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ABSTRACT

We propose and implement a new test of the dividend signaling hypothesis that is designed to discriminate between dividend signaling and other theories that would account for the apparent existence of a dividend preference. Our test refines the use of data on stock price responses to dividend announcements. In particular, we study the effect of dividend taxation on the "bang-for-the-buck," which we define as the share price response per dollar of dividends. Most dividend signaling models imply that an increase in dividend taxation should increase the bang-for-the-buck. In contrast, other dividend preference theories imply that an increase in dividend taxation should decrease the bang-for-the-buck. Since there have recently been considerable variation in the tax treatment of dividends, we are able to study dividend announcement effects under different tax regimes. Our central finding is that there is a strong positive relationship between dividend tax rates and the bang-for-the-buck. This result supports the dividend signaling hypothesis, and is consistent with alternatives. The paper also provides corroborating evidence based on the relationship between the bang-for-the-buck and bond ratings.

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1. Introduction

Economists have proposed numerous theories designed to explain corporate dividend policy. Different views about dividend policy lead to strikingly different conclusions about issues such as the cost of capital and the effects of tax policy. It is, therefore, important to distinguish between these theories on the basis of empirical evidence. Unfortunately, this task has proven difficult.

In an attempt to test various theories of corporate dividend policy, Poterba and Summers [1983, 1984, 1985] assembled evidence on the relative market value of dividends and capital gains, the effect of dividend taxation on dividend payout, and the effect of dividend taxation on investment. Their evaluation of this evidence was favorable to a "traditional view" of dividends, in which firms derive an advantage from the payment of dividends, and where this advantage is reflected in market value. This class of theories is obviously very broad, and includes (among other things) the possibility that firms pay dividends to signal private information about profitability,[1] the hypothesis that dividends provide a mechanism for restricting managerial discretion,[2] and the conjecture that investors prefer dividends for non-traditional, behavioral reasons.[3]

The fact that stock prices rise when companies announce plans to increase dividends, and fall when companies reveal that they intend to cut dividends,

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1 See e.g. Bhattacharya (1979, 1980), Hakansson (1982), Miller and Rock (1985), Kumar (1988), Kumar and Spatt (1987), John and Williams (1985), Ambarish, John, and Williams (1987), John and Nachman (1987), and Bernheim (1991).

2 See Jensen and Meckling (1976).

3 See Shefrin and Statman (1984).

is often cited as evidence for the theory that dividends signal profitability.[4] Unfortunately, this evidence does not distinguish between the hypothesis that the dividend conveys good news, and the hypothesis that the dividend is the good news. Thus, although studies of dividend announcement effects lend additional support to Poterba and Summers' "traditional view," they do not allow us to differentiate between dividend signaling and other explanations for a dividend preference.

Under the dividend signaling hypothesis, firms that pay high levels of dividends should be more profitable than otherwise identical firms (from the point of view of the investor) that pay lower levels of dividends. This observation suggests that one can test the signaling theory by examining the extent to which current dividends help to predict future earnings. Several early studies (Watts (1973) and Gonedes (1978)) concluded that dividends are essentially unrelated to subsequent earnings. However, a more recent study by Ofer and Siegel (1987) found that analysts revise their earnings forecasts in response to unanticipated dividend changes, and moreover that these revisions are rational.

Another empirical strategy was proposed by Lang and Litzenberger (1989). These authors argued that, under the managerial discipline hypothesis, dividend announcements should have larger, positive effects on share price when firms are overinvesting. This suggests that one should find larger share price responses among firms that have lower values of Tobin's Q. Lang and Litzenberger present data that are consistent with this prediction, and

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4 The literature on stock price responses to announcements of changes in dividend policy includes papers by Pettit (1972, 1977), Laub (1976), Charest (1978), Aharony and Swary (1980), Asquith and Mullins (1983), Eades (1982), Brickley (1983), Kane, Lee, and Marcus (1984), and Eades, Hess, and Kim (1985).

conclude that the data on share price responses to dividend announcements support the managerial discipline hypothesis, rather than dividend signaling.

From the preceding discussion, it is clear that the existing evidence is mixed; the literature has not succeeded in resolving the importance of dividend signaling relative to other variants of the "traditional" view. In this paper, we contribute to this debate by proposing and implementing a new test of dividend signaling that is designed to discriminate between signaling and other theories of dividend preference. Our test refines the use of data on stock price responses to dividend announcements. In particular, we study the effect of dividend taxation on the "bang-for-the-buck," which we define as the share price response per dollar of dividends. Most dividend signaling models imply that an increase in dividend taxation should increase the bang-for-the-buck. On the other hand, other dividend preference theories imply that an increase in dividend taxation should decrease the bang-for-the-buck. Since there has recently been considerable variation in the tax treatment of dividends, we are able to study dividend announcement effects under different tax regimes. Our central finding is that there is a strong positive relationship between dividend tax rates and the bang-for-the-buck. This result supports the dividend signaling hypothesis, and is inconsistent with alternative theories of a dividend preference, such as the managerial discipline hypothesis.

Our analysis of tax effects suggests a much broader strategy for testing the dividend signaling hypothesis. The dividend tax rate is simply one example of a publicly observed factor that is positively correlated with the marginal costs of paying dividends. Under the dividend signaling hypothesis, the bang-for-the-buck will tend to be high when observable information suggests that the marginal costs of paying dividends is high; the alternative hypotheses have the opposite implication. There are many publicly observed variables that are probably correlated with the marginal costs of paying dividends. One obvious candidate is a firm's bond rating. Our empirical analysis reveals a negative relationship between bond ratings and the bang-for-the-buck. Since the marginal cost of dividends is presumably low when the bond rating is high, this result corroborates our central finding: the bang-for-the-buck is high when, on the basis of public information, a rational investor would expect dividends to be costly. This finding provides additional support for the dividend signaling hypothesis.

The paper is organized as follows. In section 2, we explore the relationship between dividend taxation and the bang-for-the-buck under several alternative theories of corporate dividend policy. Our empirical strategy is discussed in section 3. Section 4 contains a description of the data. We present our results in section 5. Section 6 concludes.

2. Theoretical Preliminaries

In this section, we explore the relationship between the bang-for-the-buck and the dividend tax rate under several alternative theories of corporate dividend policy. Each of these theories implies that dividend payout, y, other observable characteristics, ω, and the tax rate, τ, are related to the market valuation of the firm according to some function $\hat{V}(y,\omega,\tau)$. The "bang-for-the-buck" refers to the impact of dividends on valuation, per dollar of dividends. One natural measure of the average bang-for-the-buck is

$$(1) \qquad \frac{\hat{V}(y,\omega,\tau) - \hat{V}(0,\omega,\tau)}{y}$$

Of course, one can also use $\hat{V}_y(y,\omega,\tau)$ as a measure of the marginal bang-for-the-buck.

