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Dividend drop ratios and tax theory: An intraday analysis under different tax and price quoting regimes

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Dividend drop ratios and tax theory: An intraday analysis under different tax and price quoting regimes

Abstract

We calculate dividend drop ratios over periods with changing quotation and taxation frameworks to assess the validity of competing explanations. Using intraday prices adjusted for non-trading, we provide a more accurate picture of price changes due to dividend payments than those produced in previous literature. Intraday estimates for dividend drop ratios are consistently higher than those calculated with end of day prices. Further findings indicate that stocks trading ex-dividend, on average, underperform the market over the following month. We attribute this phenomenon to dividend capture trading by tax advantaged and tax indifferent market participants.

Introduction

The stock price drop at the ex-dividend day has been the focus of numerous papers. The dividend drop ratio is the amount that a stock's price falls on the ex-dividend day due to the declaration of a dividend relative to the amount of the dividend. In the absence of trading costs and taxes, the dividend drop ratio is expected to be one. Elton and Gruber (1970) and Kalay (1982) both find empirically that this figure is closer to 0.8. Various theories have been proposed to explain this lower value, with the most common ones being differential tax rates, arbitrage opportunities and microstructure theories.

In this paper we reexamine the dividend drop within its theoretical context by using intraday data to more precisely isolate the dividend drop event in the current trading environment. Because our data sample spans different quotation and taxation regimes, we are able to ascertain the validity of the proposed explanations for the magnitude of the drop ratio. Our sample comprises 79,344 ex-dividend events from the NYSE, AMEX and Nasdaq collected over the period from 1994 to 2003. Such a large sample provides an opportunity to compare the value the marginal investor attaches to capital gains (price appreciation) and to ordinary income (dividends) without having to assume a valuation model, and at the same time permits a proper specification of the price to be used on the ex-dividend day.

Elton and Gruber (1970), Kalay (1982), Bali and Hite (1998) and Frank and Jagannathan (1998) and others use the closing price of the stock on the ex-dividend day to calculate the drop ratio. Taking the closing price ignores those price movements that occur during the intraday period from open to close. As Graham, Michaely, and Roberts (2003) state "the entire ex-day price movement occurs between the closing price of the cum-day and the

opening price of the ex-day, (thus) using closing prices on the ex-day adds noise and reduces our ability to make accurate inferences” (p2624).

Elton and Gruber (1970) attempt to mitigate this factor by computing the one-day return on similar stocks and then discounting the closing ex-day price by this return before calculating the drop ratio. Kalay (1982) uses two methods for adjusting the closing price on the ex-dividend day with one using the past daily returns of the selected stock and the other based on the market model returns of the selected stock. Another alternative is to take opening prices on the ex-day rather than closing prices. However, a common criticism of taking opening prices on the ex-day is that the opening prices are a biased indicator of the drop ratio because all the orders on the books of specialists in American markets are reduced by the amount of the dividend when a stock goes ex-dividend. Using opening prices will thus cause the dividend drop ratio to be biased to 1.0 or very close to it. We propose a modified methodology to calculate the intra-day drop ratio, which resolves the closing/opening price problem.

Further we stratify our sample and examine the variability in drop ratios on the ex-day and pinpoint the characteristics of stocks that impact on this variability. We know of no previous research into whether specific types of stocks have a tendency to exhibit a greater or lower variability in their drop ratios. Examining this issue does determine the characteristics of stocks that lead to a smaller variability in drop ratios, leading to greater predictability of price behavior on the ex-dividend day.

Finally we assess longer-term price movements around the ex-dividend day. Previous literature establishes the existence of dividend capture trading and abnormal returns before

the ex-day. This study confirms the dividend capture motivation for trading, although it does not appear to be associated with abnormal returns in the pre-dividend period. Further the results are independent of minimum tick increments.

The remainder of the paper is organized as follows. The next section provides a review of relevant literature. In section three we describe our sample data and the market environment for each sample. Section four describes the methodology used to test the hypotheses. Section five presents the results and the last section concludes.

Theories Explaining the Dividend Drop Ratio

The behavior of share prices around ex-dividend days has been the subject of extensive theoretical and empirical research for over 50 years. Prior empirical studies consistently document that, on average, share prices decline on the ex-dividend day by less than the dividend amount. The earliest empirical work on the ex-dividend day price drop is by Campbell and Beranek (1955), who find that the ex-day price drop averages 90 percent of the dividend. However, there is no consensus regarding the explanation for these and similar results. First, many studies attribute the ex-dividend day return anomaly to higher tax rates on dividend income as compared to long-term capital gains (e.g., Elton and Gruber, 1970). Related studies argue that, when transaction costs are relatively small, arbitrageurs will trade around the ex-dividend day to reduce tax-induced abnormal returns to a point where they reflect transactions costs rather than the tax rate differential (e.g., Kalay, 1982). Alternatively, positive ex-dividend day returns may be induced by market microstructure, most notably by the pricing of stocks in discrete ticks, which precludes share prices from fully adjusting to dividend payments (e.g. Bali and Hite, 1998). Finally, the abnormal returns on the ex-dividend day may be attributed to order imbalances, that is when stocks generally trade at the

ask price on the close of the cum-dividend day and at the bid price on the open of the ex-dividend day (e.g. Frank and Jagannathan, 1998). 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.

