_j$ = natural logarithm of the jth firm's average total assets during the sample period,

MFG_j = one if the jth firm is in manufacturing (based on two-digit SIC code) and zero otherwise, and

$NODIV_j$ = one if the jth firm pays no dividends and zero otherwise.

We compute all right-hand-side variables from the Compustat or CRSP tapes from 1979 through 1989. Summary statistics appear in Table 3 for the full sample, and for low- and high-q firm subsamples (with average q values of less than one, and greater than one, respectively). Table 3 indicates that the amount of predictive information in dividends, leverage, or both (the GFM) is not significantly different across high- and low-q firms. However, many other firm characteristics show a significant difference between high- and low-q firms.[14]

Although we could expect these firm characteristics to influence dividend and capital structure policies, there is no well-developed theory that describes precisely how these variables affect the amount of predictive information represented by the feedback measures. Still, several observations suggest that these firm-specific characteristics should be associated with the feedback measures.

First, if the market incorporates all available information, then the amount of predictive information measured by the GFM should be reflected in market valuation over time. Firms with larger feedback measures should have more predictable cash flows, which suggests lower stock-return variability and lower cash-flow variability. In this case, we expect negative coefficients for both VAR(r) and VAR(CF) in Equation (8).

Tax theories suggest that firms with more tangible assets (larger values of TGAST) might have greater tax benefits without relying on debt, and therefore might be more inclined to use dividend policy to influence information asymmetry and agency costs. Firms with larger nondebt tax shields (larger values of TAX) might rely less on debt and more on dividends. This argument suggests coefficients on TGAST and TAX that are positive in the GFM_D regression, negative in the GFM_L regression, and ambiguous in the GFM_{DL} regression.

Denis, Denis, and Sarin (1994) find that dividend yield, rather than Tobin's q, explains differences in

[14]If, under the free-cash-flow hypothesis, we expect a U-shaped relation between Tobin's q and the GFM with a minimum near a q value of one, we would not expect a significant difference in the average GFM between high- and low-q firms. This result is consistent with the previous work of Howe et al. (1992) and Denis et al. (1994).

Table 3. Descriptive Statistics for Full Sample and for Low- and High-Q Firm Subsamples

The statistics reported are calculated for the years 1979 to 1989. GFM_{DL}, GFM_L, and GFM_D are Geweke feedback measures for dividends, leverage, and both dividends and leverage. CF is the ratio of operating cash flow to total assets. D is dividends adjusted for stock splits and stock dividends. L is book value of long term debt divided by the sum of the book value of long term debt and the market value of equity. Q is Tobin's q. VAR(r) is the standard deviation of monthly stock returns. VAR(CF) is the standard deviation of quarterly cash flow. TGAST is tangible assets divided by total assets. TAX is noncash expenses divided by total assets. R&D is research and development expense divided by total assets. DIVYLD is dividend yield. SIZE is the logarithm of total assets. NODIV is an indicator variable that is one if a firm pays no dividends and zero otherwise.

Variable	Full Sample Mean	Full Sample Std. Dev.	q < 1 Mean	q > 1 Mean	t-Statistic for Difference H_0: $Mean_{q<1}$-$Mean_{q>1}$= 0
GFM_{DL}	17.8	9.2	18.32	16.25	1.50
GFM_D	7.6	6.4	7.74	6.93	0.84
GFM_L	7.5	6.0	7.58	7.22	0.39
CF	0.14	0.05	0.13	0.19	-10.43***
D	0.34	0.27	0.38	0.18	5.18***
L	0.54	0.19	0.61	0.29	15.79***
Q	0.82	0.34	0.67	1.34	-16.04***
VAR(r)	1.88%	0.68%	1.79%	2.19%	-4.06***
VAR(CF)	0.04	0.03	0.03	0.05	-3.71***
TGAST	60.0%	25.0%	66.0%	40.0%	7.87***
TAX	0.04	0.02	0.04	0.05	-1.53
R&D	0.007	2.0%	0.005	0.014	-2.98***
DIVYLD	0.014	0.009	0.016	0.007	7.63***
SIZE	6.54	1.70	6.79	5.69	4.48***
NODIV	10.8%	31.2%	6.8%	15.8%	-2.12**
Sample Size	249	-	192	57	-

***Significant at the 0.01 level.
**Significant at the 0.05 level.

the information content of dividend changes across a sample of firms. This result suggests a significant positive coefficient for DIVYLD in Equation (8), along with insignificant coefficients for q and q^2, especially in the GFM_D equation.