2.1 Dividend Signaling

A careful reading of recent papers on dividend signaling reveals that an increase in the tax rate applicable to dividends has the effect of increasing the bang-for-the-buck. The purpose of this section is to exhibit this result in the context of a simple signaling model, and to argue that the principle should be reasonably general.

The basic intuition for the result is straightforward. In a standard dividend signaling model, high quality firms pay dividends in order to deter imitation by lower quality firms. Higher dividend taxes make dividends more costly. Consequently, a high quality firm does not need to pay as large a dividend in order to deter imitation. Thus, the firm manages to convey the same information but at a lower level of payout.

Unfortunately, the result is not quite so simple. Although the high quality firm pays a smaller dividend, the total costs associated with dividend payment may actually be larger due to the higher tax rate. Consequently, the equilibrium value of a high quality firm may fall as the tax rate rises. This implies that both the numerator and the denominator in equation (1) will decline -- the ultimate impact on the bang-for-the-buck is not clear a priori.

To show how these effects play out, we consider a simple model of dividend signaling, based loosely on Bhattacharya [1979]. We use θ to denote the characteristics of the firm that are not publicly observable. θ takes on values in the interval $[\theta_L, \theta_H]$. The fundamental value of a firm (that is, the value that it would command in a world of symmetric information) is given as a function of observable and unobservable characteristics, dividends, and dividend taxes. We will write this function as

$$V^s(y,\theta,\omega,\tau) = v^s(y,\theta,\omega) - \tau y \tag{2}$$

(where τ is the tax rate applicable to dividends). Throughout, we take $V^s(\cdot)$ to be differentiable in all of its arguments. To represent the notion that θ_H denotes a higher level of quality than θ_L, we assume that $V^s_\theta > 0$. Dividends are assumed to be costly, so $V^s_y < 0$ for $\tau \geq 0$. Finally, we will for simplicity assume that dividends are more costly on the margin to lower quality firms ($V^s_{y\theta} > 0$). Under this last assumption, our model satisfies the "single crossing property," which allows us to analyze signaling equilibria in the standard way. A failure of this property would not qualitatively alter our ultimate conclusion (see Bernheim [1991]).

The quality parameter θ is known only to the manager of the firm. Investors observe the firm's other characteristics (ω), its dividend (y), and the dividend tax rate (τ). The market valuation must therefore depend only on y, ω, and τ. We will write this valuation as $\hat{V}^s(y,\omega,\tau)$. This function is produced endogenously as a consequence of the signaling equilibrium.

We assume that managers care both about current market value and their own assessment of value. The justification for this assumption is standard (see e.g. Bernheim [1991]). In particular, the managerial objective function is given by

$$\hat{V}^s(y,\omega,\tau) + \alpha V^s(y,\theta,\omega,\tau) \tag{3}$$

where α is some fixed parameter.

We solve for a separating equilibrium conditional upon the exogenous observables, ω and τ. Managers choose y to maximize (1). For each θ, the optimal choice of y satisfies

$$\hat{V}^s_y(y,\omega,\tau) + \alpha V^s_y(y,\theta,\omega,\tau) = 0 \tag{4}$$

In addition, equilibrium beliefs must be self-fulfilling. Thus, for any θ and the corresponding optimal value of y, we must have

(5) $$\hat{V}^s(y,\omega,\tau) = V^s(y,\theta,\omega,\tau)$$

We differentiate (5) to obtain

(6) $$\hat{V}^s_y(y,\omega,\tau) = V^s_y(y,\theta,\omega,\tau) + V^s_\theta(y,\theta,\omega,\tau)\,\frac{d\theta}{dy}$$

Substitution of (6) into (4) yields

(7) $$\frac{d\theta}{dy} = -\,\frac{(1+\alpha)\;V^s_y(y,\theta,\omega,\tau)}{V^s_\theta(y,\theta,\omega,\tau)}$$

Equation (7) is recognizable as a first order differential equation. The solution, $\theta^s(y,\omega,\tau)$, must also satisfy the following initial condition:

(8) $$\theta^s(0,\omega,\tau) = \theta_L$$

Equation (8) is a consequence of the fact that θ_L firms are correctly identified as such in equilibrium; consequently, they have no reason to incur the costs associated with a positive dividend.

To assess the effect of dividend taxation on the average bang-for-the-buck, we need to evaluate $\hat{V}^s_\tau(y,\omega,\tau)$. Unfortunately, we have not been able to prove a general result concerning the sign of this derivative. Instead, we will present a partial result and an example.

Suppose for the moment that $\hat{V}^s_{y\tau}(y,\omega,\tau) > 0$ for $y \geq 0$. Then clearly, the marginal bang-for-the-buck rises with τ. Moreover, since $\hat{V}^s(0,\omega,\tau) = \hat{V}^s(0,\omega,\tau') = V^s(0,\theta_L,\omega,0)$, the average bang-for-the-buck also rises with τ. If we can guarantee that $\hat{V}^s_{y\tau}(y,\omega,\tau) > 0$ only on some interval $[0,\tilde{y}]$, then, at a minimum, the average and marginal bang-for-the-buck rise with τ on this interval. Using equations (2), (5), and (7), it is possible to show that

(9) $$\hat{V}^s_{y\tau}(y,\omega,\tau) = \alpha\left[1 - v^s_{y\theta}\left(y,\theta^s(y,\omega,\tau),\omega\right)\;\theta^s_\tau(y,\omega,\tau)\right]$$

From (8), it follows that $\theta^s_\tau(0,\omega,\tau) = 0$. Thus,

(10) $$\hat{V}^s_{y\tau}(0,\omega,\tau) = \alpha > 0$$

Equation (10) establishes that an increase in τ increases the slope of the market valuation function at y = 0. Moreover, as long as $\theta^s(y,\omega,\tau)$ is continuously differentiable, $\hat{V}^s_{y\tau}$ will be positive in some neighborhood of y = 0. Thus, for small y, an increase in τ necessarily increases both the average and marginal bang-for-the-buck.

The intuition for this result is straightforward. Figure 1 depicts the function $\hat{V}^s(y,\omega,\tau)$ for some fixed τ and ω. On the same diagram, we have superimposed an indifference curve ($\tilde{I}$) for the manager of a type $\tilde{\theta}$ firm. In general, the equation for a type θ indifference curve is given by

$$\hat{V} + \alpha V^s(y,\theta,\omega,\tau) = C$$

where C is some constant. $\hat{V}^s(y,\omega,\tau)$ must be tangent to $\tilde{I}$ at the point $\left(\tilde{y},\ V^s(\tilde{y},\tilde{\theta},\omega,\tau)\right)$, where $\tilde{y}$ is the level of dividends selected by a type $\tilde{\theta}$ firm. Likewise, $\hat{V}^s(y,\omega,\tau)$ must be tangent to I_L, an indifference curve for the manager of a type θ_L firm, at the point $\left(0,\ V^s(0,\theta_L,\omega,0)\right)$. As τ rises (to τ'), the indifference curve for a θ_L manager rotates upward around this point (to I'_L). To preserve the tangency property, $\hat{V}^s(y,\omega,\tau)$ must also rotate upwards (to $\hat{V}^s(y,\omega,\tau')$).