Elton and Gruber (1970) first suggested differential tax rates as reason for dividend drop ratios smaller than one. In their paper, they studied the impact of taxes on investor decisions using the movement of share prices around ex-dividend days. They show that in a rational market, the fall in share price on the ex-day should reflect the value of dividends versus capital gains to the marginal stockholder. If taxes enter investors' decisions, then the fall in price on the ex-dividend day should reflect the post-tax value of the dividend relative to the post-tax value of capital gains on that day. Hence, the dividend drop ratio (DDR) will be less than 1.0, if dividend income is taxed more heavily than capital gains income. Elton and Gruber (1970) find that the average dividend drop ratio is 0.778 for their sample, consistent with their hypothesized tax theory. Many subsequent papers find evidence to support the tax theory [Litzenberger and Ramaswamy (1979, 1982); Poterba and Summers (1984); Barclay (1987); Elton, Gruber and Blake (2002 and Graham, Michaely, and Roberts (2003)]

While theoretically appealing, tax theory ignores the presence and effectiveness of tax advantaged and tax indifferent arbitrageurs that the current decimal price grid and decreasing transaction costs encourages. Arbitrage theory proposes another explanation for the dividend drop ratio being less than one. Rather than the tax-induced effect, this theory states that short-term arbitrageurs will engage in trades on and around the ex-dividend day so that the DDR approaches one minus the transaction costs of trading. If the price drop is less than the amount of the dividend, tax-free arbitrageurs will purchase the stock cum dividend and sell it

ex-dividend, forcing the price drop on the ex-dividend day to approach the dividend payment. These dividend capture trades are executed so that tax-induced abnormal returns are reduced to a point where they reflect transaction costs rather than the tax rate differential. Kalay (1982) was the first to present this arbitrage theory where the ex-day price drop is bound by the amount of the transaction costs relative to the dividend amount. Miller and Scholes (1982), Michaely (1991), and Stickel (1991) all present similar views and show that the size of any tax-induced abnormal returns on the ex-dividend day will be arbitrated away by short-term traders up to (or down to) the traders' marginal transaction costs. Lakonishok and Vermaelen (1986) show that trading volume increases significantly before and after ex-dividend days, and this increase is more pronounced for high yield, actively traded stocks. Consistent with this explanation, Karpoff and Walkling (1988) find that ex-day returns in the U.S. are significantly related to transaction costs.

Market microstructure issues are a third explanation for DDRs smaller than one. Especially under a coarse price grid, price discreteness has often been cited as a reason why the dividend drop ratio is less than one. Dubofsky (1992) proposes an explanation based on exchange rules and minimum tick sizes. He finds that abnormal ex-day returns are induced by NYSE Rule 118 and AMEX Rule 132, which dictate that specialists must adjust all open limit buy orders by the amount of the dividend and round down to the next tick if necessary. Based on this explanation, ex-day abnormal returns will be a generally increasing function of the dividend. Bali and Hite (1998) develop a model for ex-day trading that incorporates long-term buyers and sellers with their tax preferences, along with tax-neutral arbitrageurs. They propose that because the tick sizes are discrete while dividends are continuous, the drop ratio may deviate from one. To avoid arbitrage, the price drop must be less than or equal to the dividend. In the case where the dividend is not a multiple of the tick increment, the drop will be the dividend

less one tick. They find that 1962-1994 ex-dividend price data confirms their model. With data from finer price grids Graham, Michaely, and Roberts (2003) find that price discreteness and the drop ratio are not related. They show that over the period of reducing tick sizes, the drop ratio has become lower, contrary to the price discreteness hypothesis. Jakob and Ma (2004) show that the price drop on the ex-day is just as likely to equal the tick above or the tick below the dividend. They also find no significant decline in the magnitude of the ex-day abnormal return after a tick size reduction.

Frank and Jagannathan (1998) examine the tax effect proposed by Elton and Gruber (1970) by testing the drop ratio in Hong Kong, a country with no tax on investment income. In a perfect economy with no taxes and no transaction costs, the ex-dividend day price drop should be equal to the dividend. Since dividends and capital gains are not taxable in Hong Kong, tax theory implies that the drop ratio should be one. Anything other than a drop ratio of one must then be explained by microstructure effects, e.g., transaction related costs. They find that the drop ratio in Hong Kong for their sample was 0.43, much less than the expected result of one. However, Kadapakkam (2000) finds that abnormal ex-day returns dropped to near zero after the Hong Kong market switched from a cumbersome physical settlement procedure to an electronic procedure that greatly facilitated short-term trading.