Although the role of firm size in determining capital structure and dividends is not entirely clear, most previous studies find that firm size has an important effect. Some studies suggest that larger firms may have greater debt capacity, and find that size is positively associated with leverage. In this case we would expect to find a positive coefficient for size in the GFM_L regression.

We report the results for the expanded regression models in Table 4. The r^2 values for these regressions are much higher than those for the simple quadratic models in Table 2. This result indicates that the additional firm characteristics explain a substantial portion of the cross-sectional variation in the feedback measures (especially for GFM_D and GFM_{DL}) that remains unexplained by Tobin's q and q^2.

Table 4 also shows that the coefficients for several variables are important. First, return variability [$VAR(r)_j$] has a negative coefficient in all three regressions, which is statistically significant in the models for GFM_L and GFM_{DL}.

Second, firm size is significantly positive in the GFM_L regression and significantly negative in the GFM_D regression, indicating that the information content of leverage is greater for larger firms, and the information content of dividends is greater for smaller firms.

Third, TGAST is significantly positive in the regression model for GFM_D, suggesting that firms with more tangible assets experience greater predictive information associated with dividend policy, consistent with the previous arguments.

Finally, the no-dividend dummy variable is significantly negative in the regression models for GFM_D and GFM_{DL}, indicating that the subsample of 22 firms that does not pay dividends shows a weaker predictive relation between dividends and future cash flow (GFM_D equals zero for these 22 firms), and from both dividends and leverage to future cash flow (GFM_{DL}).

Table 4. Expanded Regression Model Estimates

This table presents the coefficient estimates of regressions of Geweke feedback measures for dividends, leverage, and both dividends and leverage (GFM_D, GFM_L, and GFM_{DL}) on Tobin's q, Tobin's q squared, and other firm variables. VAR(r) is the standard deviation of monthly stock returns. VAR(CF) is the standard deviation of quarterly cash flow. TGAST is tangible assets divided by total assets. TAX is noncash expenses divided by total assets. R&D is research and development expense divided by total assets. DIVYLD is dividend yield. SIZE is the logarithm of total assets. MFG is an indicator variable that equals one for manufacturing firms and zero otherwise. NODIV is an indicator variable that is one if a firm pays no dividends and zero otherwise. Coefficient t-statistics are in parentheses. The estimated minimum q value for the quadratic form is given in the last row of the table.

	Dependent Variable		
Independent Variables	**GFM_D**	**GFM_L**	**GFM_{DL}**
Intercept	15.12***	11.33***	29.26***
	(3.46)	(2.52)	(4.54)
q	-13.47**	-6.16	-19.19**
	(-2.61)	(-1.01)	(-2.52)
q^2	6.68***	2.69	8.95***
	(3.06)	(0.93)	(2.78)
VAR(r)	-70.30	-182.74**	-358.12***
	(-0.82)	(-2.05)	(-2.82)
VAR(CF)	4.48	8.99	49.81*
	(0.24)	(0.45)	(1.77)
TGAST	6.58**	-2.12	4.58
	(2.58)	(-0.78)	(1.18)
TAX	-3.06	12.92	8.30
	(-0.13)	(0.52)	(0.24)
R&D	23.00	-10.85	8.62
	(0.99)	(-0.44)	(0.25)
DIVYLD	-14.05	-110.93	-115.46
	(-0.18)	(-1.36)	(-1.01)
SIZE	-0.56*	0.61**	0.16
	(-1.93)	(2.03)	(0.39)
MFG	0.36	1.27	1.35
	(0.30)	(1.04)	(0.79)
NODIV	-8.02***	0.91	-7.86***
	(-5.68)	(0.62)	(3.77)
F Value	6.45***	1.61*	4.95***
(p-Value)	(0.00)	(0.10)	(0.00)
r^2	0.23	0.06	0.19
Minimum q Value	1.01	1.14	1.07