We now present an example designed to establish the proposition that the dividend signaling hypothesis can indeed produce the result that an increase in τ raises the bang-for-the-buck globally. Suppose in particular that

(11) $$v^s(y,\omega,\theta) = \theta - (\omega-\theta)y,$$

where $\omega > \theta_H$. Note that $v^s_y < 0$, $v^s_\theta > 0$, and $v^s_{y\theta} > 0$, so that $V^s(y,\theta,\omega,\tau)$ has all the properties required of it. After substituting (2) and (11) into (8), we obtain

(12) $$\frac{d\theta}{dy} = -\frac{(1+\alpha)(\omega+\tau-\theta)}{1+y}$$

Note that this differential equation is separable. It is therefore easy to verify that the solution to (12) is

(13) $$\theta^{s}(y,\omega,\tau) = \omega + \tau - K(1+y)^{-(1+\alpha)},$$

where K depends on the constant of integration. From (8), it follows that $K = \omega + \tau$. Using (2), (5), (11), and (13), we find that

(14) $$\hat{V}^{s}(y,\omega,\tau) = (\omega+\tau)\left[1-(1+y)^{-\alpha}\right]$$

From (14), it is evident that an increase in τ raises both the marginal and average bang-for-the-buck for all values of $y \geq 0$.

This analysis does not rule out the possibility that, for some parameterizations, the bang-for-the-buck falls with τ when y is sufficiently large. Nor does it rule this possibility out for theories of dividend signaling that are not captured by our simple model. Nevertheless, taken together with the existing literature on dividend signaling, it does suggest that a positive relationship between τ and the bang-for-the-buck is the most natural consequence of the dividend signaling hypothesis. If the data point to a negative relationship, we should become at least somewhat skeptical about the validity of this hypothesis.

2.2 Alternative Hypotheses

In this section, we formulate a simple model of corporate dividend policy based upon a stylized representation of alternative "traditional" hypotheses, and argue that this model is capable of explaining the existing evidence on dividend announcement effects. We then show that such a model implies that there should be an <u>inverse</u> relationship between the dividend tax rate and the bang-for-the-buck.

Since the alternative hypotheses do not concern the transmission of information, we drop the unobservable parameter θ. Thus, the fundamental value of the firm is given by:

$$V^a(y,\omega,\tau) = v^a(y,\omega) - \tau y \tag{15}$$

One can think of the function $V^a(\cdot)$ as summarizing the effect of dividends on managerial efficiency; alternatively, it could reflect shareholders' intrinsic preferences for dividends vs. retained earnings. In contrast to the signaling hypothesis, we assume here that $V^a_y(\cdot) > 0$, at least over some range. Thus, firms may pay dividends for their own sake, rather than to convey information. Since investors observe y, ω, and τ, the market valuation of this firm coincides with its fundamental value:

$$\hat{V}^a(y,\omega,\tau) = V^a(y,\omega,\tau) \tag{16}$$

While managerial utility depends in part upon $\hat{V}$, managers also care directly about dividends. When dividends are high, managers have fewer resources under their control; this depresses their utility. The relative weights placed on $\hat{V}$ and y depend upon the firm's value-relevant characteristics, ω. However, we assume that dividend policy is not perfectly predictable, given knowledge of ω and the function $V^a(\cdot)$ (if it was perfectly predictable, then share price would not respond to dividend announcements, since announcements would be perfectly anticipated, and their implications capitalized into value). We represent this lack of perfect predictability by supplementing the managerial preference function with an additional parameter, α, that is determined randomly, and that is not publicly observed. Thus, managers act as if they maximize some utility function, $W(\hat{V},y,\omega,\alpha)$, where $W_{\hat{V}} > 0$ and $W_y < 0$. Managers must, of course, obey the restriction that $\hat{V} = \hat{V}^a(y,\omega,\tau)$. The optimal choice of y is given by $y^a(\omega,\alpha,\tau)$.

Now we argue that this simple model can account for the central facts concerning share price responses to dividend announcements. Since $W_y < 0$, managers will generally choose a level of dividends below that which maximizes value. That is, $\hat{V}^a_y(y^a(\omega,\alpha,\tau),\omega,\tau) > 0$. Consequently, innovations in α that increase y will tend to raise value (for fixed ω and τ), while innovations in α that reduce y will depress value. Since α is unobserved, share price will respond positively to the announcement of a dividend increase, and negatively to the announcement of a reduction.[5]

Although this class of hypotheses -- which hold that dividends contribute directly to the value of the firm -- are capable of explaining the existing evidence on dividend announcement effects, their implications differ from those of dividend signaling models once the effect of dividend taxation on bang-for-the-buck is considered. From equations (15) and (16), it follows immediately that

$$\frac{\hat{V}^a(y,\omega,\tau) - \hat{V}^a(0,\omega,\tau)}{y} = \left[\frac{v^a(y,\omega)-v^a(0,\omega)}{y}\right] - \tau$$

and

$$\hat{V}^a_y(y,\omega,\tau) = v^a_y(y,\omega) - \tau .$$

In other words, both the average and marginal bang-for-the-buck fall with τ. The intuition for this property is straightforward. Share price responds positively to dividends because shareholders value dividends (either for their

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5 Indeed, if $\hat{V}^a(\cdot)$ is concave in y, the absolute response to a reduction will be greater than the response to an equivalent increase, which is also consistent with existing evidence.

own sake, or for their ability to discipline managers). When dividends are taxed, shareholders like them less; this attenuates the positive effect of dividends on share price.

2.3 Related Observations

The analysis of sections 2.1 and 2.2 suggests a much broader strategy for testing the dividend signaling hypothesis. Although we have interpreted τ as a tax parameter, this is not at all fundamental to our argument. Indeed, one can think of τ as <u>any</u> publicly observed variable that is positively related to the marginal cost of paying dividends. Under the dividend signaling hypothesis, the bang-for-the-buck should rise with τ, while the alternative hypotheses have the opposite implication.

The dividend signaling literature identifies the prospect of a cash shortfall as one of the most important non-tax cost of paying dividends. Certainly, there are many publicly observed variables that are correlated with financial slack. One obvious candidate is a firm's bond rating. When a firm's bond rating is low, the public knows that (on average) paying dividends is a relatively expensive activity. Thus, a firm with a low bond rating and positive private information can deter imitation by firms with low bond ratings and negative private information by paying a relatively small dividend. In contrast, when a firm's bond rating is high, the public knows that (on average) paying dividends is a relatively inexpensive activity. Thus, a firm with a high bond rating and positive private information may have to pay quite a substantial dividend in order to deter imitation by firms with high bond ratings and negative private information. It follows that, under the dividend signaling hypothesis, bond ratings should be positively correlated with the bang-for-the-buck.