Frank and Jagannathan (1998) suggest a bid-ask bounce theory as explanation for their results. Their model assumes that dividends are a nuisance to collect for ordinary investors and so investors will try to postpone buy orders until after the ex-dividend day and bring forward sell orders to before the ex-dividend day. Therefore, the likelihood of the cum-dividend day's last trade being a sell order and the likelihood of the ex-dividend day's first order being a buy order are both increased. These increased likelihoods in last and first trades

reduce the size of the measured price drop on the ex-dividend day so that the average price drop is less than the dividend amount. Hence, the magnitude of the bid-ask spread is a factor in the price drop of a stock on the ex-dividend day being less than the size of the dividend. Frank and Jagannathan (1998) imply in their findings that there are order imbalances on the cum and ex-dividend days due to asymmetrical demand at the bid and ask prices. Jakob and Ma (2003) extend this research to test the presence of such order imbalances. They find more buy than sell orders on the ex-dividend day but this imbalance does not extend to the number of shares ordered. Further, the order imbalance is limited to small orders. However, they also find that there is no significant order imbalance on the cum-dividend day in either the number of orders or the volume of shares ordered. Jakob and Ma's (2003) test of Frank and Jagannathan's (1998) theory demonstrates inconsistencies within the bid-ask bounce theory.

The prevalent methodology used to overcome the perceived bid-ask bounce is to use bid to bid, ask to ask, or midpoint to midpoint between the bid and ask prices when calculating the price drop on the ex-dividend day. However, Koski and Michaely (2000) find that abnormal ex-day returns still exist even if they are measured using cum-ask to ex-ask prices or cum-bid to ex-bid prices. Graham, Michaely, and Roberts (2003) find that by taking the midpoint of the bid-ask spread to calculate the drop ratio yields no different results to taking closing prices, thus implying that the bid-ask bounce is not a factor in the dividend drop ratio being less than one.

The majority of literature explaining price behavior around the ex-dividend day focuses on dividend capture activities (arbitrage theory). While dividend capture activities have been used to explain price movements on the cum- and ex-dividend days, this theory is also useful in explaining longer-term price movements. Dividend capture traders might not necessarily

buy dividend paying stocks on the cum-day, rather they might decide to buy these stocks in the weeks before the cum-dividend day. Similarly, these traders might not sell the stocks on the ex-dividend day, rather delaying their sale.

Eades, Hess, and Kim (1984) pointed out that there is a run-up in stock prices before the ex-day and a run-down after the ex-day. One way to interpret this evidence is that there may be information in price behavior around ex-days, not just on the ex-day alone. Moreover, Lakonishok and Vermaelen (1986) find that stocks experience abnormal price increases before ex-days and abnormal price decreases afterwards. The abnormal price increases are positively related to the dividend yield. All these results are consistent with the hypothesis that dividend capture traders have a significant impact on price behavior around ex-dividend days. The fact that most of the volume increase after the ex-day does not occur immediately after the ex-day, but a few days later, suggests that incorporated traders (who are subject to a 61 day holding rule) are responsible for a large part of the abnormal volume behavior.

Data

The data source for this analysis is the Trades and Quotes (TAQ) database. TAQ contains intra-day trade and quote prices for all securities listed on the New York Stock Exchange (NYSE) and American Stock Exchange (AMEX), as well as the Nasdaq National Market System (NMS), and several regional US exchanges. This study examines a six-years of data within a 10 year period from January 1, 1994 to December 31, 2003, when three different quotation and five different tax regimes were in effect.

During the 10 year period, minimum price increments (tick sizes) on US exchanges decreased from 1/8 of a dollar (12.5 cents) to one cent. Also during this period, maximum marginal tax

rates applicable to different types of income changed five times. Tables 1 and 2 show the tax rates and minimum price increments for various time periods from 1994-2003.

Insert Tables 1 and 2 here

To differentiate between the various hypotheses, we analyze sample subsets based on the changes to quoting conventions and tax rates. January 1, 1994 to December 31, 1995 defines the first sample where the ordinary income tax rate is 39.6 percent, the capital gains tax rate is 28 percent, and the minimum tick size is 1/8. In the second sample, January 1, 1997 to December 31, 1998, the ordinary income tax and capital gains tax rates are 39.6 percent and 20 percent, respectively. During this period, the minimum tick size changes from 1/8 of a dollar to 1/16 on January 24, 1997.

The second sample enables us to illustrate how a change in the relative tax rates influences the preference for capital gains income since the capital gains tax rate falls from 28 percent to 20 percent, while the ordinary tax rate remains unchanged at 39.6 percent. Since the tick change occurs in June of 1997, the second sample further allows for an assessment of a tick size reduction on the DDR within an unchanged tax regime.

The final sample begins on January 1, 2002 until December 31, 2003 and thus avoids the transition to decimal pricing. This period features a constant tick size of 1/100, ordinary tax rates of 38.6 percent for 2002 declining to 35 percent in 2003, and capital gains tax rates of 20 percent for 2002 declining to 15 percent in 2003. This sample is divided into two groups based on the change in tax rates from 2002 to 2003.

