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Capital Structure and the Ex-Dividend Day Return

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Abstract

We apply an option-pricing framework to the ex-dividend behavior of common stocks. The framework explains the observed behavior of positive returns on the ex-dividend day and predicts that ex-dividend day returns will be higher for firms with greater financial leverage. Empirical testing supports the prediction. In contrast to prior studies, we find that dividend-capture activity has no significant impact on ex-dividend behavior, and we offer an explanation based on the importance of tick intervals.

Keywords: option pricing, capital structure, financial leverage, dividends, ex-dividend return, dividend capture

JEL Classification: G12

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1. Introduction

Since Campbell and Beranek's (1955) article on the behavior of stock prices on ex-dividend dates, a large body of research has emerged showing that stocks tend to drop by an amount that is less than the dividend on the ex-dividend date. Some studies measure the phenomenon by computing a price-change-to-dividend ratio (the ex-dividend drop ratio) and observing that it is less than 1.0, while others compute ex-day returns and observe them to be positive.[1] Why should this happen when logic tells us that in a perfect market, the price drop should equal the dividend? In this paper, we propose and test a model in which the presence of debt in a firm's financial structure causes the true value of the firm to fall by an amount that is less than the dividend. Market imperfections allow the observed drop to be less than the dividend while arbitrage establishes limits to the lower bound of the ex-day drop. Our empirical tests control for a comprehensive set of factors believed to influence ex-dividend day behavior.

The ex-dividend phenomenon appears to persist over time and not to be limited to U.S. common stocks. McInish and Puglisi (1980) find that the effect holds for preferred stocks, and Hayashi and Jagannathan (1990) observe positive ex-dividend day returns in the Japanese stock market. Booth and Johnson (1984) conclude that the ex-dividend drop ratio of Canadian stocks is less than 1.0 and that dual listing in the United States affects the ex-day behavior.

Early explanations of the ex-day phenomenon tend to be based on different tax rates on dividend and capital gains income for the marginal long-term investor (Elton and Gruber, 1970; Elton, Gruber, and Rentzler, 1984; Barclay, 1987). While early empirical work tends to support the tax hypothesis, more recent studies call the conclusion into question. Eades, Hess, and Kim (1984) show that the results of earlier studies cannot be unambiguously interpreted as supporting taxes as an explanation. Michaely (1991) observes persistence of the ex-dividend effect after the Tax Reform Act of 1986, which eliminated the differential tax rates, and concludes that tax rates do not drive the ex-dividend day effect. Michaely and Murgia (1995), investigating the ex-dividend behavior of stocks on the Milan Stock Exchange where two classes of stock trade with different tax rates on their dividends, conclude that tax rates explain a significant portion of ex-dividend day trading, but cannot fully explain the ex-dividend day drop. Frank and Jagannathan (1998) detail a strong ex-dividend day effect in Hong Kong where neither dividends nor capital gains are taxed. Taxes, in general, while possibly affecting ex-dividend price behavior, appear unlikely to be the only element influencing ex-day returns.

Another explanation is based on short-term traders who try to take advantage of different tax treatment of dividends and capital losses or use dividend-capture

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[1] As is often the case, there are a few exceptions, the most notable of which is the stocks of public utilities. Skinner and Gilster (1990) report that the ex-day drop ratio averages greater than 1.0 for these companies. However, unique features of public utilities, such as high and stable dividends, special tax treatment of dividends, and debt guarantees, could affect their ex-dividend behavior.

strategies (Kalay, 1982; Lakonishok and Vermaelen, 1983; Karpoff and Walkling, 1988, 1990; Michaely, 1991). While some evidence supports this theory, short-term trading also does not completely account for observed ex-dividend behavior.

Transactions costs could allow the ex-dividend drop ratio to differ from 1.0. In a market with no transactions costs, short-term traders and security dealers using a dividend-capture strategy would arbitrage away any profits and ensure that the ex-dividend drop ratio would approach 1.0. However, positive transactions costs establish a lower bound on the ratio (Kalay, 1982; Karpoff and Walkling, 1988). Boyd and Jagannathan (1994) model a market in which there are transactions costs and three classes of traders. After controlling for these factors, Boyd and Jagannathan find that ex-dividend drop ratios have not been significantly different from 1.0. Although transactions costs may allow ex-dividend drop ratios to be less than 1.0 because of arbitrage, they provide no mechanism to explain why the ratio would be less than 1.0.

Other explanations that seem to have merit rely on the market microstructure. Dubofsky (1992) advances an explanation based on New York Stock Exchange (NYSE) rules that require open buy orders to be marked down on the ex date by an amount that is more than the amount of the dividend, while open orders to sell are not reduced.