Under the alternative hypotheses, the bang-for-the-buck will tend to be low when observable information suggests that the marginal costs of paying dividends is high (e.g. the firm has a low bond rating). This conclusion follows from the same considerations identified in section 2.2: when dividends are known to be more costly, shareholders like them less, and this attenuates the positive effect of dividends on share price.[6]

Our empirical analysis is designed to test between dividend signaling and the alternative hypotheses by examining the effects of <u>both</u> dividend taxation <u>and</u> observable firm characteristics (specifically, bond ratings) on the bang-for-the-buck. In the next section, we discuss our strategy for measuring the relationship between dividend tax rates (τ) and the bang-for-the-buck. The reader should bear in mind that it is equally appropriate to interpret τ as any publicly observed variable that is positively correlated with the marginal costs of paying dividends. Any factor that increases this marginal cost can, in a broad sense, be thought of as a dividend "tax."

3. Empirical Strategy

In the next section, we estimate the derivative of the market valuation function with respect to dividends $\left(\hat{V}_y(y,\omega,\tau)\right)$. We then examine the sign of $\hat{V}_{y\tau}$ to distinguish between signaling ($\hat{V}_{y\tau} > 0$) and the alternative hypotheses ($\hat{V}_{y\tau} < 0$).

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6 Under the managerial discipline hypothesis, there is an additional reason to expect this result. Management is assumed to operate inefficiently when an organization has financial slack. Firms with high bond ratings typically have more slack. Thus, a given dividend should be more beneficial when bond ratings are high. One might object to this conclusion on the grounds that firms with low bond ratings are generally managed by individuals who are more inclined to place their own interests over those of the stockholders. This hypothesis strikes us as only marginally plausible.

Estimates of $\hat{V}_y(y,\omega,\tau)$ are obtained by studying the effects of dividend announcements on share price. This is accomplished as follows. Let S_t denote the value of a firm's equity at time t, and let y_t, τ_t, and ω_t denote respectively the contemporaneous dividend announcement, dividend tax rate, and other pertinent information. Define the return R_t as follows:

$$R_t = \frac{S_t - S_{t-1}}{S_{t-1}}$$

Using the fact that $S_t = \hat{V}(y_t,\omega_t,\tau_t)$, it is easy to verify that

$$R_t = E\left[R_t|\omega_t,\tau_t\right] + \frac{\hat{V}(y_t,\omega_t,\tau_t) - E\left[\hat{V}(y,\omega_t,\tau_t)|\omega_t,\tau_t\right]}{S_{t-1}} \tag{17}$$

(where the operator E takes an expectation, treating y as a random variable).

Now suppose that we estimate an equation of the form

$$R_t = \Gamma(y_t,\omega_t,\tau_t) + \epsilon_t \ , \tag{18}$$

where ϵ_t is a random disturbance. Presumably, ϵ_t arises from our inability to control for all of the relevant information revealed at time t. Under the assumption that ϵ_t is uncorrelated with other observable variables (including the dividend announcement), $\Gamma(y_t,\omega_t,\tau_t)$ represents an estimate of the right-hand side of (17). Note that

$$\Gamma_y(y_t,\omega_t,\tau_t) = \frac{\hat{V}_y(y_t,\omega_t,\tau_t)}{S_{t-1}} \ , \tag{19}$$

and

$$\Gamma_{y\tau}(y_t,\omega_t,\tau_t) = \frac{\hat{V}_{y\tau}(y_t,\omega_t,\tau_t)}{S_{t-1}} \tag{20}$$

Since S_{t-1} is strictly positive, $\Gamma_{y\tau}$ and $\hat{V}_{y\tau}$ are necessarily of the same sign. Consequently, we implement our test by determining the sign of $\Gamma_{y\tau}$.

If the function $\hat{V}(\cdot)$ is linear in y, then R_t will depend upon y_t only through the term

$$u_t = y_t - E[y|\omega_t, \tau_t].$$

That is, share price will respond to the unexpected component of the dividend announcement. In that case, one can write $\Gamma(\cdot)$ as a function of u_t, ω_t, and τ_t. We adopt this simplification in our empirical analysis.

Historical data on daily share prices and dividend announcements were obtained from the Center for Research in Security Prices (CRSP) NYSE/AMEX and NASDAQ data files. For the purpose of our analysis, an observation consists of an instance in which a firm announced an increase in dividends. Previous research suggests that share price responds more strongly to the announcement of a negative change in dividends, than to the announcement of a positive change. It is conceivable that positive and negative changes are driven by fundamentally different processes. We therefore chose to focus exclusively on cases in which firms announced increases in dividends. Our basic sample consists of all such announcements occurring between the beginning of 1962 and the end of 1988.

For the regressions reported here, cumulative abnormal returns (A_{it}) are used as the dependent variable. These returns are measured over a three-day window, centered on the announcement date. Conceptually, the abnormal return should be thought of as $R_t - E\left[R_t|\omega_t, \tau_t\right]$; in other words, we simply move the term $E\left[R_t|\omega_t, \tau_t\right]$ to the left-hand side of equation (17). This comports with common practice in the literature on the measurement of dividend announcement effects.

In practice, $E\left[R_t|\omega_t, \tau_t\right]$ is not observable. For the results reported here we simply use the concurrent return on a value-weighted market portfolio, R_{mt}. When abnormal returns are calculated in this manner, they are usually referred to as "market adjusted returns" (see Brown and Warner (1985)).

Clearly, R_{mt} is not an ideal measure of $E\left[R_t | \omega_t, \tau_t\right]$. However, this is not likely to create problems for two reasons. First, we are not concerned here with the level of dividend announcement effects. Rather, we are attempting to estimate the extent to which dividend announcement effects vary with dividend tax rates. Even if the average abnormal return is biased in one direction or another, as long as this bias does not change systematically with tax rates, it does not affect our ability to test between the hypotheses of interest. Second, if it is possible to write $E\left[R_t | \omega_t, \tau_t\right]$ as the sum of R_{mt} and some function $g(\omega_t, \tau_t)$, then one can interpret our estimated relationship as a version of equation (17) in which R_{mt} has been moved to the left-hand side, and $g(\omega_t, \tau_t)$ remains on the right-hand size.

Independent variables were constructed as follows. ΔDIV_{it} measures the size of the dividend change announced at time t for security i. Formally, this variable is defined as follows:

$$\Delta DIV_{it} = \frac{D_{it} - D^0_{it}}{P^0_{it}}$$

where D^0_{it} is the last dividend paid prior to date t, D_{it} is the new dividend announced at date t, and p^0_{it} is the average share price in the ten-day period preceding the dividend announcement window.

