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ORIGINAL RESEARCH

The impact of nominal stock price on ex-dividend price responses

Keith Jakob[1] · Ryan Whitby[2]

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Abstract In this paper, we examine whether nominal stock price can help to explain the ex-dividend day anomaly where stock prices drop by less than the dividend amount on the ex-dividend date. We find that stocks with lower nominal prices have ex-dividend day price drops that are more consistent with theoretical predictions based on an efficient market. After controlling for factors that have been previously documented to influence ex-dividend day stock price behavior, price-drop-to-dividend ratios are closer to one for lower priced stocks. To further explore this phenomenon, we examine the change in the price-drop-to-dividend ratio around stock splits. Firms that split their shares have a larger price-drop-to-dividend ratio after the split, and companies that reverse split their shares have a smaller price-drop-to-dividend ratio after the split. Our evidence indicates that ex-dividend day stock price behavior is influenced by the nominal price of a share and that this relation could also influence the decision to split a firm's shares.

Keywords Stock split · Ex-dividend · Nominal stock price · Market efficiency

JEL Classification G01 · G14 · G35

1 Introduction

Ex-dividend day studies possess a unique advantage for exploring the concept of market efficiency since both the precise event date and exact size of the dividend distribution are pre-announced. In a perfect capital market, the share price following a dividend should fall

✉ Ryan Whitby
ryan.whitby@usu.edu

Keith Jakob
keith.jakob@business.umt.edu

[1] University of Montana, 32 Campus Drive, Missoula, MT 59812, USA

[2] Department of Economics and Finance at Utah State University, 3565 Old Main Hill, Logan, UT 84322, USA

by exactly the amount of the dividend paid on each share. Not unexpectedly given the various market frictions that exist, empirical studies on this issue consistently find that, on average, stock prices actually drop by less than the dividend amount on the ex-dividend date [e.g., Campbell and Beranek (1955), Elton and Gruber (1970), Michaely (1991), and Eades et al. (1994)]. The observation of aggregate incomplete price adjustment on ex-dividend days sharply contradicts the concept of an efficient capital market and suggests that some form of market friction is restricting prices from completely adjusting for the dividend distribution.

The ex-dividend day literature focuses on several market frictions as possible causes for the observed ex-dividend day anomaly. The most well-cited studies of ex-dividend day behavior incorporate either separately or a combination of taxes, transaction costs, and market microstructure as influential frictions. As an interesting note, all three of these possible frictions are mentioned in the very first ex-dividend day study by Campbell and Beranek (1955). Later papers in this line of literature test various models based on these frictions. Elton and Gruber (1970) conjecture that because investors care only about after-tax returns, a higher tax on dividend income than on capital gains leads to an ex-dividend day price drop that is smaller than the dividend. As an extension to this tax-based theory, they suggest that tax clienteles form for different levels of dividend yields. These tax clienteles produce a positive relation between dividend yield and the price-drop-to-dividend ratio. While Kalay (1982) suggests that transaction costs are another important friction that inhibits the complete price drop on the ex-dividend day, Dubofsky (1992), and Jakob and Ma (2004) suggest that market microstructure effects of limit order adjustment mechanisms and tick size constraints impact the ex-day anomaly.

While the majority of explanations for the ex-day anomaly are quite rational, most of the proxies used for frictions include the price per share of the stock. Metrics used in these explanations such as dividend yield, transaction costs, and tick size constraints are all generally calculated as a percentage of the price and therefore often systematically vary by price. Given the growing body of literature that shows the influence of nominal price in financial markets (see Dyl and Elliott 2006; Weld et al. 2009; Green and Hwang 2009; Chan et al. 2013), we examine the role of nominal price in ex-dividend day stock price behavior. We find that nominal stock price is highly correlated with the ex-dividend price-drop-to-dividend ratio. Regression results indicate that stocks with lower nominal prices have price-drop-to-dividend ratios closer to one. That is, lower priced stocks have price changes that are more consistent with theoretical predictions based on an efficient market. Our results also indicate that stock price is a strong predictor of the ex-dividend day anomaly, and nominal stock price significantly influences market efficiency around dividend distributions. In multivariate tests, we use control variables for tax clienteles, transaction costs, and a variety of other possible stories. In all cases, the nominal share price is able to significantly explain the level of the price-drop-to-dividend ratio.

Since our finding that lower priced stocks have ex-dividend price-drop-to-dividend ratios that are more consistent with theoretical predictions may seem puzzling, we attempt to control for a number of factors that could influence our result. Furthermore, given the number of studies that have examined the ex-dividend day anomaly, concerns about data mining are warranted. However, we find that this nominal price to ex-dividend relation is not only robust to a variety of control variables but that consistent results are found when examining stock splits and reverse stock splits. In both the stock split and reverse stock split subsamples, stock price and the price-drop-to-dividend ratio continue to exhibit a negative and significant relationship. Stocks that split their shares have a larger price-drop-to-dividend ratio after the split and stocks that reverse split their shares have a smaller price-drop-to-dividend ratio after the split. These findings are new and valuable with respect to research on the ex-dividend day, the stock split, and the nominal price.