Methodology

The DDR is calculated as follows:

$$DDR = \frac{P_b - P_a}{D} \quad \text{where,} \quad (1)$$

D is the dividend amount, P_a is a price after the stock goes ex-dividend and P_b is the last closing price before the stock goes ex-dividend. For an investor to be indifferent between receiving the dividend and then selling the share afterwards, and selling the share prior to the dividend payment, the tax hypothesis implies:

$$IMPDDR = \frac{P_b - P_a}{D} = \frac{1 - t_o}{1 - t_c} \quad \text{where,} \quad (2)$$

t_o is the tax rate applicable to dividend income and t_c is the rate applicable to capital gains. In other words, the DDR implied by the tax hypothesis is the ratio of one minus the tax rate on ordinary income divided by one minus the tax rate on capital gains. This implied DDR renders taxable investors indifferent to holding the stock thus accepting the dividend and the associated price drop, or alternatively selling the stock at a higher price prior to the ex-dividend day and forgoing the dividend payment.

To test the tax hypothesis we compare actual DDRs to the IMPDDRs under different tax regimes. An analysis of the impact of declining minimum tick sizes from 1994-2003 provides information regarding the market microstructure hypotheses such as price discreteness, bid/ask bounce and transaction costs.

Results

Table 3 includes the implied DDRs and the corresponding actual close-to-close DDRs for the various sample periods of the study. As illustrated in the table, all of the actual DDRs are less than one. Consistent with the tax hypothesis, as the capital gains and ordinary income tax rates change, the close-to-close DDRs move in the direction suggested by the implied DDR calculations in each case except the 2003 period. For example, with the lowering of the capital gains tax rate, implied DDRs fall from 83.89 in 1994-1995 to 75.50 in 1997-1998. Then, with a lowering of the ordinary income tax rate in 2002, the implied DDR increases to 76.75. This same pattern occurs for the actual close-to-close DDRs as the actual ratios move from 97.67 in 1994-1995 to 88.21 and 93.58 in 1997-1998 and 2002, respectively. While the pattern of movement is consistent with the tax hypothesis, the actual close-to-close DDRs are higher than the implied DDR for all periods with the exception of 2003.

Insert Table 3 here

The larger close-to-close DDRs compared to the implied DDRs indicate that the effective tax rates faced by arbitrageurs (tax advantaged or tax indifferent investors) implementing dividend capture strategies are less than the highest rates of the different tax regimes. The results in table 3 are not consistent with the main market microstructure hypotheses. During the period studied, minimum tick increments fall from 1/8 of a cent to one cent. Accordingly, under either the price discreteness or the bid/ask bounce hypotheses, DDRs should be strictly increasing over the 1994-2003 period. This is not supported by the data since the largest DDR occurs in the 1994-1995 period when the minimum tick size is the largest. While tax

induced arbitrage is the dominant explanation for the results, the fact that the ratios do not converge to one warrants further investigation.

Since the dividend drop occurs between the last transaction on the trading day prior to the ex-dividend day and the first price after the stock goes ex-dividend, close of trading day prices on the ex-dividend day may provide a noisy measure of the DDR. However, contamination due to the volatile nature of prices during the market opening process also suggests that opening prices are inappropriate to calculate DDRs. With the availability of intraday data, it is possible to use prices closer to the ex-dividend day market open while avoiding contamination associated with the market opening process, and at the same time avoid the noise associated with closing prices that result from factors other than the fact that the stock has gone ex-dividend.

Table 4 and the associated graphs in Figure 1 illustrate several features regarding the intraday patterns of actual DDRs based on transaction prices.

Insert Table 4 and Figure 1 here

The first distinct pattern from Table 4 and the DDR graphs labeled ‘normal’ show that the ratios strictly and severely increase for about the first 90 minutes of trading. After this, the DDRs peak and remain fairly constant until the end of the trading day, as they tend to decline over the final 90 minutes of trading. These observed patterns are purely a function of the intraday price fluctuations on the ex-dividend day since the other two variables in the DDR calculation (cum-dividend price and dividend) are constant throughout the day.

Closer examination of the intraday DDR calculation indicates a downward bias since the DDR is an average of all stocks DDRs at a particular interval. Thus, until a stock trades, its DDR will be zero which exerts a downward bias on the average DDR. As the day progresses, more stocks open and trade resulting in an increase in DDR ratios. Table 5 provides information on the percentage of stocks that are trading over the day and indicates that roughly 50 percent of the stocks trade at the opening, and this figure increases to approximately 85 percent within the next hour. Adjusting the DDR calculations for stocks that have not yet traded, results in DDR patterns denoted in figure 1 as ‘adjusted’. This adjustment results in higher DDRs that level off similar to those based on all stocks after a few hours of trading. The adjusted DDRs converge to the unadjusted DDRs by the end of the day when the majority of stocks have traded. Interestingly, in the case of the adjusted DDRs, there is a downward pattern for both the first hour of trading and the last hour of trading in the 1994-1995 and 1997-1998 periods. This is consistent with the inverted u-shaped pattern of security returns documented in the market microstructure literature. The results presented in Tables 4 and 5 and Figure 1 indicate that DDRs should not be calculated using prices in either the first or last 90 minutes of trading.