***Significant at the 0.01 level.
**Significant at the 0.05 level.
*Significant at the 0.10 level.

Again, we note that the focus of our analysis is on the coefficients of Tobin's q and q^2, and the coefficients' implications for the free-cash-flow hypothesis specified in H_4. As in Table 2, the coefficient of q^2 is positive in all three regressions, and it is statistically significant in the two regressions on GFM_D and GFM_{DL}. Again, these results imply a U-shaped relation between each GFM and Tobin's q, and the minimum value of the relation is near a q value of one. (The minimum occurs at a q of 1.01 for GFM_D, at a q of 1.14 for GFM_L, and at a q of 1.07 for GFM_{DL}.)

C. Joint Determination of Stock Return Variability and the Geweke Feedback Measures

In Equation (8), we implicitly assume that stock return variability [$VAR(r)_j$] influences the amount of predictive information in each feedback measure. However, if the variability of stock returns is a function of all available information, then the information content of the policy variables (the GFMs) should be jointly determined with $VAR(r)_j$ over the sample period. Simultaneity would result in biased and inconsistent estimates in the single-equation regression model estimated above and potentially misleading implications regarding the free-cash-flow hypothesis.

We address the joint determination of return variability and each GFM by adding a second equation to the single-equation model (Equation (8)):

$$\begin{aligned} GFM_{ij} = {} & b_0 + b_1 q_j + b_2 q_j^2 + b_3 VAR(r)_j + b_4 VAR(CF)_j \\ & + b_5 TGAST_j + b_6 TAX_j + b_7 R\&D_j + b_8 DIVYLD_j \\ & + b_9 SIZE_j + b_{10} MFG_j + b_{11} NODIV_j + \varepsilon_{1ij} \qquad (9) \end{aligned}$$

$$\begin{aligned} VAR(r)_j = {} & c_0 + c_1 GFM_{ij} + c_2 Var(CF)_j + c_3 SIZE_j + c_4 L_j \\ & + c_6 DIVYLD_j + \varepsilon_{2ij} \qquad (10) \end{aligned}$$

We specify return variability as a function of the feedback measure, cash flow variability, firm size, firm leverage, and dividend yield.

Two-stage-least-squares regression results appear in Table 5. The first two columns show the model that jointly determines return variability and GFM_D. The next columns present the analogous results for GFM_L and GFM_{DL}, respectively.

First, we consider the estimation results for return variability in Equation (10) from this simultaneous system. For the jointly determined GFM_D and GFM_{DL} models, the return variability equation shows a significant negative coefficient of GFM_D and GFM_{DL}, as expected. This result indicates that a firm with smaller values of GFM_D or GFM_{DL} has greater return variability, ceteris paribus. In addition, a firm has greater return variability if it has greater cash flow variability, smaller size, greater leverage, or lower dividend yield.

Results for the first equation of this simultaneous model are robust with respect to the previous estimation of the single-equation model, Equation (8), presented in Table 4. The only notable difference in results is that, although the coefficient of return variability [$VAR(r)_j$] is still negative in all three models, it is no longer statistically significant. This result suggests that the information content of dividend or capital structure policies, or both (the GFMs) influences return variability, not vice versa.

Once again, the focus is on the coefficients of q and q^2. As in Tables 2 and 4, the results in Table 5 show that the information content of the policy variables exhibits a similar U-shaped relation with Tobin's q for all three feedback measures (minima occur at a q of 1.01 for GFM_D, a q of 1.29 for GFM_L, and a q of 1.06 for GFM_{DL}). The fitted quadratic relations implied by these results are plotted in Figures 4, 5, and 6 for GFM_D, GFM_L, and GFM_{DL}, respectively. Each plotted quadratic relation includes the intercept and the estimated regression coefficients of Tobin's q and q^2 from the first equation for each model in Table 5.