Using ex-dividend behavior before and after stock splits, we are able to demonstrate that stock splits move stock prices to a nominal price range that enhances market efficiency with respect to dividend payments. The results in our paper are consistent with other research that demonstrates that nominal prices are influential. Our results also indicate that the size of the price-drop-to-dividend ratio on the ex-dividend day is best explained by the level of nominal stock price. Higher nominal stock prices lead to less efficient market behavior (i.e., less complete price drops on ex-dividend days). Our results help to explain the ex-day anomaly, and also increase our understanding of why managers might choose to change the nominal price of their shares through a stock split. Section 2 discusses the related literature and our hypotheses. Section 3 presents the data and methodology. Section 4 presents our results, and Sect. 5 contains our concluding remarks.

2 Related literature

Our paper is influenced by two separate literature streams: the ex-dividend day literature and the stock split/nominal price puzzle literature. The ex-dividend day literature focuses on the possible causes for the ex-dividend day anomaly where stock prices fall by less than the dividend amount. There are competing tax clientele and microstructure models, which can be combined with an additional transaction costs hypothesis.

Elton and Gruber (1970) derived the Tax Effect Model. According to their model, the ex-dividend behavior of a corporation's common stock is related to the tax rates of its marginal stockholders. In the situation where a shareholder has decided to sell his shares, the shareholder must contemplate whether to sell the shares before the stock goes ex-dividend or after. For this shareholder to be indifferent to the timing of the sale, the wealth received from either course of action must be the same. Based on this premise, the price-drop-to-dividend ratio always reflects the relative marginal tax rates of the stockholders of the firm's common stock. According to Elton and Gruber (1970), we should, therefore, be able to infer the relative tax rates by observing the price-drop-to-dividend ratio of the common stock. In their analysis of ex-day behavior, they find an average price-drop-to-dividend ratio of 0.778. This implies a preference for capital gains over dividends and is consistent with the tax structure in the United States.

As an extension to their initial analysis, Elton and Gruber (1970) divide their sample into deciles based on dividend yield. They find that the price-drop-to-dividend ratio tends to increase with yield, but the increase is not strictly monotonic across deciles. They interpret this increasing trend as consistent with a dividend clientele effect. For higher dividend yields the clientele will prefer dividend income to capital gain income, leading to higher price-drop-to-dividend ratios. Thus, dividend yield should determine the level of the price-drop-to-dividend ratio. Whitworth and Rao (2010) test the model in Elton and Gruber (1970) and find evidence consistent with tax clienteles. They also find that higher dividend yield stocks are driven by corporate tax rates while lower yield stocks are influenced by personal tax rates. Francis et al. (2012) examine the implications of Elton and Gruber (1970) in the Taiwanese market.

Several studies expand on the tax clientele hypothesis and examine the interaction of taxes and transaction costs on ex-dividend days (e.g., Kalay 1982; Lakonishok and Vermaelen 1983, 1986; Karpoff and Walkling 1988, 1990; Boyd and Jagannathan 1994;

Michaely et al. 1997). These papers suggest that when transaction costs are high, the ex-day price-drop-to-dividend should reflect the relative taxation of dividends and capital gains as predicted by the tax hypothesis. However, when transaction costs are low, arbitrage trades will push the price-drop-to-dividend ratio toward one. This joint tax/transaction costs model suggests that a positive relation between dividend yield and the ex-day price-drop ratio is not solely driven by taxes. According to this theory, higher dividend yield stocks have relatively lower transaction costs and arbitrage can more heavily drive the price-drop-to-dividend ratios towards unity.

Additional explanations for the ex-dividend day anomaly are based on market microstructure effects of tick size and ex-day limit order adjustment methods regulated by the exchange. Bali and Hite (1998) present a model where prices are constrained to discrete tick multiples while dividends are essentially continuous. They argue that the expected price drop is strictly less than the dividend but within one tick of the dividend. According to their model, the price-drop-to-dividend ratio will be less than one, increase with dividend size, and decline between tick multiples, giving a sawtooth pattern in the data. Graham et al. (2003) and Jakob and Ma (2004) examine changes in ex-dividend day behavior as the NYSE converted price quotations from 1/8th to 1/16th and finally to decimals. Both studies find evidence inconsistent with Bali and Hite (1998). Graham et al. (2003) support the tax clientele hypothesis while Jakob and Ma (2004) find evidence consistent with a limit order adjustment model based on Dubofsky (1992).