ΔDIV_{it} functions as our measure of u, the unexpected component of the dividend announcement. The use of this variable is justified if, as is commonly assumed in the literature, investors typically expect firms to maintain their dividends at previous levels. However, it is important to realize that our central test of the dividend signaling hypothesis remains valid even when this assumption is not satisfied. In that case, u can be thought of as a linear combination of D^0_{it} and other right-hand side variables. Although this alters the interpretation of coefficients for variables other than ΔDIV_{it}, the coefficient of ΔDIV_{it} still measures $\Gamma_y(\cdot)$.

$THETA_{it}$ measures the tax burden on dividends, relative to capital gains. In particular,

$$THETA_t = \sum_{i=1}^{s} w_{it} \cdot \frac{\left(1-m_{it}\right)}{\left(1-z_{it}\right)\left(1-\tau_t^u\right)}$$

where m_{it} is the marginal dividend tax rate at time t for investors in class i, z_{it} is the accrual-equivalent capital gains tax rate at time t for investors in class i, τ_t^u is the tax rate on undistributed profits prevailing at time t, w_{it} are equity ownership weights, and s is the number of distinct shareholder classes. We obtained historical data on $THETA_t$ from Poterba [1987].[7]

Three features of this variable deserve emphasis. First, $THETA_t$ varies only over time, not across firms. In principle, one could construct a firm-specific tax clientele variable by studying ex-dividend day behavior for individual firms (as in Auerbach [1985]). Unfortunately, this method of measuring effective tax rates is not valid under certain important hypotheses concerning dividend policy.[8] In addition, measures of tax rates constructed from ex-dividend day share price movements are usually very imprecise. It is therefore not surprising that, in previous studies, the use of firm-specific tax clientele variables has shed little if any light on the determinants of corporate financial policy (see e.g. Auerbach [1985] and Mackie-Mason [1988]). We eschew this approach, and use a more reliable aggregate measure of the tax burden on dividends.

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[7] For 1987 and 1988 data on $THETA_t$ were obtained directly from Poterba (private communication).

[8] For example, if shareholders prefer dividends because dividends provide liquidity, then firms should pay dividends until, on the margin, the benefits of liquidity just offset the tax costs. This implies that share prices should fall by one dollar for each dollar of dividends on the ex-day, regardless of the tax rate.

Second, Poterba's measure of the relative tax burden on dividends is only available on a yearly basis. Let θ_k denote the value of this variable in year k. For a dividend announcement date (t) falling in year k, we set $THETA_t = \theta_k$. In other words, we assume that dividend tax rates change discretely at the end of each year. In some cases, this is entirely appropriate (e.g. new statutes went into effect at the end of the year). In other instances, it is more likely that changes in θ_k occurred gradually (e.g. because of changes in the composition of stock ownership). Since most of the variation in θ_k results from changes in the tax law, and since we omit dividend announcements that occurred close to the effective dates of major tax reforms (see below), it is unlikely that our analysis is significantly flawed by our failure to account for intra year variation in $THETA_t$.

Third, note that $THETA_t$ is inversely related to the effective tax rate on dividends (m_{it}). It is important to bear this fact in mind when evaluating our empirical results. Under the signaling hypothesis, an increase in $THETA_t$ should decrease the bang-for-the-buck; the alternative hypotheses imply that an increase in $THETA_t$ should increase the bang-for-the-buck.

In section 2.3, we argued that, for the purpose of our analysis, one can think of any publicly observed factor that increases the marginal cost of paying dividends as a dividend "tax." It follows that one can also test the dividend signaling hypothesis against the alternatives by examining the relationships between bang-for-the-buck and other firm-specific characteristics. In this paper, we focus on bond ratings, which are summarized by the variable $HIRATED_{it}$. $HIRATED_{it}$ is a dummy variable that takes on a value of 1 if firm i's bond rating is BB+ or better, and is equal to 0 if the bond rating is worse than BB+. Under the dividend signaling hypothesis, we expect to observe a greater bang-for-the-buck when $HIRATED_{it} = 0$.

Historical data on bond ratings were obtained from quarterly Compustat files. These data are available beginning in 1977. For years prior to 1977, we assumed that firm i's bond rating was equal to its 1977 value. To obtain some feel for the validity of this assumption, we examined changes in bond ratings between the earliest and latest dates for which Compustat data were available. It should be noted that these data span a 14-year period (1977-1990). Over this period, roughly 97% of all firms did not experience changes in bond ratings large enough to alter their values of $HIRATED_{it}$. For a number of reasons, we also conducted our analysis of dividend announcement effects using a shorter sample period (1978-1988) that is completely covered by the Compustat files.

Even subsequent to 1977, Compustat does not contain information on bond ratings for all firms covered by the CRSP tapes. When bond ratings were not available, we imputed the value of $HIRATED_{it}$ based on auxiliary regressions.[9]

Our empirical strategy also requires us to identify variables that summarize important aspects of publicly available information (ω_t). Obviously, the market has access to a great deal of information on virtually every publicly traded company. In our analysis, it is important to control for variables that ought to affect the market's interpretation of a dividend announcement.

If a company has experienced substantial share price appreciation since its last dividend change, the market may regard the announcement of a dividend increase as an effort to keep pace, rather than as an attempt to signal fundamentally new information. Likewise, if there has been substantial inflation since a company last changed its dividend, the announcement of an

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[9] Each auxiliary regression explained $HIRATED_{it}$ as a function of the other independent variables. We estimated the auxiliary regressions using subsamples for which complete data were available.

increase might be interpreted as an adjustment for inflation. To control for these factors, we introduce the variables GRO_{it} and $INFL_{it}$, which represent, respectively, the growth in share price and the CPI since firm i's last dividend change.

The amount of time that has elapsed since a company's last dividend change may also color the market's reaction to the announcement of an increase. A given change in dividends may be more significant for companies that rarely alter dividend policy, than for companies that have changed dividends frequently. To account for this possibility, we introduce the variable $MONTHS_{it}$ which is defined as the length of time (in months) between t and t', where (as before) t' is the date of firm i's most recent dividend change prior to date t.

Finally, it is conceivable that share price responses to dividend announcements may vary with current macroeconomic conditions. For example, a dividend increase may be a more persuasive signal of good prospects during a recession than during a boom. To allow for this possibility, we include the variable CAP_t, which measures seasonally adjusted capacity utilization in the manufacturing sector for the month in which the dividend announcement (at time t) took place. Note that, in contrast to $THETA_t$, CAP_t varies monthly, rather than annually.