Insert Table 5 here

The previous results are based on average DDR calculations. This section considers the variability of the DDRs and firm specific characteristics that impact DDR values. Table 6 presents the standard deviation and coefficient of variation for the average DDRs in each sample period. As indicated by these measures, DDR variability is increasing, which implies that ex-dividend day stock prices have become more volatile and less predictable. Table 7 (Panels A, B and C) shows the quintile standard deviations and coefficient of variations based

on stock price, dividend amount and trading volume, where the quintiles are established based on the cum-dividend day values of the variables. Panel A indicates that DDR variability is positively related to stock prices as standard deviations and coefficient of variations decrease as stock prices decrease. Panel B presents the relationship between DDRs and dividend amount and shows that DDRs decrease as the size of the dividend increases. Finally, Panel C shows the relationship between DDRs and trading volume. Again, the results are consistent across the three sample periods and indicate that the lowest DDR variability is associated with the highest trading volume.

The final analysis maps the average price of the dividend paying stocks relative to the price pattern based on weighted market returns for the 20 days before and after the dividend payment. The weights for the hypothetical prices are based on the proportion of the dividend paying stocks within each of the markets (NYSE, AMEX and Nasdaq). Figure 2 shows the price patterns for the three sample periods with each graph exhibiting a similar pattern. For example, over the 20 days leading up to the ex-dividend day, average prices steadily increase. On the ex-dividend day itself, prices drop sharply and then gradually rise over the next 20 days. Interestingly, the price rise in the pre-period closely tracks the hypothetical price increase, however, the post period pattern suggest that dividend paying stocks underperform relative to the market with price increases well below the hypothetical.

The higher returns before the ex-dividend day followed by lower returns afterward supports the tax induced arbitrage hypothesis. Prior to the ex-day, tax induced arbitrageurs buy dividend paying stocks thus bidding up their prices. After the ex-day the arbitrageurs' selling activity exerts downward pressure on the dividend paying stocks relative to non-dividend paying stocks. While previous literature documents abnormal returns prior to the ex-dividend

day, our results indicate that dividend capture strategies take place gradually without creating excess demand or abnormal returns. After the ex-day however, tax arbitrageurs sell quickly and create excess supply leading to a slower price recovery and below average returns.

Conclusion

This paper examines intraday dividend drop ratios using high frequency data and considers the contending theories of ex-day stock price behavior. We improve on previous methodology by providing intraday DDR calculations which reduces the downward bias of calculated DDRs. The study also documents the impact of firm characteristics (stock price, dividend amount and trading volume) on DDR variability. Finally, we investigate the longer-term price patterns surrounding the ex-dividend day.

Our findings indicate that prices after the opening, but well before the close of trading on the ex-dividend day, provide a more accurate measure of the DDR. We also provide a proper adjustment for nontrading stocks and find that this reduces the downward bias in DDR calculations. The reported dividend drop ratios are generally higher than those documented in previous literature, but they are remarkably resilient to changes in the minimum price increment. While the findings support tax arbitrage as the primary determinant of DDRs, the considerable dispersion about the mean suggests that the price impact of other events may override the dividend event. Considering a longer event window, we document price appreciation commensurate with the market in the month prior to the ex-dividend day and in the month after a lackluster price recovery leading to market underperformance.

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Table 1: Minimum price increments for US exchanges during the three sample periods

The transition to decimal pricing occurred in stages and was completed for the NYSE on 1/29/2001. The transition period is not used in our analysis.

Years	Tick Size
1994 - June 23, 1997	1/8
June 24, 1997 - 2000	1/16
January 29, 2001 - present	1/100

Table 2: Maximum marginal US tax rates during the entire study period

Year	Ordinary Income	Capital Gains
1994 - 1996	39.6%	28%
1997 - 2000	39.6%	20%
2001	39.1%	20%
2002	38.6%	20%
2003*	35%	15%

* qualifying dividends taxed at 15 percent

Table 3: Implied and realized dividend drop ratios

The table shows the theoretical dividend drop ratio and the close-to-close dividend drop ratio during the four sample periods. Equation 1 is used to calculate the implied dividend drop ratio using the income and capital gains tax rates from table 1, and the close-to-close dividend drop ratio is calculated using the 4:00pm prices on the ex-dividend day.

Years	Implied DDR	Close-to-close DDR
1994-1995	83.89	97.67
1997-1998	75.50	88.21
2002	76.75	93.58
2003	76.47	53.00

Table 4: DDR over the Ex-Dividend Day

This table documents the intraday changes in the DDR over the ex-dividend day for the different sample periods. DDRs are reported at 30 minute intervals.