According to Dubofsky (1992), the rules related to limit order adjustments on ex-dividend days strongly influence ex-day price drop behavior. The key feature of the model is the exchange mandated price adjustment for existing limit orders on the ex-dividend day. According to NYSE Rule 118, on the ex-day, all existing limit buy orders are reduced by the dividend amount, and if the resulting price is not a multiple of a tick, the limit buy price is further reduced to the next tick. Existing limit sell orders are not adjusted. Dubofsky's model gives an exact prediction of the ex-day price drop only under very strict assumptions. It is important to note that Dubofsky (1992) and Jakob and Ma (2004) recognize that the assumptions will not be fully satisfied in most cases. As with the case of the tax hypothesis, transaction costs can be introduced to the limit order adjustment model as well. These papers suggest that the combination of the limit order adjustment method and transaction costs jointly explain ex-dividend day behavior.

The fact that most firms keep their stock price within a specific range is well documented. Dyl and Elliott (2006) document that firms tend to set their stock prices in very particular price ranges and conclude that firms manage their share prices to increase firm value. Weld et al. (2009) investigate the nominal share price puzzle. They document that the average nominal price for a share of stock on the New York Stock Exchange has remained constant for over 70 years. They examine several possible explanations proposed by previous studies. Dolley (1933) indicates that corporations primarily split their shares to increase the marketability of those shares. Later studies, which include Baker and Gallagher (1980), Baker and Powell (1993), Muscarella and Vetsuypens (1996), So and Tse (2000), and Fernando et al. (2004) find support for the marketability hypothesis. In a related hypothesis, Angel (1997) develops a theory that is based on the notion that firms set their share price to induce brokers and dealers to provide liquidity.

In contrast to the marketability related hypotheses, Brennan and Copeland (1988) develop a model where firms use stock splits to signal the quality of their future prospects. However, most studies that have examined the relation between stock splits and future returns have found a negative relation [see Lakonishok and Lev (1987), Asquith et al. (1989) and Chou et al. (2005)]. In the end, Weld et al. (2009) find little support for these competing hypotheses, but instead, conclude that firms appear to be following societal norms and tradition more than any economic based rationale. More recently, Green and Hwang (2009) find that similarly priced stocks move together and that co-movement between stocks shift when stocks split their shares to adjust their nominal price. Their findings suggest that although changes in price are primarily cosmetic, they can also influence investor behavior. Additionally, Chan et al. (2013) find that stock price levels are related to the price informativeness of the stock. To some extent, our findings indicate that splitting shares could be related to market efficiency, which could be further explored within the context of nominal price.

3 Data and methodology

Our analysis incorporates data from several sources. We extract dividends, prices, spreads, volume, and returns from CRSP. Since key variables such as the bid–ask spreads are only available on CRSP after 1982, our sample goes from 1983 to 2012. We aggregate dividends at the daily level, so multiple dividend payments on the same day are combined in our analysis. To measure the ex-dividend price-drop-to-dividend ratio (hereafter price drop ratio), we follow the prior literature and calculate a market-adjusted ratio as follows.

$$\frac{P_{cum}(1 + r_m) - P_{ex}}{Div\,Amt} \tag{1}$$

Here *Pcum*, *Pex*, and r_m are the cum-day and ex-day close prices and the ex-day equal-weighted market return as reported by CRSP, respectively. We use market adjusted numbers throughout this paper to properly account for the systematic nature of market movements. Since the average daily return is positive, adjusting for market returns results in average ex-day price-drop-to-dividend ratios closer to one. We also eliminate outliers by excluding stocks with prices less than \$2 and dividends with payment amounts less than one cent. After eliminating observations with missing data, our final sample is comprised of 152,702 dividends which are paid by 4691 unique firms. Panel A of Table 1 reports the means, medians, and standard deviations for our main sample. The average dividend is \$0.196 and the average market-adjusted price drop ratio is 0.766. Firms in the full sample have an average dividend yield of 0.79 %, and a bid–ask spread of \$0.383, which is approximately 1.84 % when measured as a percentage of stock prices. The mean values for our sample are in line with the prior ex-dividend day literature, and the average price drop ratio suggests that for a \$0.196 dividend, stocks fall on average only \$0.15. Following Graham et al. (2003), we also report summary statistics for a sample where the most extreme 2 % of observations have been deleted. It is important to note that the high standard deviation of the price drop ratio is driven by these outliers. After removing the most extreme 2 % of observations, the means and medians are only slightly different and the majority of the numbers reported in Panel B are very similar to those reported in Panel A. The rest of our analysis uses the untrimmed sample, but it is worth noting that our results are almost always stronger using the trimmed sample and quite robust. We have chosen to report and focus on the more conservative numbers associated with the untrimmed sample throughout this paper.