Bali and Hite (1998) model how trading at discrete price intervals (ticks), when considering the different trading strategies of long-term investors and arbitragers, can cause the ex-day price drop to be less than the dividend. Their evidence shows that as the dividend amount increases past a tick interval (a multiple of 0.125 during the period of their study), the ex-day drop jumps to a high percentage of the dividend, then decreases as the distance from the tick increases, falling to its lowest at the next tick multiple. The existence of discrete ticks does seem to explain a major portion of the ex-dividend day behavior. However, there is a puzzling difference between the mean ex-day drop for cash dividends and for stock dividends. If tick levels were the sole determinant of the ex-day phenomenon, then ex-day drops should be the same for both cash and stock dividends. However, the cash dividends in Bali and Hite's sample had a mean drop of 76.5% of the dividend, while the stock dividend portion experienced a larger ex-day decline of 86.3%.[2] The difference between cash and stock distributions is that cash dividends represent an outflow of cash from the firm and a decrease in the equity portion of the firm's capital structure, while stock dividends have no effect on total asset value or capital structure.

Although each theory of ex-dividend behavior has some empirical support, none of the evidence points to any superior explanation of the ex-dividend day effect.

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[2] Bali and Hite (1998) observe that the ex-dividend drop ratio is closer to 1.0 for stock dividends, but that this could be because stock dividends are larger than cash dividends on average, which makes discreteness less important. While larger dividends make the tick proportionately less important, the price drop to dividend drop ratios for cash dividends in Bali and Hite seem to be consistently less than those for stock dividends across all dividend levels. For example, for the tick interval from 13.75 to 25 cents (which is sufficiently low to make the tick relatively important), the mean ratio is 71% for cash dividends and 87% for stock dividends (computed from Bali and Hite, Table 4).

Even considering all of the possible explanations, it appears that there remains some unexplained ex-dividend behavior. All the explanations are based on market imperfections such as taxes or market trading rules. The purpose of this paper is to show that there is a theoretical explanation for a stock's fundamental value to decrease less than the amount of a cash dividend payment. Our analysis relies on the valuation of corporate securities in an option-pricing framework where the payment of a cash dividend causes the value of the firm to fall by an amount equal to the dividend. In this environment, the debt absorbs a portion of this decrease, and the remaining portion of the decrease (the fall in value of equity) will be less than the amount of the dividend. While efficient market theory argues that any such wealth transfer from bondholders to stockholders should occur at the time the dividend payment becomes known (the dividend declaration), evidence supports the notion that this and other dividend-related price behavior that should occur on the declaration date actually happens on the ex-dividend date. We provide empirical evidence to support our hypothesis while considering that ex-dividend behavior is a combination of this and other theories of the ex-dividend phenomenon.

2. Dividend-related price behavior in an option-pricing context

2.1. The basic model

The Black-Scholes (Black and Scholes, 1973) option-pricing model can provide a framework for the valuation of corporate securities when we view the firm as an entity whose equity holders have an option to purchase the firm from the debtholders for a fixed price. Take the simple case of a firm with one issue of pure-discount bonds outstanding. The firm's equity is comparable to a call option of which the face value of debt is the exercise price of that option and the time to maturity of the debt is the time to expiration of the option. Since a continuous-time model such as Black-Scholes is not applicable to pricing securities for which a continuously hedged portfolio cannot be maintained, researchers present discrete-time solutions for pricing corporate securities (Rubinstein, 1976; Brennan, 1979; Hsia, 1981). The value of common stock can be stated as

$$S = U \cdot N(d_1) - r^{-1}b \cdot N(d_2), \tag{1}$$

where S is the value of common stock; U is the value of the unlevered firm; $N\{\cdot\}$ is the cumulative normal distribution function; r is 1 + the riskless rate of interest; t is the time to maturity of the firm's debt; b is the face value of the firm's debt; and σ is the standard deviation of the return on the unlevered firm.

$$d_1 = \frac{\ln(U/b) + (\ln r + \sigma^2/2) \cdot t}{\sigma\sqrt{t}},$$

$$d_2 = d_1 - \sigma\sqrt{t}$$

The value of the firm's pure-discount bond is

$$B = U \cdot N\{-d_1\} + r^{-t} b \cdot N\{d_2\}, \tag{2}$$

where B is the value of the firm's pure-discount debt.

The value of the levered firm is the sum of the value of the equity and the value of debt:

$$V = S + B. \tag{3}$$

In the absence of corporate taxes, debt-related agency costs (bonding and monitoring costs), and bankruptcy costs, the value of the unlevered firm is equal to the value of the levered firm:

$$U = V. \tag{4}$$

Assuming that the firm declares and pays a dividend at the same instant, and letting the payment of a cash dividend diminish the value of U by the amount of the dividend at the ex-dividend moment, we have

$$U_x = U_c - D, \tag{5}$$

where x denotes the ex-dividend day; c denotes the cum-dividend day (the day prior to the ex-dividend day), and D is the cash dividend payment.

The change in the value of the stock value (S) for a given change in firm value (U) is

$$\frac{\partial S}{\partial U} = N\{d_1\}. \tag{6}$$

Equation (6) also represents the ex-dividend day drop ratio, the ex-dividend stock-price change as a fraction of the dividend.

Since

$$0 < N\{d_1\} < 1, \tag{7}$$

the ex-dividend change in a stock's price should be less than the amount of the dividend and depend on the value of U/b (firm leverage), t, r, and σ. The value of the firm's debt should fall by an amount equal to the difference between the dividend and the drop in the stock's price. This would represent a transfer of wealth from debtholders to stockholders.