D. Robustness Checks

We further investigate the robustness of the relations between the GFMs and Tobin's q by reestimating Equations (7) through (10) over two different subsamples of firms. One subsample consists of firms with the most stable q values. The other subsample consists of firms with no significant increases in cash flow during the 11-year sample period.

1. Stability of Tobin's q

We calculate q values for each firm, for every year of the sample period from 1979 to 1989. We follow the Lindenberg and Ross (1981) computation method as modified by Perfect and Wiles (1994).[15]

In the cross-sectional regression analysis of the previous section, we use the average q value over the 11-year period. Given this relatively long sample period, a firm's q value can change over time. If a firm changes from a low-q to a high-q firm (or vice versa) over the sample period, the interpretation of the results with respect to H_4—that dividend and capital structure policies provide more information about cash flow for firms with values of Tobin's q greater than or less than one—becomes clouded.

A priori, there are at least three paths that Tobin's q could follow over time:

1. from q equals one to q less than one (average q les than one);
2. from q equals one to q greater than one (average q greater than one); and
3. from q less than one to q greater than one (average q close to one).

According to the free-cash-flow hypothesis, dividend, capital structure, or both policies for Firms 1 and 2 should provide more information (their GFMs should be larger) than a comparable firm whose Tobin's q is close to one throughout the entire sample period. For these firms, we should find a U-shaped relation between average q and their GFMs.

Similarly, dividend, capital structure, or both policies should also provide more information for Firm 3 than for a firm with q equal to one throughout the sample period. However, since the average q value is close to one for Firm 3, the presence of such firms in our sample would make it more difficult for regression analysis to detect a U-shaped relation, making our empirical approach more conservative.

For each firm, we calculate descriptive statistics for the annual q values over the 11-year sample

[15]Lewellen and Badrinath (1997), Lee and Tompkins (1999), and Chung and Pruitt (1994) suggest other modifications for computing Tobin's q, but we do not use them in this analysis.

Table 5. Joint Determination of Geweke Feedback Measures and Stock Return Variability

This table presents the coefficient estimates of a simultaneous-equations model for each Geweke feedback measure (GFM) and return variability. GFM_D, GFM_L, and GFM_{DL} are the Geweke feedback measures for dividends, leverage, and both dividends and leverage, respectively. VAR(r) is the standard deviation of monthly stock returns. Q is Tobin's q value. TGAST is tangible assets divided by total assets. TAX is noncash expenses divided by total assets. R&D is research and development expense divided by total assets. MFG is an indicator variable that equals one for manufacturing firms and zero otherwise. NODIV is an indicator variable that is one if a firm pays no dividends and zero otherwise. VAR(CF) is the standard deviation of quarterly cash flow. SIZE is the logarithm of total assets. L is book value of long-term debt divided by the sum of the book value of long-term debt and the market value of equity. DIVYLD is dividend yield. Coefficient t-statistics are in parentheses. The estimated minimum q value for the quadratic form is given in the last row of the table.