Table 1 Summary statistics

	Mean	Median	SD
Panel A			
Price drop ratio	0.766	0.757	10.685
Price	29.321	24.000	32.958
Dividend	0.196	0.150	0.188
Dividend yield	0.79 %	0.62 %	0.72 %
Spread	0.383	0.250	0.869
Spread percentage	1.84 %	1.02 %	2.61 %
Volume	651	46	3215
Market value	4156	444	17,400
Prior 3-day return	0.30 %	0.00 %	3.92 %
Panel B: 2 % trimmed sample			
Price drop ratio	0.656	0.715	3.517
Price	29.255	24.125	29.602
Dividend	0.2085	0.150	0.192
Dividend yield	0.83 %	0.65 %	0.68 %
Spread	0.372	0.250	0.603
Spread percentage	1.78 %	0.98 %	2.50 %
Volume	631	46	3085
Market value	4196	459	17,467
Prior 3-day return	0.30 %	0.00 %	3.76 %

This table reports statistics that describe the sample used in the analysis. The sample includes all dividend payments from 1983 to 2012 for stocks trading above $2 and dividend payments of more than $0.01 for a total of 152,072 observations. Price drop ratio is the market adjusted ex-day price drop as described in Eq. 1. Price is the nominal stock price of equity. Dividend is the amount of dividend paid. Dividend yield is the dividend amount divided by the current price. Spread is the bid–ask spread in dollars and spread percentage is the bid–ask spread divided by current price. Volume is the number of shares traded per day in thousands. Market value is the product of shares outstanding and price in millions. Prior 3-day return is the compounded return from day t-4 to day t-1. Panel B reports summary statistics for a sample with the most extreme 2 % of observations deleted

4 Results

We begin our analysis by examining the relationship between nominal price and the price drop ratio with simple regressions. Table 2 reports various regressions for the full sample where the ex-day price drop ratio is the dependent variable. In each simple regression, the independent variable is different. Table 2 Column [1] uses our key variable of interest, nominal share price, as the independent variable. The price drop ratio is negatively related to nominal price and significant at the 1 % level. This finding indicates that lower priced stocks tend to have more complete price adjustment on the ex-dividend day. Prior papers related to dividend size, limit order adjustment and tick size such as Dubofsky (1992) and Bali and Hite (1998) suggest that as dividend size increases price drop ratios will increase. Table 2 Column [2] uses the dividend amount as the independent variable. The relation for dividend amount and the price drop ratio is insignificant and, therefore, inconsistent with models where dividend size is a key factor in ex-dividend price movements. Table 2 Column [3] uses dividend yield as the independent variable. The price drop ratio and

Table 2 Simple regressions

	[1]	[2]	[3]	[4]	[5]
Intercept	0.314	0.224	0.187	0.211	0.200
	(0.605)	(0.432)	(0.359)	(0.407)	(0.386)
Price	−0.002**				
	(−2.855)				
Dividend		0.109			
		(0.745)			
Dividend yield			8.214*		
			(2.139)		
Spread percentage				2.914*	
				(2.520)	
Prior 3-day return					13.934**
					(19.957)
R-squared	0.001	0.001	0.001	0.001	0.003
F-statistic	2.927	2.665	2.804	2.865	16.390
Probability of F	0.000	0.000	0.000	0.000	0.000

This table reports results from estimating a regression with the price drop ratio as the dependent variable and the respective independent variables. Price drop ratio is the market adjusted ex-day price drop as described in Eq. 1. Price is the nominal stock price of equity. Dividend is the amount of dividend paid. Dividend yield is the dividend amount divided by the current price. Spread is the bid–ask spread in dollars and spread percentage is the bid–ask spread divided by current price. Volume is the number of shares traded per day in thousands. Market value is the product of shares outstanding and price in millions. Prior 3-day return is the compounded return from day t-4 to day t-1. The sample includes all dividend payments from 1983 to 2012 for stocks trading above $2 and dividend payments of more than $0.01 for a total of 152,072 observations. *t*-statistics, which are obtained from White (1980) robust standard errors are reported in parentheses. Each regression includes year fixed effects and * and ** denote statistical significance at the 0.05, and 0.01 levels, respectively

dividend yield are positively related and significant at the 5 % level. This result is consistent with the tax and tax/transaction costs hypotheses. Table 2 Column [4] uses percentage spread as the independent variable. Interestingly, percentage spread is positively and significantly related to the price drop ratio at the 5 % level, which contradicts the transaction costs hypothesis. In this sample, stocks with higher percentage spreads generally have price drop ratios closer to one. Table 2 Column [5] uses the three-day prior return as the independent variable. Eades et al. (1984) point out that there is a statistically significant run-up in stock prices before the ex-day. They suggest that ex-day returns are part of a larger ex-dividend period anomaly where the days prior to the ex-day are also relevant. Because of this well-known phenomenon we add prior 3-day returns to several of our models as a control variable. The relation between prior return and the price drop ratio are positive and significant at the 1 % level. Thus, higher returns prior to the ex-day lead to more complete price drop ratios.