Before the dividend, investors hold a portfolio of risky equity and debt in the firm. On the ex date, their portfolio becomes comprised of risk-free cash along with risky equity and debt. The risk of these cum- and ex-dividend portfolios must be equal, so the existence of risk-free cash in the ex-dividend portfolio means that the risk of the equity-debt portion must increase. If the increase in risk is entirely borne by equity, then the value of equity would decrease by the amount of the dividend. However, on the ex-dividend date, the cash becomes forever unavailable to debtholders to cover future interest and principal payments on the debt. The risk of the debt must increase and cover at least some portion of the increase in the equity-debt portion of the ex-dividend portfolio. The equity portion's risk change, therefore, is less than if there were no debt, and the fall in value of the equity is less than the amount of the dividend. This result is consistent with Galai and Masulis (1976), who show that the risk of both equity and debt securities of the levered firm increases when the value of the firm falls.

The above analysis shows that the existence of debt in a firm's capital-structure results in an ex-dividend day decline in the value of equity that is less than the amount of the dividend. With positive transactions costs, this causes the ex-dividend day return to be positive (in the absence of stock-price changes caused by other factors). The existence of arbitrage or risk-arbitrage opportunities in the form of dividend-capture trading strategies should limit ex-day returns observed in the market to a range consistent with transactions costs.

2.2. *Relaxing the assumptions of the basic model*

For the sake of simplicity, the above model assumes that there are no corporate taxes, no agency costs, and no bankruptcy costs. However, it is possible to relax these assumptions and reach the same conclusion regarding ex-dividend behavior. Hsia's (1981) model for pricing corporate securities in an option-pricing framework includes variables for a corporate tax rate, bankruptcy costs, and monitoring costs. The ex-dividend stock-price change as a fraction of the dividend would be

$$\frac{\partial S}{\partial U} = N\left\{\frac{\ln[U/(b(1+i(1-(T_{\mathrm{c}}-a))))] + \ln r + \sigma^2/2}{\sigma\sqrt{t}}\right\} \tag{8}$$

where i is the interest rate on the debt; T_{c} is the corporate income tax rate, and a is the monitoring costs as a portion of the face value of debt.

According to Equation (8), the existence of corporate income taxes or an increase in the tax rate results in a greater stock-price change (lower ex-day returns). Countering the effect of taxes are monitoring costs, the existence of which serves to decrease the stock-price change (increase ex-day returns). Normally, we would anticipate that $T_{\mathrm{c}} > a$, so the net effect of taxes and monitoring costs is to decrease ex-dividend day returns and make the ex-dividend day effect less pronounced. Note that bankruptcy costs, while in Hsia's model, do not appear in the first derivative, so bankruptcy costs have no effect on ex-dividend day stock-price behavior.

How much would taxes and monitoring costs affect ex-day behavior? To answer this question, we compute the first derivative (Equation (8)) assuming some reasonable parameters: $U = 71.43$, $b = 34.94$, $t = 10$, $r = 0.05$, and $\sigma = 0.3$. With no taxes or monitoring costs, the result is 0.9497. With a tax rate of 35% ($T_{\mathrm{c}} = 0.35$), monitoring costs of 3% ($a = 0.03$), and an interest rate on corporate debt of 10% ($i = 0.10$), Equation (8) yields a value of 0.9528. The effect of taxes and monitoring costs is small. Therefore, the existence of taxes, bankruptcy costs, and monitoring costs does not affect the conclusion: the existence of debt in a firm's capital-structure results in positive ex-day returns.

2.3. Timing of the capital-structure-induced stock-price reaction

With separate dividend declaration and ex-dividend dates, the stock price in a perfectly efficient market should rise to reflect the wealth transfer immediately upon the forthcoming dividend's becoming known in the market (on the declaration date). Studies of dividend announcements report significant stock-price reactions, on average, to dividend announcements (e.g., Petit, 1972; Kalay and Loewenstein, 1985; Bajaj and Vijh, 1995; Howe, Vogt, and He, 2003). However, these reactions are associated with information flows resulting from market interpretations of a dividend change or from the concurrent release of other information relevant to firm value. Dividend announcements not conveying new information relevant to future firm cash flows tend to show no market reaction. Aharony and Swary (1980) report that firms with no dividend change exhibit no announcement-date excess return, on average. When examining only dividends in which there was no change from the previous dividend and controlling for confounding effects of any ex-distribution day occurring during a period beginning five days before the announcement and ending 15 days after, Eades, Hess, and Kim (1985) report insignificant announcement-day returns. As Eades, Hess, and Kim (p. 588) state, "Apparently, the market interprets the announcement of a no-change in dividends as no news." Furthermore, studies of bond returns on dividend announcement dates fail to show reactions or wealth transfers other than those associated with information signaling (see, e.g., Woolridge, 1983; Handjinicolaou and Kalay, 1984; Jayaranan and Shastri, 1988; Dhillon and Johnson, 1994).