We estimated a variety of empirical specifications explaining abnormal returns, A_{it}, as a function of ΔDIV_{it}, $THETA_t$, CAP_t, GRO_{it}, $INFL_{it}$, $MONTHS_{it}$, and $HIRATED_{it}$, as well as interactions between these variables. Our results were robust across specifications. For purposes of brevity, we report results based on only two specifications. Both have the following form:

$$A_{it} = \beta_0 + \Delta DIV_{it}\left[\beta_1 + \beta_2 THETA_t + \beta_3 HIRATED_{it} + X_{it}\gamma_1\right] + Z_{it}\gamma_2 + \epsilon_{it} ,$$

where X_{it} is a vector of the other publicly observed variables and the vector Z_{it} consists of X_{it}, $THETA_t$, and $HIRATED_{it}$. The first specification does not restrict the values of any coefficients in this equation. While this provides for a flexible functional form, evaluation of the bang-for-the-buck through a casual inspection of the estimated coefficients is difficult. Our second specification imposes the restriction that $\gamma_1 = 0$, which allows the reader more easily to infer a bang-for-the-buck for different values of THETA and HIRATED. In light of equation (20), one can determine the sign of $\hat{V}_{y\tau}$ by examining β_2. If $\beta_2 < 0$, higher dividend taxation increases the bang-for-the-buck, as predicted by the dividend signaling hypothesis. One can also perform a comparable test based on bond ratings by examining β_3.

These specifications were estimated with OLS, using White's [1980] method of calculating heteroscedasticity-consistent standard errors.[10] From our basic sample covering the 1962-1988 period, we excluded observations for a number of reasons.

First, to construct several independent variables, we required data on a prior dividend change. Consequently, we were forced to drop the first dividend announcement for each firm.

Second, we excluded all dividend announcements occurring in close proximity to major shifts in tax policy. During our sample period, there were two instances of tax reform that significantly altered the relative taxation of dividends and capital gains. The first occurred in 1981, the second in 1986. Theory suggests that a given change in dividends may convey different information, depending upon whether it occurs in response to a change in tax regime, or to other factors. In particular, the distribution of y_t conditional on ω_t and τ_t may be different when tax policy has just changed (and firms are adjusting to the new regime) than when the current tax policy

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[10] The use of White's correction is particularly appropriate given the fact that $HIRATED_{it}$ is imputed for some observations.

has persisted for some time. We handled this problem by dropping dividend announcements occurring in one-year windows centered around January 1, 1982 and January 1, 1987 (exclusion criterion "A"). We examined the sensitivity of our results to alternative selection criteria. We also report here results based upon the alternative criterion of dropping the first dividend change for each firm after the two major shifts in tax policy (exclusion criterion "B"). We also estimated (but do not report) regressions in which no observations were excluded for this reason; the results were similar.

Some previous studies of dividend announcement effects also exclude observations for which earnings announcements occur in close proximity to dividend announcements. This is important when one's purpose is to measure the absolute level of abnormal returns on dividend announcement dates. Our object is to examine how the sensitivity of abnormal returns to dividends varies with observable factors that are correlated with the marginal cost of dividends. There is no particular reason to believe that the bias created by including observations with earnings announcement conflicts is systematically related to tax regimes or bond ratings. Thus, we estimate one set of regressions in which no exclusions are made for this reason.

To ascertain the extent to which our results might be affected by the inclusion of observations with earnings announcement conflicts, we also estimated a set of regressions in which these observations were removed from the sample. Unfortunately, the available data on earnings announcements begin in 1978. Thus, when excluding observations with earnings announcement conflicts, we also dropped all dividend announcements occurring before 1978.[11]

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11 For completeness we also estimated (but do not report) a set of regressions for the sample period 1978-1988, where earnings announcement conflicts were <u>not</u> removed. The results were similar.

These regressions are of particular interest since, as mentioned previously, data on bond ratings are available beginning in 1977.

For the 1962-1988 sample period, exclusion criterion A leaves us with 12,961 observations. For exclusion criterion B, the number of observations falls to 12,054. For the 1978-1988 sample period with earnings announcement conflicts removed, we have 4519 observations with exclusion criterion A, and 3749 observations with exclusion criterion B.

At several points in this discussion, we mentioned that our results are not particularly sensitive to alternative (unreported) estimation strategies, such as the use of different specifications, sample definitions, and exclusion criteria. We also experimented with variable definitions, and continued to obtain similar results. The regressions presented in the next section were chosen because they exemplify the robust patterns exhibited by a much larger set of estimates.

4. Results

Regression results for the 1962 through 1988 sample period are reported in Table 1. Table 2 contains results for the 1978-1988 sample, where earnings announcement conflicts have been removed. For our purposes, the coefficients of primary interest are those associated with ΔDIV, ΔDIV·THETA, and ΔDIV·HIRATED. An inspection of these coefficients reveals two robust patterns.

First, the coefficients of ΔDIV·THETA are negative and estimated quite precisely. In each of the eight regressions, the associated t-statistic exceeds 2; in most cases it exceeds 2.5. These coefficients imply that an increase in the dividend tax rate raises the bang-for-the-buck ($\hat{V}_{y\tau} > 0$) for firms with low bond ratings. This finding is consistent with the dividend signaling hypothesis, and inconsistent with the alternatives outlined in section 2.

Second, the coefficients of ΔDIV·HIRATED are all negative. Unfortunately, in Table 1 the estimated values of these coefficients are not statistically significant at conventional levels of confidence. More significant effects -- both economically and statistically -- are found in Table 2. This is to be expected, since all bond ratings prior to 1977 are imputed. The effect of a high bond rating on the bang-for-the-buck is both negative and statistically significant (at conventional levels) in equations 1 and 3 of Table 2. Statistical significance is somewhat lower in equations 2 and 4.

As we have argued in section 2.3, a negative relationship between bond rating and bang-for-the-buck also argues in favor of the dividend signaling hypothesis. In effect, an increase in the marginal cost of paying dividends arising from an observable deterioration of a firm's financial condition is analogous to an increase in the marginal cost of dividends arising from an increase in the dividend tax rate. Under the signaling hypothesis and the alternatives, the effect of a decline in bond rating should therefore be comparable to the effect of an increase in the tax rate. Thus, the evidence on the effect of bond ratings contained in Tables 1 and 2 offers qualified support for the dividend signaling hypothesis.

As a plausibility check on the estimates in Tables 1 and 2, we have also calculated the bang-for-the-buck (the derivative of the excess return with respect to ΔDIV), evaluated at the mean values of the other independent variables. The resulting estimates of bang-for-the-buck, along with their associated standard errors, are presented in the final row of these tables. For example, the estimates in the second column of Table 1 imply that a one percentage point increase in the ratio of dividends to share price raises the abnormal return over the announcement window by 3.28 percentage points. Note that this effect is estimated with great precision in all of the specifications. To put these estimates in perspective, consider the fact that, over the sample period, the average announced dividend increase was roughly 0.14% of share price. A firm announcing an increase equal to twice this average would, on average, improve its abnormal return over the announcement window by 0.46 percentage points. This compares with an average abnormal return of 1.19% for all observations in our sample.