While all of the simple regressions in Table 2 have F-statistics that are significant at the 1 % level, we feel that it is important to have a short discussion about the relatively low R-squares. In Table 1 the price drop ratio has a mean of 0.766 but a standard deviation of 10.685. The very large standard deviation relative to the mean is consistent with prior studies of the ex-day phenomenon. For each individual dividend distribution, the actual price drop ratio is heavily influenced by new firm-specific information that arrives on the ex-dividend day. For this reason, we do not expect any particular independent variable, even if it is highly significant, to explain a large portion of individual ex-dividend day price behavior. The firm-specific noise on the ex-dividend day is essentially unexplained variation in all of the ex-dividend models. However, across the full sample, the significance and magnitude of the findings are still relevant to the discussion of market efficiency. As an example, the −0.002 coefficient on price in Table 2 would suggest that price drop ratios for stocks with a nominal price of $20 would have mean price drop ratios 0.08 higher than otherwise similar stocks with nominal prices of $60.

Consistent with previous studies, many of the variables included in our analysis are related to price. Correlations for all included variables are reported in Table 3. Stock price is positively related to dividend amount, dollar spread, trading volume, market value, and prior 3-day return. Price is negatively related to dividend yield and spread percentage. While perhaps not surprising, these results highlight the need to control for outside factors in a multivariate setting.

Table 4 reports results from multivariate regressions where the price drop ratio is the dependent variable and nominal price and a variety of control variables are independent

Table 3 Correlations

	Price drop ratio	Price	Dividend	Div yield	Spread	Spread %	Volume	MV
Price	−0.008							
	(0.000)							
Dividend	0.000	0.109						
	(0.781)	(0.000)						
Dividend yield	0.000	−0.013	0.359					
	(0.906)	(0.000)	(0.000)					
Spread	−0.016	0.171	0.026	0.000				
	(0.000)	(0.000)	(0.000)	(0.913)				
Spread percentage	−0.006	−0.148	−0.006	0.070	0.603			
	(0.001)	(0.000)	(0.000)	(0.000)	(0.000)			
Volume	0.000	0.068	0.016	0.009	−0.032	−0.066		
	(0.860)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)		
Market value	−0.005	0.181	0.017	−0.006	−0.025	−0.087	0.386	
	(0.001)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	
Prior 3-day return	0.083	0.004	0.014	0.007	0.006	0.001	−0.002	0.000
	(0.000)	(0.013)	(0.000)	(0.000)	(0.001)	(0.580)	(0.103)	(0.969)

Pairwise correlations and their respective p-values are reported in this table. The sample includes all dividend payments from 1983 to 2012 for stocks trading above $2 and dividend payments of more than $0.01 for a total of 152,702 observations. Price drop ratio is the market adjusted ex-day price drop as described in Eq. 1. Price is the nominal stock price of equity. Dividend is the amount of dividend paid. Dividend yield is the dividend amount divided by the current price. Spread is the bid–ask spread in dollars and spread percentage is the bid–ask spread divided by current price. Volume is the number of shares traded per day in thousands. Market value is the product of shares outstanding and price in millions. Prior 3-day return is the compounded return from day t-4 to day t-1

Table 4 Multivariate analysis

	[1]	[2]	[3]	[4]
Intercept	0.180	0.258	0.267	0.253
	(0.346)	(0.501)	(0.514)	(0.486)
Price	−0.003**	−0.003*	−0.003**	−0.002*
	(−3.369)	(−2.575)	(−2.744)	(−2.442)
Dividend	0.305*		0.220	0.313
	(1.938)		(1.073)	(1.499)
Dividend yield		6.749	3.274	−1.354
		(1.743)	(0.648)	(−0.264)
Market value				−0.005*
				(−2.385)
Volume				0.018
				(1.684)
Spread percentage				2.653*
				(2.222)
Prior 3-day return				13.912**
				(19.916)
R-squared	0.003	0.001	0.001	0.001
F-statistic	14.19	2.93	2.96	2.87
Probability of F	0.000	0.000	0.000	0.000

This table reports results from estimating a regression with the price drop ratio as the dependent variable and the respective independent variables

$Drop_i = \beta_0 + \beta_1 Price_i + \beta_2 Dividend_i + \beta_3 Dividend\ Yield_i + \beta_4 Market\ Value_i + \beta_5 Volume_i + \beta_6 Spread\ Percentage_i + \beta_7 Prior\ 3\text{-}Day\ Return_i + \varepsilon_i$