With no evidence of a stock-price reaction or wealth transfer on the dividend announcement date (except for those associated with information flows), the ex-dividend date becomes the candidate date on which a capital-structure-induced positive price reaction might occur. Ample evidence exists of positive stock returns on ex-dividend days, even after accounting for the effects of the various other explanations for positive ex-day returns. It remains a puzzle, of course, that any market reaction should occur on the ex date rather than the announcement date. However, other phenomena also manifest themselves on the ex date rather than on the declaration date. Studies of stock splits report that stock return variances are unaffected on split announcement dates but increase significantly on the ex-split date and continue at higher levels for an extended period of time (Ohlson and Penman, 1985; Dravid, 1987; Desai, Nimalendran, and Venkataraman, 1998). Manifestation of the increased post-split variance is also delayed until the ex date for volatilities implied in call option prices (French and Dubofsky, 1986; Sheikh, 1989). Attempts to explain this anomaly rely on market microstructure factors such as the bid-ask bounce and trading at discrete price intervals, both of which could generate an increase in return variance solely due to lower prices in effect beginning only on the ex date. Koski (1998), however, shows that neither the bid-ask spread nor the discrete trading intervals cause the observed increase in return variance on the ex date, and it remains an enigma that these increased variances occur on the ex date rather than on the announcement date.

In light of the observations that there is apparently no market reaction on the dividend announcement date associated with a dividend and capital-structure-induced wealth transfer and that we observe other market reactions occurring on the ex date that should occur on the announcement date, we hypothesize that the stock-price reaction occurs on the ex-dividend date and will at least partially explain observed positive ex-dividend day returns.

2.4. Magnitude of the capital-structure-induced ex-dividend effect

To illustrate how the levered firm's securities would respond to a dividend payment, Table 1 shows values computed using Equations (1)–(3) with reasonable values for D (0.25), t (10 years), r (1.05), and σ (0.3 per year). The table lets leverage, measured by the debt to total value ratio, range from 0.1 to 0.5 and computes security values such that the stock price S for each leverage level is 50.[3] For example, the table shows that a \$50 stock paying a 25 cents dividend with a debt ratio of 0.3 should fall by 23.7 cents (column 8), or 94.95% of the dividend (column 9), yielding an ex-dividend day return of 0.0252% (column 10).

Any decline in the value of the firm that is not attributable to a fall in stock value must be borne by the fall in the value of debt. In the theoretical example from Table 1, the \$50 stock paying the 25 cents dividend and falling by 23.7 cents would have a bond worth 21.429 that would decline by 1.3 cents to 21.416. Bondholders usually are successful in anticipating wealth transfers and preventing expropriation of their wealth. For example, there is little evidence of wealth transfers in the event of mergers (Asquith and Kim, 1982; Dennis and McConnell, 1986), or spin-offs (Hite and Owers, 1983; Schipper and Smith, 1983). Bond covenants limit the shareholders' ability to expropriate bondholder wealth by restricting the dividend-paying ability of the firm while the bonds are outstanding (Smith and Warner, 1979). However, bond covenants usually permit small dividend payments which result in declines in value that are small relative to the value of the debt. The decrease in the value of our example firm's debt is only 0.06% of the debt value, relatively small compared to the 0.5% drop in the stock.

Why are bondholders willing to consent to even small dividend payments? Small dividend payments can encourage management actions that benefit both shareholders and bondholders. For example, the use of secured debt can increase the value of the firm (Stulz and Johnson, 1985). Because such loan guarantees may result in

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[3] The constant \$50 stock value is arbitrary but selected so that the dividend could be a constant 0.25, making the ex-day drop comparisons easy. Ex-day dividend drop ratios and returns are the same when the table is constructed holding the total firm value constant for each leverage level (and varying the dividend by holding the yield constant).

Table 1

Hypothetical cum/ex-dividend day stock returns and values using an option-pricing framework

The results are based on the following assumed values for a hypothetical firm:

Variable	Definition	Value
D	Cash dividend payment	0.25
t	Years to maturity of pure-discount debt	10.00
r	$1 +$ riskless rate	1.05
σ	SD of the unlevered firm value	0.30
S	Cum-dividend value of a share of stock	50.00
	Ex-dividend value of a share of stock	computed with Equation (1)
B	The market value of debt (cum- and ex-dividend)	computed with Equation (2)

Cum-dividend or Ex-dividend (1)	Value of the unlevered firm, U (2)	Face value of debt, b (3)	Market value of equity, S (4)	Market value of debt, B (5)	Value of the levered firm, $V = S + B$ (6)	Debt-to-total-value ratio, B/V (7)	Ex-dividend stock price drop, $S_c - S_x$ (8)	Stock price drop as percent of dividend, $\frac{S_c - S_x}{D}$ (9)	Ex-dividend day return on stock, $\frac{S_x - S_c + D}{S_c/100}$ (10)
Cum	55.556	9.113	50.000	5.556	55.556	0.1			
Ex	55.306	9.113	49.750	5.555	55.306		0.250	0.9981	0.0010
Cum	62.500	21.189	50.000	12.500	62.500	0.2			
Ex	62.250	21.189	49.754	12.496	62.250		0.246	0.9833	0.0084
Cum	71.429	38.433	50.000	21.429	71.429	0.3			
Ex	71.179	38.433	49.763	21.416	71.179		0.237	0.9495	0.0252
Cum	83.333	64.610	50.000	33.333	83.333	0.4			
Ex	83.083	64.610	49.777	33.307	83.083		0.224	0.8953	0.0523
Cum	100.000	107.095	50.000	50.000	100.000	0.5			
Ex	99.750	107.095	49.795	49.955	99.750		0.205	0.8199	0.0900