	Dividends Model		Leverage Model		Both Dividends and Leverage Model	
	GFM_D	VAR(r)	GFM_L	Var(r)	GFM_{DL}	Var(r)
Intercept	15.91**	0.02**	10.33*	0.02***	28.19***	0.02***
	(2.83)	(12.89)	(1.77)	(10.16)	(3.39)	(11.95)
q	-13.36**	-	-7.44	-	-18.45**	-
	(-2.59)		(-1.38)		(-2.42)	
q^2	6.62**	-	2.89	-	8.67***	-
	(3.03)		(1.27)		(2.69)	
VAR(r)	-88.15	-	-66.58	-	-270.68	-
	(-0.61)		(-0.44)		(-1.26)	
TGAST	6.42**	-	-2.63	-	4.08	-
	(2.44)		(-0.96)		(1.05)	
TAX	0.45	-	18.42	-	19.81	-
	(0.02)		(0.73)		(0.55)	
R&D	22.49	-	-13.13	-	4.49	-
	(0.97)		(-0.54)		(0.13)	
MFG	0.40	-	1.52	-	1.65	-
	(0.35)		(1.26)		(0.97)	
NODIV	-7.94**	-	0.43	-	-8.11***	-
	(-5.35)		(0.28)		(-3.69)	
GFM	-	-0.0003**	-	-0.0004	-	-0.0003***
		(-2.83)		(-1.50)		(-3.31)
VAR(CF)	-1.11	0.09**	-6.81	0.09***	19.67	0.09***
	(-0.06)	(7.51)	(-0.38)	(7.41)	(0.76)	(7.58)
SIZE	-0.60*	-0.0006**	0.61*	-0.0004	0.09	-0.0004**
	(-1.95)	(-3.39)	(1.91)	(-1.49)	(0.20)	(-2.00)
L	-	0.01**	-	0.01***	-	0.01***
		(7.05)		(7.09)		(6.15)
DIVYLD	-20.85	-0.45**	-78.89	-0.54***	-86.79	-0.45***
	(-0.24)	(-9.66)	(-0.86)	(-10.81)	(-0.67)	(-9.77)
F Value	6.42**	89.05**	1.21	77.97***	4.35***	85.41***
(p-Value)	(0.00)	(0.00)	(0.28)	(0.00)	(0.00)	(0.00)
r^2	0.23	0.65	0.05	0.62	0.17	0.64
q Minimum	1.01	-	1.29	-	1.06	-

***Significant at the 0.01 level.
**Significant at the 0.05 level.
*Significant at the 0.10 level.

period.[16] The highest annual q value for a low-q firm is 2.51, and the lowest annual q value for a high-q firm is 0.24. These results indicate that, for extreme cases, some firms have annual q values that change from low- to high-q, and vice versa. However, 80% of the low-q firms have annual q values that are always below one. Of the low-q firms, 96% do not have more than two annual q values greater than one.

High-q firms have more variable q values, and more of these firms have minimum q values below one. Of the high-q firms, 21% have no annual values below one, and 55% have only one annual q value below one.

[16]These results are available on request.

Figure 4. Fitted GFMD by q Value

This figure shows the fitted parabola from the partial regression model for the Geweke feedback measures for dividends (GFMD) using the coefficient estimates for q and q squared. The figure also shows the number of firms at different significance levels for the feedback measures.

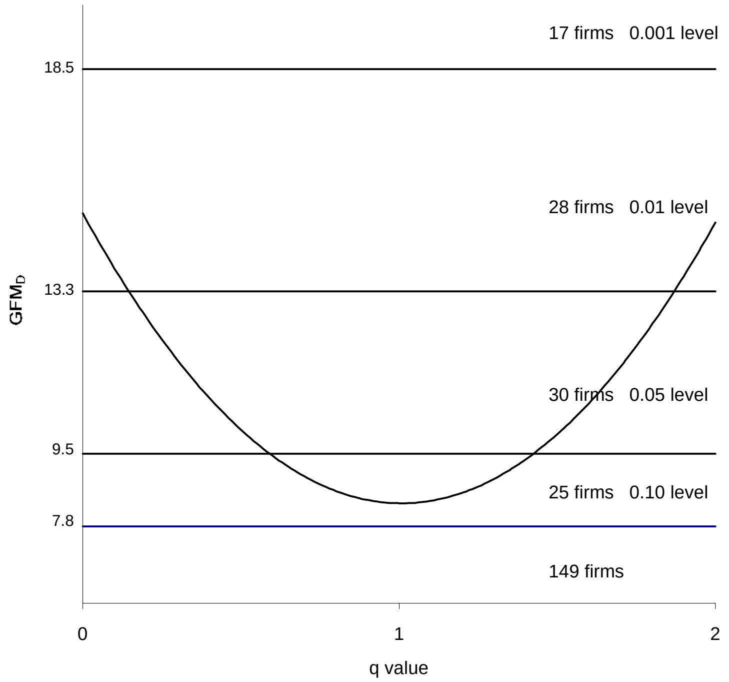


Figure 5. Fitted GFML by q Value

This figure shows the fitted parabola from the partial regression model for the Geweke feedback measures for leverage (GFML) using the coefficient estimates for q and q squared. The figure also shows the number of firms at different significance levels for the feedback measures.