Price drop ratio is the market adjusted ex-day price drop as described in Eq. 1. Price is the nominal stock price of equity. Dividend is the amount of dividend paid. Dividend yield is the dividend amount divided by the current price. Spread is the bid–ask spread in dollars and spread percentage is the bid–ask spread divided by current price. Volume is the number of shares traded per day in thousands. Market value is the product of shares outstanding and price in millions. Prior 3-day return is the compounded return from day t-4 to day t-1. The sample includes all dividend payments from 1983 to 2012 for stocks trading above $2 and dividend payments of more than $0.01 for a total of 152,702 observations. *t*-statistics, which are obtained from White (1980) robust standard errors are reported in parentheses. Each regression includes year fixed effects and * and ** denote statistical significance at the 0.05, and 0.01 levels, respectively

variables. Various specifications of the following model are estimated with year fixed effects and robust standard errors.

$$\begin{aligned} Drop_i = {} & \beta_0 + \beta_1 Price_i + \beta_2 Dividend_i + \beta_3 Dividend\ Yield_i + \beta_4 Market\ Value_i \\ & + \beta_5 Volume_i + \beta_6 Spread\ Percentage_i + \beta_7 Prior\ 3\text{-}Day\ Return_i + \varepsilon_i \end{aligned} \quad (2)$$

Model 1 of Table 4 reports results from a regression where the independent variables are price and dividend amount. Dividend amount is added since it is a key feature in tick size models, limit order adjustment models, and in transaction costs models. The coefficient on price in Table 4 Model 1 remains negative and significant at the 1 % level. Model 2 of Table 4 includes dividend yield and price as the two independent variables. Dividend yield is the key variable in the tax and tax/transaction costs models. In this model, the coefficient on price remains negative and significant at the 1 % level and the coefficient on dividend yield is positive, but only significant at the 10 % level. Model 3 of Table 4 includes price, and both dividend amount and dividend yield as independent variables. In this regression, the coefficient on price remains negative and significant at the 1 % level, and the coefficients on the other two variables are insignificant. In Model 4 of Table 4, several other control variables are included in the regression. The coefficient on price remains negative and significant at the 5 % level. In each of multivariate tests on the full sample, coefficients on price are negative and significantly related to the ex-dividend day price drop, which is consistent with our previous findings.

Although the relationship between the price drop ratio and nominal price appears strong and quite robust, further investigation is warranted. We believe that one possible rationale for our findings that bridges nominal price and market efficiency is based on the concept of liquidity. Our paper is unique in that we are testing market efficiency measured as the price drop to dividend ratio and how it relates to nominal price. However, there are several papers that examine stock liquidity which is a related measure to market efficiency. These papers examine liquidity benefits associated with stock splits and nominal share price (See, for example, Muscarella and Vetsuypens (1996)). They report that after ADR solo-splits, total volume and the number of trades both increase significantly, but more so in the smallest trade size. The cost of liquidity falls significantly after the split for small trades. Upon announcement of an ADR solo-split, they also find that both the ADR and the home price increase by a statistically significant 1–2 %. They argue that the favorable price reaction to such events indicates that the market rewards firms that make their stock more accessible to U.S. investors. There is an additional line of literature that shows such liquidity benefits are tied to market efficiency. Chordia et al. (2008) suggest that liquidity stimulates arbitrage activity, which, in turn, enhances market efficiency. They also suggest that there is an increased incorporation of private information into prices during more liquid regimes.

With the discussion of liquidity and market efficiency in mind, one way to further examine the relationship between the market response to dividend payments and nominal price is to examine firms that change their nominal price through stock splits. Our next tests, therefore, focus on stock splits and reverse splits, which result in drastically different nominal prices. Stock splits quickly reduce nominal prices, and reverse splits quickly increase nominal prices. If nominal price indeed plays a role in market efficiency, then we should see changes in the price drop ratio after splits and reverse splits. Panel A in Table 5 reports mean and median price drop ratios for stocks pre- and post-stock splits. For the stock split sample, the mean price drop ratio increases from 0.496 to 0.831. The difference in the pre- and post-split mean price drop ratio is significant at the 1 % level. This result is consistent with an increase in market efficiency due to the lower nominal price. Examining stock splits is also helpful in that it helps alleviate concerns regarding spurious correlations. Although the relation between nominal price and the price drop ratio appears robust to a variety of controls, examining the price drop ratio around splits, or a shock to nominal price is a cleaner test of the relation. This result also suggests that the decision by management to split their shares might be motivated by market efficiency concerns.