wealth transfers from shareholders to existing bondholders, managers may be willing to permit them only when their effects can be moderated through other financial transactions such as dividend payouts (Selby, Franks, and Karki, 1988). Also, the information conveyed through the dividend signal may be of value to both bondholders and shareholders. Further, according to Jensen's (1986) free cash flow hypothesis, the payment of dividends may limit management's ability to invest in perquisites and other negative net-present-value projects and thus increase the value of the firm.

To summarize, we describe a market environment in which the value of a stock falls by an amount less than the dividend due to wealth transfers related to firm leverage. Positive transactions costs allow observed market prices to fall by less than the dividend up to the point where arbitrage profits are no longer possible. The higher the firm leverage, the smaller is the ex-dividend drop ratio and the greater the ex-day return. The hypothesis of this paper is that firm leverage affects the ex-dividend day return on a common stock, and it is testable using market data in which we expect to observe stocks with higher debt ratios exhibiting greater ex-day returns.

3. Empirical tests

As the basis for conducting empirical tests of the effect of leverage on ex-day returns, we extract from the Center for Research in Security Prices (CRSP) U.S. stock database the cash dividends and prices for all NYSE and American Stock Exchange (AMEX) traded stocks with ex-dividend dates in 1989–1996. We delete instances where a stock has more than one cash dividend on the same ex-dividend date. To avoid confounding influences of other types of stock distributions, we also delete observations with either a stock split or a stock dividend on the cum-dividend or ex-dividend date. We obtain debt and other financial data for each firm from Standard & Poor's Compustat for the years 1989–1996. There are 40,251 ex-dividend day events of firms that also have debt data available on Compustat. Table 2 presents summary statistics for the sample.

For each observation in the sample, we compute the ex-dividend drop ratio and the ex-dividend return. The drop ratio is

$$\mathrm{DROP} = \frac{P_{\mathrm{c}} - P_{\mathrm{x}}}{D}, \tag{9}$$

Table 2

Summary statistics for 40,251 common stock ex-dividend days, 1989–1996

Description	Mean	SD
Dividend	0.249	0.224
Stock price	29.861	23.648
Dividend yield (annual)	0.036	0.008
Debt to total assets	0.432	0.164
Return on assets	0.075	0.406

where P_c is the cum-dividend price, the closing price of the stock on the day prior to the ex-dividend day and P_x is the ex-dividend price, the closing price of the stock on the ex-dividend day.

The ex-dividend day return is

$$R_x = \frac{P_x - P_c + D}{P_c}, \tag{10}$$

where R_x is the ex-dividend day return on the stock.

Equations (9) and (10) represent ex-dividend behavior measures unadjusted for market returns. We adjust for market returns in the multivariate analysis of section 3.2. Table 3 gives the summary statistics for the returns and ex-dividend drop ratios. The ex-dividend day behavior observed in prior studies is also present here. The mean drop ratio is 0.771, which is significantly less than 1.0 ($p < 0.001$), and the mean ex-day return of 0.159% is greater than 0 at the same significance level.

3.1. Ex-dividend behavior for zero- and positive-debt firms

To check for differences in ex-dividend day behavior among firms with different debt levels, we divide the sample by whether the firm has long-term debt. Table 3 presents the summary statistics. Firms without long-term debt tend to fall on average

Table 3

Drop ratios and returns for 40,251 common stock ex-dividend days, 1989–1996

The drop ratio is

$$\text{DROP} = \frac{P_c - P_x}{D}$$

and the ex-dividend day return in percent is

$$R_x = \frac{P_x - P_c + D}{P_c} \times 100$$

where P_c is the closing price of the stock on the day before the ex-dividend day (cum dividend); P_x is the closing price of the stock on the ex-dividend day, and D is the dividend per share.

The null hypothesis for the drop ratio is H_0: DROP = 1.0. The null hypothesis for the ex-dividend day return is H_0: $R_x = 0$.

		Ex-dividend drop ratio, DROP (t-statistic)			Ex-dividend day % return, R_x(t-statistic)		
Data	N	Mean	SD	Median	Mean	SD	Median
All stocks	40,251	0.771* (−5.81)	7.64	0.834	0.159** (16.67)	1.91	0.141
Stocks with no long-term debt	4,108	1.008 (0.08)	6.81	0.925	0.043 (1.24)	2.21	0.072
Stocks with long-term debt	36,143	0.744* (−6.06)	8.02	0.833	0.172** (17.45)	1.88	0.148

** Significant at the 0.001 level; H_0: $\mu = 0$.

* Significant at the 0.001 level; H_0: $\mu = 1$.

by an amount equal to the dividend. The typical ex-dividend day behavior is not present for zero-long-term debt firms. The mean ex-dividend drop ratio for this group is 1.008 (not significantly different from 1), and the mean ex-dividend day return is 0.043% (not significantly different from 0). For the positive-debt group, the mean drop ratio of 0.744 is less than 1.0 and significant at the 0.01 level. The ex-dividend day return of 0.172% is positive and significant at the 0.01 level.