Time	1994-1995	1997-1998	2002	2003
9:35	57.56%	49.16%	44.27%	39.29%
10:00	82.01%	68.60%	73.82%	58.05%
10:30	88.10%	77.80%	83.34%	64.70%
11:00	91.60%	81.89%	89.55%	65.91%
11:30	92.86%	84.65%	97.47%	66.48%
12:00	94.60%	85.15%	97.31%	61.61%
12:30	95.44%	86.72%	102.24%	59.85%
13:00	96.22%	86.45%	101.31%	57.47%
13:30	95.79%	86.56%	99.37%	58.37%
14:00	96.53%	88.00%	97.63%	62.59%
14:30	97.11%	90.18%	100.77%	61.06%
15:00	95.77%	92.24%	99.45%	60.03%
15:30	95.64%	92.16%	96.77%	55.72%
16:00	97.67%	88.21%	93.58%	53.00%
16:30	94.31%	85.09%	92.22%	55.22%
17:00	94.23%	85.17%	90.49%	54.99%

Table 5: Percentage of stocks trading during the ex-dividend day

Time	1994-1995	1997-1998	2002-2003
9:35	51.55%	49.98%	56.49%
10:00	78.72%	78.57%	81.17%
10:30	84.95%	84.99%	86.27%
11:00	88.91%	88.90%	89.44%
11:30	91.43%	91.72%	91.79%
12:00	93.52%	93.61%	93.38%
12:30	94.96%	95.05%	95.66%
13:00	95.98%	95.97%	96.55%
13:30	96.79%	96.71%	97.29%
14:00	97.45%	97.47%	97.92%
14:30	98.13%	98.14%	98.53%
15:00	98.67%	98.75%	98.79%
15:30	99.30%	99.32%	99.49%
16:00	99.89%	99.93%	99.97%

Table 6: DDR Variability

This table includes the standard deviation and coefficient of variation of DDRs for each of the sample periods

	1994-1995	1997-1998	2002-2003
Std. Dev.	4.48	7.24	7.55
CV	4.75	8.50	10.93

Table 7: The impact of price, dividend amount and trading volume on DDR variability

This table includes quintile standard deviations and coefficient of variations. Panels A reports the values for price-based quintiles, Panel B reports values based on dividend amount and Panel C considers quintiles based on trading volume.

Panel A – Quintile 1 includes the highest priced stocks and quintile 5 includes the lowest priced stocks

	1994-1995		1997-1998		2002-2003	
Quintile	St. Dev.	CV	St. Dev.	CV	St. Dev.	CV
1 st	6.25	7.57	11.00	18.27	13.53	20.52
2 nd	4.73	6.88	7.89	9.26	5.48	9.28
3 rd	4.59	5.20	7.12	8.41	6.56	11.49
4 th	2.80	2.29	4.00	4.07	3.33	4.00
5 th	3.10	2.82	3.48	3.57	4.23	5.26

Panel B – Quintile 1 includes stocks with the highest dividend payments and quintile 5 includes the stocks with the lowest dividend payments

	1994-1995		1997-1998		2002-2003	
Quintile	St. Dev.	CV	St. Dev.	CV	St. Dev.	CV
1 st	0.94	1.05	1.46	1.75	1.16	1.38
2 nd	1.66	2.05	2.48	3.10	1.81	2.41
3 rd	2.86	3.80	4.20	6.25	3.74	6.58
4 th	3.21	2.82	4.41	4.88	3.22	4.13
5 th	8.66	7.87	14.73	14.02	16.00	30.14

Table 7 continued

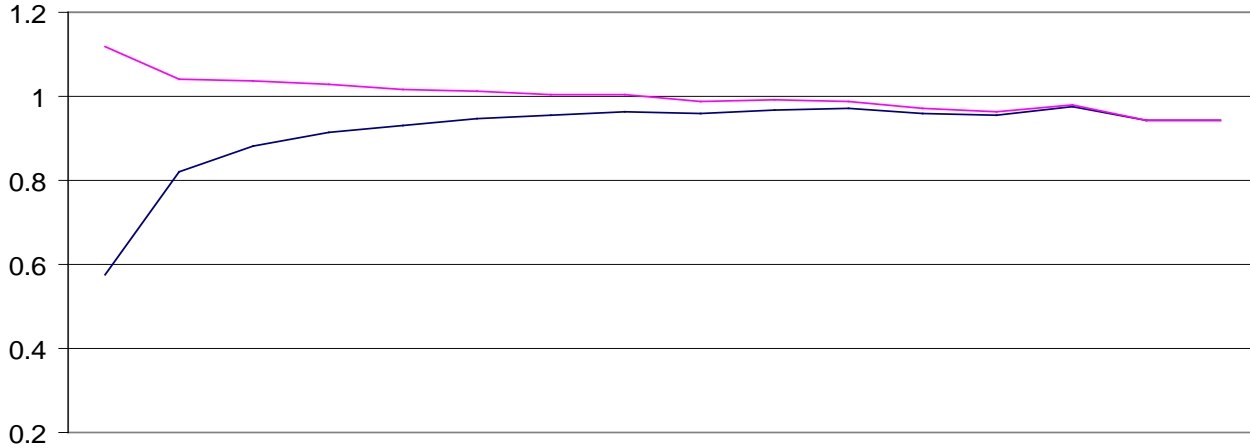
Panel C – Quintile 1 includes stocks with the highest trading volume and quintile 5 includes the stocks with the lowest trading volume