Table 5 Panel B reports mean and median price drop ratios for stocks pre- and post-reverse stock splits. In the reverse split case, the median price drop ratios exhibit a significant decline. Median ratios decline from 0.753 to 0.559 and the change is significant at better than the 1 % level. This result is consistent with a decrease in market efficiency due to a higher nominal stock price. Unlike stock splits, reverse stock splits actually appear to

Table 5 Splits and reverse splits

	Drop/dividend			
	Pre-split	Post-split	Difference	*p* Value
Panel A—stock splits				
Mean	0.496	0.831	0.334	0.01**
Median	0.710	0.673	−0.037	0.56
Panel B—reverse stock splits				
Mean	0.773	0.799	0.026	0.40
Median	0.753	0.559	−0.194	0.00**

This table reports a univariate analysis of the price drop ratio around stock splits. Panel A examines splits and Panel B examines reverse splits. The analysis examines the five dividend payments before a split to the five dividend payments after a split. * and ** denote statistical significance at the 0.05, and 0.01 levels, respectively

harm market efficiency at least from a price drop ratio perspective. Although this result questions the effectiveness and motivation of a reverse split, it should be taken with a grain of salt since reverse splits are much less common and often initiated when the firm is under duress. Our finding is consistent with the reverse split literature that suggests that reverse splits often are implemented by managers out of desperation to maintain listing on an exchange, to make the company's shares marginable, or to attract institutional investors. As an example, Kim et al. (2008) examine the long-run return performance of over 1600 firms with reverse stock splits. These stocks record statistically significant negative abnormal returns over the 3-year period following the month of the reverse split. The sample firms experience poor operating performance over the 4 years that include and follow the year of the reverse split, which suggests informational inefficiencies.

In Tables 6 and 7 we report regression analyses for the split and reverse split sub-samples. Various specifications of the following model are estimated with year fixed effects and robust standard errors.

$$\begin{aligned} Drop_i = {} & \beta_0 + \beta_1 Price_i + \beta_2 After + \beta_3 Dividend_i + \beta_4 Dividend\ Yield_i \\ & + \beta_5 Market\ Value_i + \beta_6 Volume_i + \beta_7 Spread\ Percentage_i \\ & + \beta_8 Prior\ 3\text{-}Day\ Return_i + \varepsilon_i \end{aligned} \quad (3)$$

In these regressions we add a dummy variable to the tests to examine changes pre- and post-split. In all three regressions in the regular stock split sample, the coefficient on stock price remains negative and significant at the 1 % level. The coefficient on the after-split dummy variable is positive and significant at the 5 % level in all three regressions. The results suggest that price is negatively related to the ex-day price drop ratio and that the price drop ratio significantly increases from the period before to the period after the split date. The results suggest that the management decision to split the firm's shares enhances market efficiency around dividend payments. The large change in the price drop ratio after a stock split strongly conflicts with the dividend yield explanation, because when firms perform a stock split the dividend is generally adjusted downward to keep yields at a similar level to the pre-split level. In Table 6 Models 2 and 3 dividend yield is also insignificant.

Table 6 Multivariate analysis of splits

	[1]	[2]	[3]
Intercept	0.677	0.985	0.958
	(1.132)	(1.688)	(1.611)
Price	−0.005*	−0.007**	−0.007*
	(−2.343)	(−2.818)	(−2.502)
After	0.295*	0.329*	0.349*
	(2.143)	(2.371)	(2.509)
Dividend		0.951*	1.081*
		(1.814)	(2.022)
Dividend yield		−6.304	−9.627
		(−0.454)	(−0.683)
Market value			−0.004
			(−1.025)
Volume			0.039
			(1.606)
Spread percentage			5.556*
			(2.085)
Prior 3-day return			13.730**
			(8.998)
R-squared	0.003	0.001	0.001
F-statistic	3.713	1.392	1.435
Probability of F	0.000	0.000	0.000

This table reports results from estimating a regression with the price drop ratio as the dependent variable and the respective independent variables on the sample of stocks that initiate splits

$Drop_i = \beta_0 + \beta_1 Price_i + \beta_2 After + \beta_3 Dividend_i + \beta_4 Dividend\ Yield_i + \beta_5 Market\ Value_i + \beta_6 Volume_i + \beta_7 Spread\ Percentage_i + \beta_8 Prior\ 3\text{-}Day\ Return_i + \varepsilon_i$

Price drop ratio is the market adjusted ex-day price drop as described in Eq. 1. Price is the nominal stock price of equity. Dividend is the amount of dividend paid. Dividend yield is the dividend amount divided by the current price. Spread is the bid–ask spread in dollars and spread percentage is the bid–ask spread divided by current price. Volume is the number of shares traded per day in thousands. Market value is the product of shares outstanding and price in millions. Prior 3-day return is the compounded return from day t-4 to day t-1. After is an indicator variable that is equal to 1 for dividend payments after a split and 0 otherwise. The sample includes 6510 splits between 1983 and 2012. *t*-statistics, which are obtained from White (1980) robust standard errors are reported in parentheses. Each regression includes year fixed effects and * and ** denote statistical significance at the 0.05, and 0.01 levels, respectively