As our theory predicts, leveraged firms exhibit lower ex-dividend drop ratios and higher returns than do firms without long-term debt. The difference in drop ratios between the zero-debt and positive-debt groups is statistically significant according to the Kruskal-Wallis test ($\chi^2 = 13.66, p < 0.001$). The returns also differ significantly ($\chi^2 = 14.83, p < 0.001$). Therefore, at least at first glance, companies with no long-term debt behave on ex-dividend days just as they do on other days, while levered firms tend to exhibit the behavior that investigators commonly find. However, to fully capture any ex-dividend effect of firm leverage, we should control for other variables that could influence the ex-day behavior.

3.2. Ex-dividend behavior, firm debt levels, and other factors

As a general test for the factors affecting ex-dividend behavior, we build a regression model to identify the relationships between these factors and ex-dividend day behavior. The first issue to address is the choice of dependent variable. Although using the ex-dividend day drop ratio may be intuitively appealing, there are several reasons that discourage its use. First is that the empirical distribution of drop ratios is far from being normally distributed. The Kolmogorov-Smirnov test easily rejects normality ($D = 0.237, p < 0.001$). A second reason for not using the ex-dividend day drop ratio is that ex-dividend drop ratios are heteroskedastic because they are scaled by dividends that vary widely across firms (Eades, Hess, and Kim, 1984). Prior studies control for heteroskedasticity by combining all observations of a given day into a portfolio. This is not feasible for our test because we need to examine the effects of individual firms' debt on ex-dividend day behavior. A third reason is that the economic significance of the drop is only important to the extent that abnormal returns are available in the market. A low drop ratio is not meaningful if it is associated with a high-priced stock whose ex-day return would be insignificantly small. Some prior studies use ex-day returns, but the use of returns on the left-hand side may be inappropriate because dividends are a component of return, and also including the dividend yield on the right-hand side of the model may yield regression estimates with unpredictable behavior.

To construct a dependent variable to reflect ex-dividend behavior, we begin with the Security Market Line:

$$R_{\mathrm{x}} = R_{\mathrm{f}} + \beta(R_{\mathrm{m}} - R_{\mathrm{f}}), \tag{11}$$

where R_{f} is the risk-free return; β is the stock's beta; and R_{m} is the return on the market portfolio.

Equating (10) and (11) and rearranging yields:

$$\frac{P_{\mathrm{x}} - P_{\mathrm{c}} - P_{\mathrm{c}}(\beta R_{\mathrm{m}} - (\beta R_{\mathrm{f}} - R_{\mathrm{f}}))}{P_{\mathrm{c}}} = -\frac{D}{P_{\mathrm{c}}}. \tag{12}$$

Noting that $\beta R_{\mathrm{f}} - R_{\mathrm{f}}$ is virtually zero for a single day, Equation (12) becomes

$$\frac{P_{\mathrm{x}} - P_{\mathrm{c}} - P_{\mathrm{c}}\beta R_{\mathrm{m}}}{P_{\mathrm{c}}} = -\frac{D}{P_{\mathrm{c}}}. \tag{13}$$

Bali and Hite (1998) show that the portion of the dividend that exceeds the nearest tick multiple is an important factor in the ex-day return. Dividends can be divided into two components: (1) the amount of the dividend that is an exact multiple of the tick and (2) the amount of the dividend in excess of the tick multiple. To allow the amount of the dividend in excess of the tick multiple to be part of our analysis, we express the dividend as the sum of the dividend tick multiple and the dividend tick remainder, and Equation (13) becomes

$$\frac{P_{\mathrm{x}} - P_{\mathrm{c}} - P_{\mathrm{c}}\beta R_{\mathrm{m}}}{P_{\mathrm{c}}} = -\frac{D_{\mathrm{tm}} + D_{\mathrm{tr}}}{P_{\mathrm{c}}}, \tag{14}$$

where D_{tm} is the dividend tick multiple, the amount of the dividend that is an exact multiple of the tick interval; $D_{\mathrm{tm}} = D - D_{\mathrm{tr}}$ and D_{tr} is the dividend tick remainder, the amount of the dividend that exceeds the tick multiple; $D_{\mathrm{tr}} = D$ modulo 0.125.