	1994-1995		1997-1998		2002-2003	
Quintile	St. Dev.	CV	St. Dev.	CV	St. Dev.	CV
1 st	0.94	1.05	1.46	1.75	1.16	1.38
2 nd	1.66	2.05	2.48	3.10	1.81	2.41
3 rd	2.86	3.80	4.20	6.25	3.74	6.58
4 th	3.21	2.82	4.41	4.88	3.22	4.13
5 th	8.66	7.87	14.73	14.02	16.00	30.14

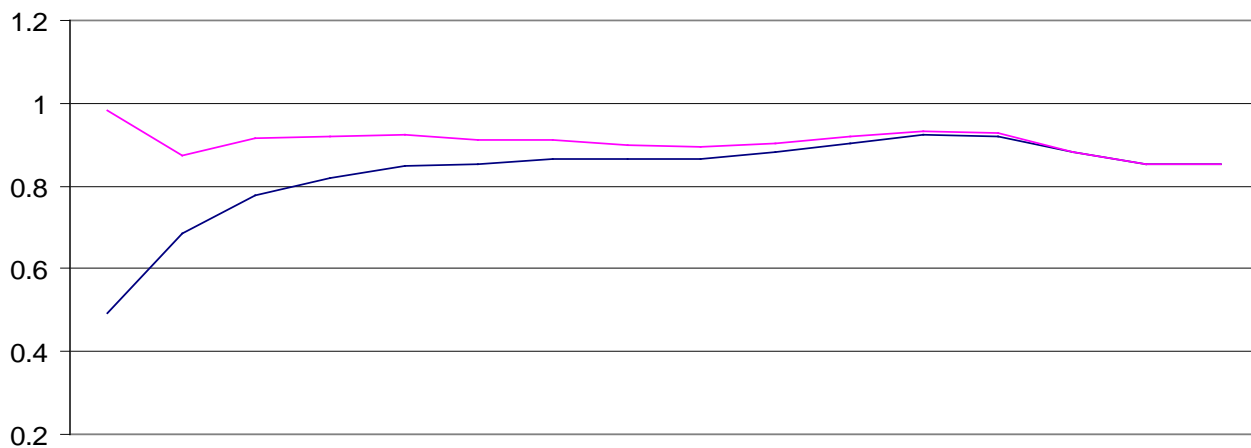
Figure 1: Dividend drop ratios during the ex-dividend day

The panels show dividend drop ratios during the ex-dividend day and the adjusted DDR which excludes the DDR of shares until they have traded. 'Normal' includes all stock in the DDR calculation whether or not they have traded.

Panel A: Sample I (1994-95)



Panel B: Sample II (1997-98)



Panel C: Sample III (2002-03)