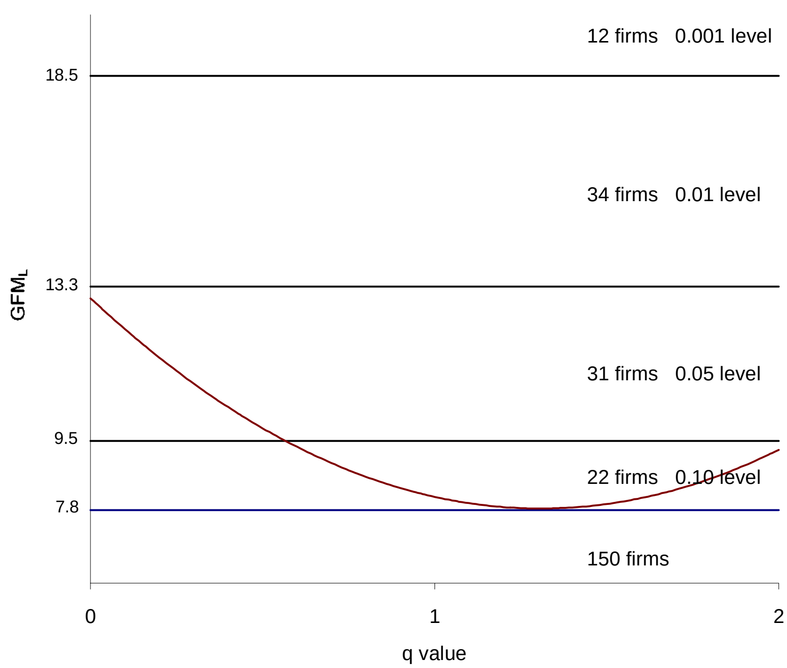
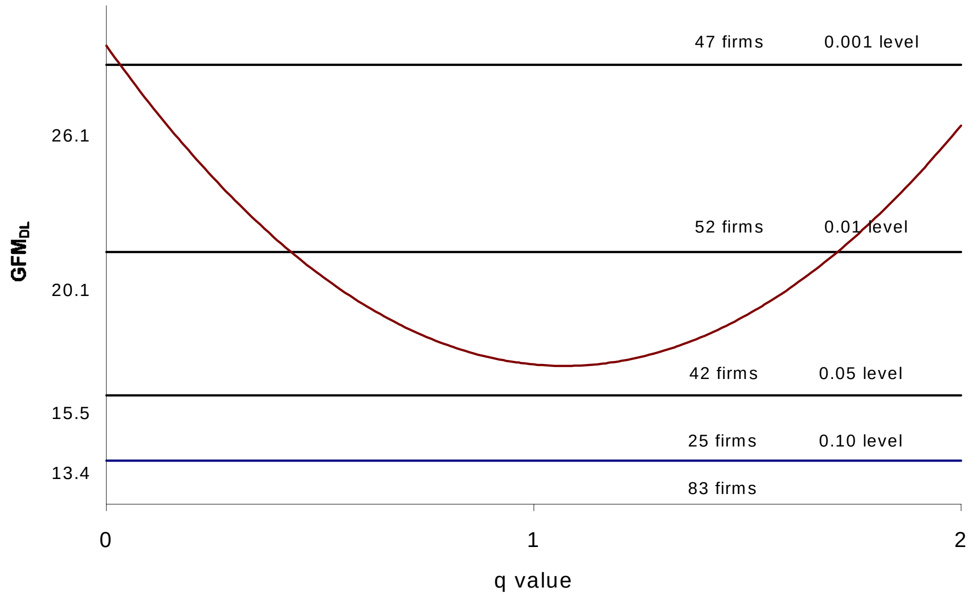


Figure 6. Fitted GFMDL by q Value

This figure shows the fitted parabola from the partial regression model for the Geweke feedback measures for dividends and leverage (GFMDL) using the coefficient estimates for q and q squared. The figure also shows the number of firms at different significance levels for the feedback measures.