Equation (14) identifies the dependent variable and two primary independent variables for the model of ex-day returns. The dependent variable represents the percentage change in the stock price on the ex-dividend day adjusted for market returns on that day. Stating the equation as a regression, we have

$$\frac{P_{\mathrm{x}} - P_{\mathrm{c}} - P_{\mathrm{c}}\beta R_{\mathrm{m}}}{P_{\mathrm{c}}} = a_0 + a_1\frac{D_{\mathrm{tm}}}{P_{\mathrm{c}}} + a_2\frac{D_{\mathrm{tr}}}{P_{\mathrm{c}}} + \mu. \tag{15}$$

The values of the estimated coefficients of the tick multiple (a_1) and of the tick remainder (a_2) are meaningful. If stocks fall by an amount equal to the dividend on the ex-dividend date, then $a_1 = a_2 = -1$. However, given the typically observed ex-dividend drop of less than the dividend, we would expect at least one of the coefficients to be less than one. If ex-dividend behavior is only related to the tick remainder as in Bali and Hite (1998), then we would expect to find $a_1 = -1$ and $-1 < a_2 < 0$.

To the model in Equation (15), we add a variable to test for the hypothesis of this paper (leverage effects) and variables shown in prior studies to affect ex-dividend behavior (taxes, transactions costs, and dividend-capture trading). We measure leverage by the debt-to-total-assets ratio (DEBT). If the leverage hypothesis is valid, then higher debt ratios should be associated with higher ex-day adjusted percentage price changes, leading us to anticipate a positive value for the coefficient of DEBT.

Previous studies (Karpoff and Walkling, 1988; Boyd and Jagannathan, 1994; Michaely and Murgia, 1995) report transactions costs to be significant in ex-dividend day pricing. Previous studies including Glosten and Harris (1988) report that volume is inversely correlated with transactions costs. Therefore, we use trading volume as a proxy for transactions costs, as do Michaely and Murgia (1995). Our measure is the average monthly trading volume (in millions of shares) of the stock over the previous three years (AVGVOL). Since lower transactions costs would lead to lower ex-dividend day price changes, we would expect to observe higher average volume being associated with lower ex-day adjusted percentage price changes, yielding a negative expected estimated regression coefficient.

Tax effects were the first explanation of ex-dividend behavior. Although recent research lends less support for taxes as the main determinant of the ex-dividend day phenomenon, the notion that taxes contribute to ex-day behavior continues to receive attention. The existence of non-taxable dividends in the sample allows the inclusion of a dummy variable (TAX) to account for the taxability of dividends. The dummy variable has a value of 0 for non-taxable distributions and a value of 1 for taxable cash dividends. The taxability of dividends is a market imperfection that, like transactions costs, should result in smaller ex-dividend day price changes. Since the expected ex-day price change is negative, taxes on the dividend would move the expected price change in the positive direction. Therefore, with a value of 1 for taxable dividends, TAX should have a positive coefficient.

Dividend-capture strategies representing arbitrage activity in the stock might also affect ex-dividend day behavior. To proxy for dividend-capture activity, we use the volume of trades in the stock occurring on the ex-dividend day (VOL) measured in millions of shares. Prior studies (Boyd and Jagannathan, 1994) associate dividend capture with lower ex-day returns, which would imply a negative coefficient for VOL.

To summarize, the empirical model used is

$$\begin{aligned}\frac{P_{\mathrm{x}} - P_{\mathrm{c}} - P_{\mathrm{c}}\beta R_{\mathrm{m}}}{P_{\mathrm{c}}} &= a_0 + a_1\frac{D_{\mathrm{tm}}}{P_{\mathrm{c}}} + a_2\frac{D_{\mathrm{tr}}}{P_{\mathrm{c}}} + a_3\mathrm{DEBT} \\ &\quad + a_4\mathrm{AVGVOL} + a_5\mathrm{TAX}\,\mu + a_6\mathrm{VOL} + \mu. \qquad (16)\end{aligned}$$

The β, DEBT, and AVGVOL come from Computstat. Combining the variables with the CRSP data, 29,504 observations remain in the sample. The reduced sample represents 73.3% of the original sample. The reduced sample is likely a good representation of the entire sample because it is such a large portion of the original sample and because the occurrence of missing values appeared to be random.

3.3. Regression results

Table 4 presents the regression results. The estimate of the DEBT coefficient is 0.002. It is of the predicted sign (positive) and highly significant ($p = 0.003$). This shows that firms with higher debt levels exhibit greater returns and smaller ex-dividend day drops after controlling for other variables that may influence ex-day returns. The result provides strong support for the option-pricing framework for ex-dividend behavior and its implication that leverage is an important determinant of ex-dividend day behavior.

Table 4

Regression of 29,504 ex-dividend day stock returns, 1989–1996

Dependent variable:

$$\frac{P_x - P_c - P_c \beta R_m}{P_c}$$

Independent variables:

Variable	Definition
D_{tm}/P_c	The dividend tick multiple as a portion of the stock cum-dividend price
D_{tr}/P_c	The dividend tick remainder as a portion of the stock cum-dividend price
DEBT	The firm's debt-to-total-assets ratio
AVGVOL	Average monthly trading volume over past three years
TAX	0 for non-taxable dividends, 1 for taxable dividends
VOL	Volume on the ex-dividend day

For D_{tm}/P_c and D_{tr}/P_c, the null hypotheses for the test statistics are H_0: D/Pc $= -1$. For this reason, the sign of the t-statistic may be different from the sign of the estimated coefficient. For all other coefficients, the null hypothesis is H_0: coefficient $= 0$.