In Table 7 similar regressions are performed on the reverse split sample. In all three regressions, the coefficient on price remains negative and significant at the 1 % level. These results suggest that nominal price impacts the price drop ratio in the reverse split sub-sample in the same way as the full sample. Although the values are insignificant, the coefficients on the after reverse split dummy variable are negative in all three cases. Overall, the signs of the coefficients on nominal price and the dummy variable coefficients are consistent with the reverse split results found in Table 5. Finally, the coefficients for dividend yield in Table 7 Models 2 and 3 are significant, but the negative signs are the opposite direction than predicted by the tax or tax/transaction costs hypotheses.

Table 7 Multivariate analysis of reverse splits

	[1]	[2]	[3]
Intercept	0.203	0.378	0.432
	(0.167)	(0.311)	(0.355)
Price	−0.014**	−0.019**	−0.018**
	(−4.120)	(−4.538)	(−4.470)
After	−0.046	−0.066	−0.083
	(−0.186)	(−0.269)	(−0.336)
Dividend		1.438*	1.996**
		(1.890)	(2.589)
Dividend yield		−25.871*	−37.428*
		(−1.768)	(−2.534)
Market value			0.008
			(0.673)
Volume			−0.044
			(−1.246)
Spread percentage			18.437**
			(4.953)
Prior 3-day return			12.650**
			(5.687)
R-squared	0.008	0.003	0.004
F-statistic	2.908	1.386	1.432
Probability of F	0.000	0.000	0.000

This table reports results from estimating a regression with the price drop ratio as the dependent variable and the respective independent variables on the sample of stocks that initiate reverse splits

$Drop_i = \beta_0 + \beta_1 Price_i + \beta_2 After + \beta_3 Dividend_i + \beta_4 Dividend\quad Yield_i + \beta_5 Market\quad Value_i + \beta_6 Volume_i + \beta_7 Spread\ Percentage_i + \beta_8 Prior\ 3\text{-}Day\ Return_i + \varepsilon_i$

Price drop ratio is the market adjusted ex-day price drop as described in Eq. 1. Price is the nominal stock price of equity. Dividend is the amount of dividend paid. Dividend yield is the dividend amount divided by the current price. Spread is the bid–ask spread in dollars and spread percentage is the bid–ask spread divided by current price. Volume is the number of shares traded per day in thousands. Market value is the product of shares outstanding and price in millions. Prior 3-day return is the compounded return from day t-4 to day t-1. After is an indicator variable that is equal to 1 for dividend payments after a split and 0 otherwise. The sample includes 2720 reverse splits between 1983 and 2012. *t*-statistics, which are obtained from White (1980) robust standard errors are reported in parentheses. Each regression includes year fixed effects and * and ** denote statistical significance at the 0.05, and 0.01 levels, respectively

5 Conclusion

In this paper, we examine whether nominal stock price can help to explain the ex-day anomaly. We find that nominal stock price is highly correlated with the ex-dividend price-drop-to-dividend ratio. Our regression results indicate that stocks with lower nominal prices have price-drop-to-dividend ratios closer to one. That is, lower priced stocks have price changes that are more consistent with theoretical predictions based on an efficient market. Our results indicate that nominal stock price is a strong predictor of the ex-dividend day anomaly and that nominal stock price significantly influences market efficiency around dividend distributions.

In multivariate tests, we use other independent variables to control for tax clienteles, transaction costs, and a variety of other possible stories. In all cases, the nominal share price continues to have significant explanatory power with respect to the level of the price-drop-to-dividend ratio.

We find that this nominal price to ex-dividend price drop relation is not only robust to a variety of control variables but that consistent results are found when examining stock split and reverse stock split sub-samples. For these samples, stocks that split their shares have a larger price-drop-to-dividend ratio after the split and stocks that reverse split their shares have a smaller price-drop-to-dividend ratio after the split. These results provide a unique contribution to both the ex-dividend day and the stock split literature. The results demonstrate that stock splits move stock prices to a nominal price range that enhances market efficiency. This suggests that managers choosing to split their firm's shares might be rationally adjusting the firm's stock price to enhance the efficiency of trading. At the same time, since stock splits lead to higher transaction costs, this finding is inconsistent with the pure transaction costs explanation in the ex-dividend literature. Our findings for reverse stock splits are consistent with prior literature that suggests that the management decision regarding reverse stock splits are typically done out of desperation, and they do not lead to enhanced liquidity or better future stock performance.

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