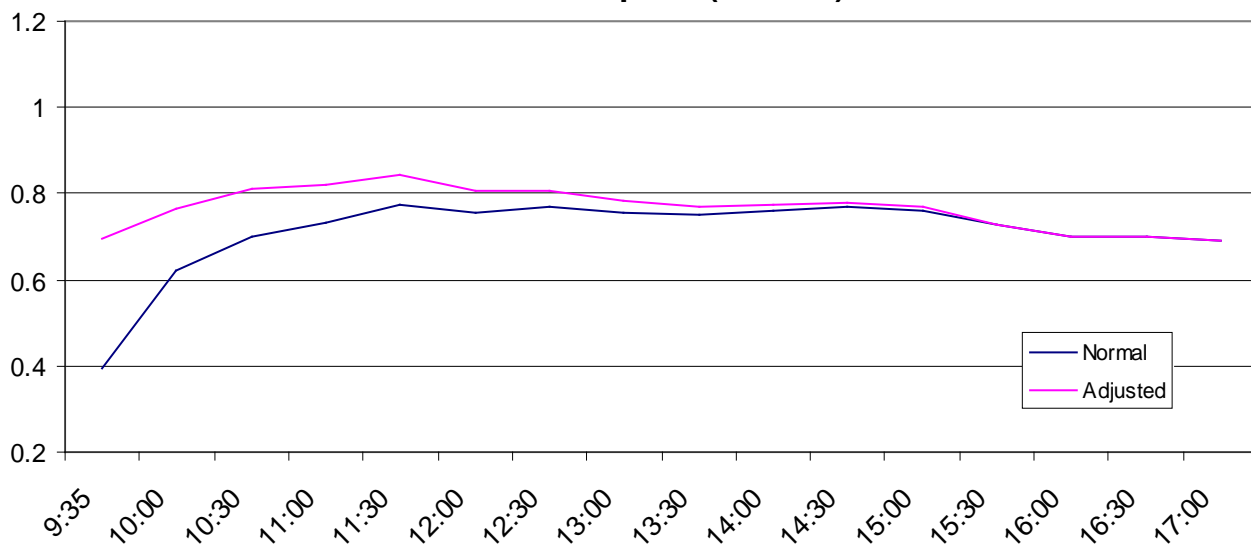
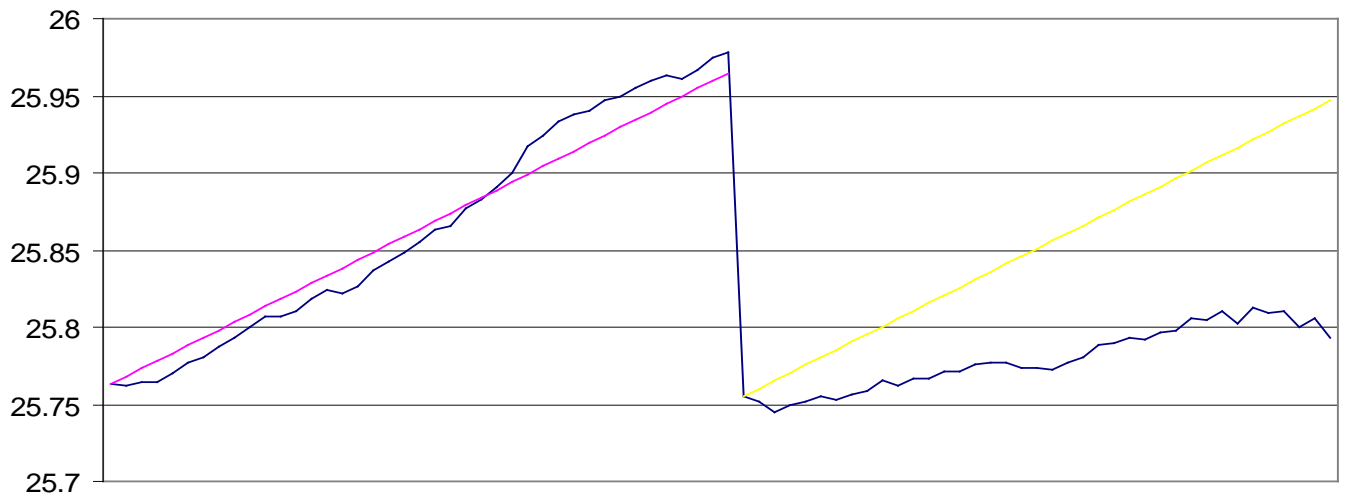


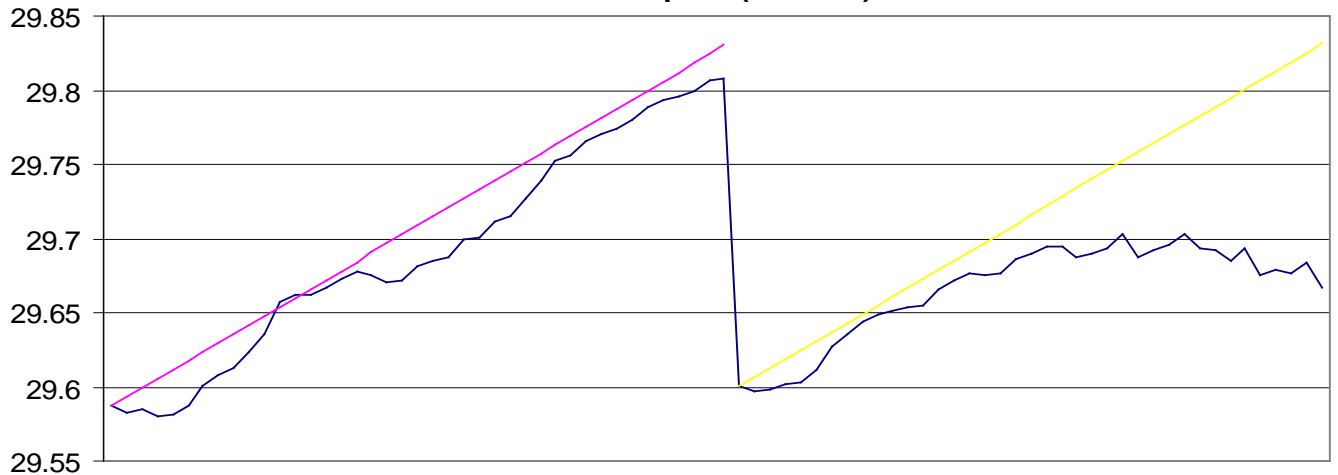
Figure 2: Average prices of stocks around dividend payment dates

These graphs show the average price of dividend paying stocks from 20 days before to 20 days after the ex-dividend day.

Panel A: Sample I (1994-95)



Panel B: Sample II (1997-98)



Panel C: Sample III (2002-03)