$R^2 = 0.1356$
$N = 29{,}504$

Independent variable	Hypothesized coefficient	Estimated coefficient	Standard error	t-statistic	p-value
Intercept	0	−0.0006	0.0004	−1.619	0.1055
D_{tm}/P_c	−1	−1.0007	0.0149	−0.046	0.9633
D_{tr}/P_c	−1	−0.8400	0.0384	4.171	0.0001
DEBT	+	0.0020	0.0007	2.998	0.0027
AVGVOL	−	-6.07×10^{-5}	1.72×10^{-5}	−3.512	0.0004
TAX	+	−0.0104	0.0044	−2.348	0.0189
VOL	−	8.35×10^{-5}	1.70×10^{-4}	0.492	0.6225

The estimated intercept is close to zero and not significant at the 0.10 level. The coefficients of the two dividend variables are of the predicted sign and magnitude. The estimate of a_1 is not significantly different from -1, and the estimate of a_2 of -0.84 is significantly different from -1. The results resemble those of prior research (Bali and Hite, 1998) that stocks tend to drop by an amount equal to the even tick multiple portion of the dividend (i.e., $a_1 = -1$) but less than the remainder of the dividend over the even tick multiple ($a_2 > -1$). As anticipated, the coefficient of AVGVOL is positive and significant, agreeing with prior studies showing transactions costs to be significant in ex-dividend behavior. The coefficient of TAX is also of the anticipated positive sign. While it is significantly different from zero ($p = 0.019$), there are only 18 dividends out of the total of 29,504 that qualify as non-taxable, so it is unwarranted to make broad conclusions about tax effects on the ex-dividend day return.

The coefficient of the proxy for dividend-capture trading, VOL, is insignificant. Why might we find no significant activity associated with dividend capture when other studies conclude that dividend-capture trading reduces ex-day returns? Boyd and Jagannathan (1994) suggest that, for high-yield stocks, dividend-capture strategies are likely to be the primary determinants of the ex-dividend day behavior. They predict that dividend-capture activity will drive ex-day returns down and note that earlier work in Eades, Hess, and Kim (1984) showing high-yield stocks to exhibit lower (even negative) ex-day returns should be evidence of the influence of dividend-capture activity. Boyd and Jagannathan also provide their own evidence associating dividend yields and ex-day returns.

Why should dividend-capture strategies be associated with lower returns? Assuming that professional dividend-capture traders are informed and rational, they would choose to conduct trading in stocks whose ex-day returns tend to be higher, not lower. If so, and if VOL is a good proxy for dividend capture, then the insignificant coefficient for VOL in our study is reasonable. Why, then, is there an observed negative relationship between dividend yields and ex-day returns? We believe that the answer lies with the tick effect. Higher returns are available the greater the tick remainder. It happens to be an artifact of the data that for low dividend-paying stocks, a majority of the observations fall in the upper levels of the tick interval (they have greater tick remainders), while observations for high-yield stocks tend to be more evenly distributed over the tick interval. This is evident by examination of Table 4 in Bali and Hite (1998, p. 139). For example, for the two lowest tick intervals (0–0.125 and 0.125–0.25), 55% of the dividends lie within the top 5 cents of the interval, while for all of the higher intervals, only 45% of the dividends fall in the upper 5 cents of their interval. This phenomenon is also present in our sample. The correlation between the tick multiple and the tick remainder is −0.081, which is significantly negative ($p < 0.001$). In other words, higher dividends tend to have lower tick remainders. Since the tick remainder is a significant source of observed ex-day returns, it follows that higher-dividend-yield stocks will exhibit lower ex-day returns solely as a result of the tick effect.

4. Summary and conclusion

We propose a model to explain observed ex-dividend behavior that stocks tend to fall in price by less than their dividend on the ex-dividend date. Assuming that the total value of the firm decreases by an amount equal to the dividend, when a firm's financial structure contains a debt component, the concept of option pricing applied to equity valuation leads to a situation in which the payment of a cash dividend results in the ex-dividend day stock decline being less than the dividend. The difference between the drop in the value of the firm and the drop in stock value is equal to the decline in value absorbed by the debt.

In a perfect market, arbitrage should occur such that the ex-dividend day behavior yields no abnormal returns (i.e., the decline will equal the dividend). However, the existence of transactions costs allows for positive ex-day returns before transactions costs as long as the after-transactions costs returns are zero. In a market with transactions costs where stocks of levered firms fall by less than their dividends, we should observe a positive relationship between the degree of financial leverage and ex-day returns.

In a sample of 40,251 ex-dividend day observations, stocks fall by an average of 77% of the dividend on the ex-dividend date. Distinguishing stocks with no long-term debt and those with positive long-term debt, the no-debt group falls on average by 100% of the dividend while the positive-debt group falls by only 74%. In a regression model that considers other factors influencing ex-dividend behavior, the amount of firm debt has a significant and positive relationship with observed ex-dividend day price changes. Since the model controls for other variables that affect ex-dividend day return (tick intervals, transactions costs, the tax status of the dividend, and dividend-capture activity), we conclude that the option-pricing framework provides a valid explanation for a portion of observed ex-dividend day behavior.

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