One possible criticism of this analysis is that THETA may not be an appropriate measure of the tax burden on dividends, relative to undistributed profits. THETA depends in part on the measurement of effective tax rates for different classes of investors. Measurement of such rates--particularly the accrual-equivalent capital gains tax rate--is notoriously difficult. Indeed, Balcer and Judd [1987] have argued that it is impossible to summarize the "effective" rate of capital gains taxation with a single number. Moreover, THETA is calculated as a weighted average of effective tax rates for different classes of investors. If some particular class of investors accounts for a disproportionate share of arbitrage activity, then this weighted average will be inappropriate.

Fortunately, it is possible to test the hypotheses of interest without attaching significance to particular values of THETA. Although the dividend tax rate does vary form year to year, much of this variation results from a small number of significant tax reforms. For example, although THETA rose from 0.691 in 1979 to 0.784 in 1985, more than half of this increase occurred between 1981 and 1982, when the first round of the Regan administration's tax reforms went into effect. A second round of tax reforms increased THETA from 0.783 in 1986, to 0.825 in 1987, and to 0.880 in 1988. Regardless of whether one credits the particular numbers, it is clear that the relative tax burden on dividends declined significantly after each round of tax reform. Consequently, we divided our sample period into three regimes: pre-1982 (regime I, high dividend taxation), 1982 to 1986 (regime II, medium dividend taxation), and 1987 to 1988 (regime III, low dividend taxation). We reestimated our basic specification for each regime, omitting THETA and interactions involving THETA. We then compared estimates across regimes. The signaling hypothesis implies that the bang-for-the-buck should decline from regime I to regime II, and from regime II to regime III. It also implies that the bang-for-the-buck should be lower for firms with higher bond ratings within each regime. The alternative hypotheses have the opposite implications.

Results appear in Table 3. Estimates for regimes I, II, and III are based on 2154, 1710, and 655 observations, respectively. The final row of this table provides an estimate of the bang-for-the-buck for firms with low bond ratings, evaluated at the mean values of the other independent variables. An inspection of these results reveals several patterns. First, the bang-for-the-buck declines sharply across regimes. Indeed, in the third regime, one can no longer reject the hypothesis that an increase in dividends makes no marginal contribution to abnormal returns. Second, the estimated bang-for-the-buck is significantly lower (both economically and statistically) for firms with high bond ratings, both in regime I and regime II. Although it is higher in regime III, this result is not statistically significant (the coefficient of ΔDIV·HIRATED is small relative to its standard error). Apparently, the absence of stronger results on the effect of bond rating in Tables 1 and 2 is exclusively attributable to behavior in regime III, during which low dividend tax rates apparently muted the marginal effect of dividends on excess returns. Overall, these findings argue strongly in favor of the dividend signaling hypothesis.

Another potential objection to this analysis is that variation in tax rates is only present across years, and not across firms. Since $THETA_t$ tends to decline over the sample period, our effort to measure tax effects could conceivably pick up some spurious trend. We are inclined to doubt this hypothesis for two reasons. First, the evidence on tax effects is corroborated by evidence on bond ratings, and bond ratings vary considerably across firms. Second, the most plausible explanation for a spurious trend suggests that our estimates should be biased against the dividend signaling hypothesis. During the 1980s, domestic firms faced increasing levels of competition from abroad. Casual evidence suggests that, as a result, investors became more sensitive to managerial inefficiency. Thus, in the absence of signaling, one would have expected to observe an increase in the bang-for-the-buck during the 1980s.

It is also possible to test directly the hypothesis that the evolution of the bang-for-the-buck through time results from changes in the tax regime, rather than from some other consideration. We refer the reader to figure 2 for a schematic depiction of our testing strategy. In this figure, the sampling period is divided into the 3 tax regimes. The second regime is further subdivided into two subregimes, IIa and IIb. We propose performing tests for structural change across regimes and subregimes. Test 1 examines whether the relationship governing excess returns is the same in regime I as in regime IIa. Test 2 examines the stability of the excess return relationship over regimes IIa and IIb. Test 3 compares the estimated relationships for regimes IIb and III. Each of these comparisons involves a joint test for the equality of 12 coefficient pairs. Under the hypothesis that the evolution of the excess return relationship is driven by changes in the tax regime, we would expect to obtain the following results:

Test 1: Reject equality of coefficients

Test 2: Do not reject equality of coefficients

Test 3: Reject equality of coefficients

Under the alternative hypothesis that the evolution of the excess return relationship is driven by spurious factors, one would not expect to obtain the same pattern of results, except by some improbably coincidence. If, for example, the process of change was relatively smooth, one would expect to obtain roughly similar test statistics for tests 1, 2, and 3. Each joint hypothesis might or might not be rejected; the key point is that there would not be a dramatic, systematic difference in the test statistics across the three joint hypotheses.

One might object that the data are more likely to reject test 1, for two reasons. First, although regimes IIa, IIb, and III are all roughly of the same duration, regime I is roughly twice as long. If there is a spurious trend, then there will be less similarity between behavior in regime Ia (the first half of regime I) and regime IIa than between behavior in regimes IIa and IIb, since the temporal separation between regimes Ia and IIa is greater than that between regimes IIa and IIb. Second, since regime I is longer, it contains substantially more data. This implies that the coefficients will be estimated more precisely. If any change occurs through time, greater precision makes rejection more likely.

We address this objection by performing a fourth test (test 1^*), which examines the stability of the excess return relationship over regimes Ib and IIa. Since regime Ib is roughly of the same duration as regimes IIa, IIb, and III, the basis for the objection is eliminated.

Results are contained in Table 4. Tests 1 and 1^* decisively reject the hypothesis of structural stability at the 99% level of confidence. Test 3 also rejects the hypothesis of structural stability at that 95% level of confidence. In sharp contrast, the F-statistic for test 2 is actually less than unity. Thus, there is strong evidence that the relationship of interest changed significantly between regimes I and II, and between regimes II and

III, but that this relationship remained remarkably stable during regime II. This is precisely the pattern that would emerge if the evolution of the relationship for excess returns was primarily driven by changes in the tax system, and it differs sharply from the pattern that one would expect to find if the evolution of the relationship for excess returns was primarily driven by other factors.

5. Conclusions

In this paper, we have shown that the dividend signaling hypothesis implies that abnormal returns should be more sensitive to the magnitude of announced dividend changes when observable factors (such as tax rates and bond ratings) suggest that the marginal costs of dividends are high. Plausible alternative hypotheses have the opposite implication. Our empirical investigation reveals that the "bang-for-the-buck" generated by dividend announcements rises with the dividend tax rate and falls with bond rating. These findings are favorable to the signaling hypothesis.