We reestimated Equations (7) through (10) with a subsample of stable q firms. The results of the re-estimation are similar to the results reported in Tables 2, 4, and 5.[17] We still find a U-shaped relation between q and the GFMs.

2. Results for a Subsample of Firms with No Significant Increases in Cash Flow

The free-cash-flow hypothesis provides no rationale for dividend and capital structure policies to inform about subsequent performance for value-maximizing firms. However, signaling theory does provide such a rationale for all firms, regardless of whether they are overinvestors, underinvestors, or value-maximizers.

Empirically, we attempt to distinguish predictive relations attributable to agency cost considerations versus those due to signaling. We do this by analyzing a subsample of firms that did not have large cash flow increases over the 11-year sample period. We know ex post that this subsample of firms had no reason to signal changes in their cash flow ex ante. Therefore, any systematic differences across this subsample of firms in terms of the information content of their dividend, capital structure, or both, policies is more likely due to agency considerations. Analyzing the amount of predictive information provided by dividends, leverage, or both for this subsample of firms offers another robustness check on the free-cash-flow hypothesis specified in H_4.

We selected a subsample of 92 firms whose average annual change in cash flow over the 11-year sample period is less than 10%. We reestimated the quadratic model in Equation (7), the expanded model in Equation (8), and the simultaneous-equations model in Equations (9) and (10) for this subsample.[18] Again, results uniformly show a robust U-shaped relation between the GFMs and Tobin's q. In fact, for this subsample, the minimum of each U-shaped relation is located at a q value closer to one, and all other relevant results for H_4 display higher levels of statistical significance than in earlier analyses. When we restrict the sample to firms that do not have significant increases in cash flow during the sample period, these findings show stronger support for the free-cash-flow agency hypothesis specified in H_4 for all three sets of feedback measures, GFM_D, GFM_L, and GFM_{DL}.

V. Summary and Conclusions

Several empirical studies have examined the information effect of dividend changes for firms with different values of Tobin's q. Some have found support for the agency theory of free cash flow, but others

[17]We use two different selection procedures to determine stable-q firms. Both selection procedures have robust results. Details of the selection procedures and the full regression results are available on request.

[18]These results are available on request.

have not. We expand previous analyses by incorporating Stulz's (1990) argument, which suggests that dividends and capital structure should provide more predictive information regarding future cash flow for underinvesting and overinvesting firms than for value-maximizing firms. This argument implies a U-shaped relation between an information measure and Tobin's q. The minimum of this relation should occur at a q value equal to one.

We investigate these issues by using a two-stage procedure. In the first stage, we estimate three time-series Geweke feedback measures (GFMs) for each firm in the sample. Each GFM measures the incremental predictive information about future cash flow provided by a firm's dividend and capital structure policies. Results of the first stage indicate that both dividend and capital structure policies interact to provide significant predictive information for most sample firms. However, the information content of dividend and capital structure policies varies substantially across firms, including many firms for which dividends and capital structure policies provide no significant predictive information.

In the second stage, we regress each collection of feedback measures on Tobin's q and q^2 to see why the information content of dividend and capital structure policies varies across firms. We expand this quadratic regression model to account for both the potential influence of other firm characteristics on each feedback measure and possible simultaneity between return variability and each feedback measure.

Our results reveal a distinct U-shaped relation between Tobin's q and the amount of predictive information contained in a firm's dividend and capital structure policies, with a minimum at a q value near one. This result is robust when other firm characteristics and potential simultaneity are incorporated in the regression model. It is also robust when we analyze a subsample of firms with stable values of Tobin's q, and when we analyze another subsample with no significant increases in cash flow during the sample period. This empirical evidence is consistent with the free-cash-flow hypothesis, and it suggests that that dividends and capital structure policies provide more predictive information for over- and underinvesting firms than for value-maximizing firms. ■

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