Our tests emphasize implications of signaling that do not appear to be particularly model-specific. Consequently, it may be possible to adapt our approach in order to test signaling models in other contexts. For example, one might test the hypothesis that education functions as a signal of ability by identifying observable employee characteristics that are systematically correlated with the costs of obtaining education. Under the signaling hypothesis, the returns to additional education should be higher for those individuals whose observable costs of education are also high.

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Table 1: Estimates for 1962-1988

Variable	Equation 1	Equation 2	Equation 3	Equation 4
Constant	0.0168 (0.0147)	0.0189 (0.0187)	0.00787 (0.0163)	0.00904 (0.0209)
ΔDIV	14.9 (4.37)	14.2 (10.1)	13.3 (4.55)	14.3 (10.6)
ΔDIV·THETA	-16.0 (5.53)	-20.8 (5.77)	-14.2 (5.75)	-18.6 (6.08)
ΔDIV·HIRATED	-1.57 (1.28)	-1.03 (1.11)	-1.04 (1.23)	-0.534 (1.10)
ΔDIV·CAP		0.238 (0.0610)		0.226 (0.0610)
ΔDIV·GRO		0.472 (0.909)		0.855 (1.05)
ΔDIV·INFL		-15.8 (5.84)		-17.2 (6.21)
ΔDIV·MONTHS/10^2		1.02 (0.402)		1.10 (0.422)
THETA/10^2	-1.31 (0.984)	-0.789 (0.999)	-1.73 (0.982)	-1.35 (1.00)
HIRATED/10^3	2.25 (2.17)	1.53 (1.98)	1.94 (2.09)	1.25 (1.94)
CAP/10^4	-0.316 (0.788)	-3.66 (1.05)	-0.0187 (0.837)	-3.30 (1.10)
GRO/10^4	0.225 (7.52)	-5.23 (12.95)	-0.729 (8.30)	-12.2 (15.3)
INFL/10^2	0.182 (0.699)	2.41 (1.03)	1.12 (0.837)	3.56 (1.20)
MONTHS/10^6	2.16 (4.38)	-12.7 (6.83)	-1.02 (4.88)	-17.1 (7.40)
Root MSE	0.0366	0.0365	0.0357	0.0355
Selection criterion	A	A	B	B
Bang-for-the-buck	2.43 (0.358)	3.28 (0.388)	2.45 (0.373)	3.44 (0.409)

Notes: (1) Standard errors in parentheses

(2) Bang-for-the-buck is calculated at the mean values of the independent variables for the 1962 - 1988 period.

Table 2: Estimates for 1978 - 1988, with Earnings Announcement Conflicts Removed

Variable	Equation 1	Equation 2	Equation 3	Equation 4
Constant	-0.0444 (0.0305)	-0.0395 (0.0355)	-0.0599 (0.0334)	-0.0548 (0.0363)
ΔDIV	17.0 (6.61)	12.6 (16.7)	15.6 (6.97)	18.5 (17.8)
ΔDIV·THETA	-18.7 (7.74)	-23.6 (9.19)	-17.1 (8.16)	-18.5 (7.74)
ΔDIV·HIRATED	-2.84 (1.25)	-1.79 (1.20)	-2.66 (1.38)	-1.82 (1.14)
ΔDIV·CAP		0.337 (0.136)		0.326 (0.137)
ΔDIV·GRO		-0.174 (1.11)		-0.147 (1.11)
ΔDIV·INFL		-20.0 (9.34)		-30.5 (12.7)
ΔDIV·MONTHS/10^2		1.45 (0.751)		3.81 (1.93)
THETA/10^2	2.29 (1.64)	-3.14 (1.80)	1.98 (1.72)	2.27 (1.69)
HIRATED/10^3	2.81 (3.05)	1.25 (3.02)	4.06 (3.05)	2.56 (2.87)
CAP/10^4	-0.336 (1.48)	-4.87 (2.34)	-0.467 (1.65)	-5.18 (2.54)
GRO/10^4	35.9 (11.2)	36.0 (16.7)	37.7 (14.0)	36.9 (18.6)
INFL/10^2	3.09 (1.91)	5.72 (2.31)	4.99 (2.13)	8.38 (2.42)
MONTHS/10^6	-15.2 (11.8)	-32.9 (15.6)	-37.9 (15.4)	-79.7 (24.2)
Root MSE	0.0364	0.363	0.336	0.0336
Selection criterion	A	A	B	B
Bang-for-the-buck	1.34 (0.467)	1.58 (0.472)	1.41 (0.483)	1.97 (0.543)

Notes: (1) Standard errors in parentheses

(2) Bang-for-the-buck is calculated at the mean values of the independent variables for the 1978 - 1988 period.

Table 3: Tax Regime Estimates

Variable	Regime 1 (1978- 1981)	Regime II (1982 - 1986)	Regime III (1987 - 1988)
Constant	-0.324	0.0284	0.199
	(0.197)	(0.0491)	(0.238)
ΔDIV	181	11.6	1.45
	(118)	(32.7)	(47.2)
ΔDIV·HIRATED	-9.89	-4.80	3.00
	(2.20)	(1.98)	(4.87)
ΔDIV·CAP	0.305	0.335	0.180
	(0.346)	(0.246)	(0.544)
ΔDIV·GRO	-4.38	4.70	-2.17
	(1.55)	(2.04)	(7.29)
ΔDIV·INFL	-197	-38.5	-13.9
	(96.4)	(28.2)	(37.4)
ΔDIV·MONTHS/10^2	20.5	1.77	-0.255
	(8.57)	(1.73)	(2.64)
HIRATED/10^3	12.1	2.72	6.43
	(4.47)	(3.81)	(13.1)
CAP/10^4	-5.95	-9.48	-45.8
	(5.66)	(3.77)	(18.9)
GRO/10^4	67.9	-3.36	122
	(30.4)	(19.9)	(78.5)
INFL/10^2	36.9	4.89	17.7
	(16.6)	(3.88)	(15.1)
MONTHS/10^6	-370	-19.5	-70.0
	(150)	(22.8)	(67.0)
Root MSE	0.0313	0.0313	0.0495
Bang-for-the-buck	19.8	5.21	-2.17
	(5.35)	(1.83)	(2.24)

Notes: (1) Standard errors in parentheses

(2) Bang-for-the-buck is calculated at the mean values of the independent variables for the 1978 - 1988 period, except for HIRATED, which is set equal to zero.

Table 4: Tests for Structural Change

Test	Regimes	Test Statistic (F)	Probability >F
1	I and IIa	F(12,3020) = 2.86	0.06%
1*	Ib and IIa	F(12,2064) = 2.27	0.75%
2	IIa and IIb	F(12,1686) = 0.74	71.29%
3	IIb and III	F(12,1451) = 1.91	2.95%