Ex-dividend Day Bid-Ask Spread Effects in a Limit Order Book Market Setting*

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Abstract

Liquidity and transaction costs are key considerations in short-term trading strategies. Literature on ex-dividend day trading has not considered how bid-ask spreads change around the ex-dividend day, despite its importance to the ex-dividend equilibrium. Theoretical models of the limit order book show that liquidity will be affected by the presence of a trading deadline, such as that faced by traders engaging in dividend capture. We find the effective bid-ask spread increases substantially on the ex-dividend day for stocks in the limit order book setting of the Australian Stock Exchange. The higher spread is attributed to a reduction in the cost of delaying execution on the ex-dividend day, and uncertainty about the ex-dividend price drop. These effects result in less aggressive limit orders and thereby higher spreads on the ex-dividend day, consistent with predictions of dynamic models of the limit order book. The level of tax credits attached to the dividend creates greater differences in the subjective valuation of traders and is positively related to the ex-dividend spread increase. The results show that bid and ask depth is lower on the ex-dividend day and the aggressiveness of orders also declines, as a result of the lower cost of delaying execution. Our results indicate that the actual profitability of traders utilizing a dividend-induced trading strategy are likely to be lower after considering the higher spread and reduced liquidity.

Keywords: bid-ask spread, liquidity, dividend capture, ex-dividend day.

JEL classification: G14

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Abstract

Liquidity and transaction costs are key considerations in short-term trading strategies. Literature on ex-dividend day trading has not considered how bid-ask spreads change around the ex-dividend day, despite its importance to the ex-dividend equilibrium. Theoretical models of the limit order book show that liquidity will be affected by the presence of a trading deadline, such as that faced by traders engaging in dividend capture. We find the effective bid-ask spread increases substantially on the ex-dividend day for stocks in the limit order book setting of the Australian Stock Exchange. The higher spread is attributed to a reduction in the cost of delaying execution on the ex-dividend day, and uncertainty about the ex-dividend price drop. These effects result in less aggressive limit orders and thereby higher spreads on the ex-dividend day, consistent with predictions of dynamic models of the limit order book. The level of tax credits attached to the dividend creates greater differences in the subjective valuation of traders and is positively related to the ex-dividend spread increase. The results show that bid and ask depth is lower on the ex-dividend day and the aggressiveness of orders also declines, as a result of the lower cost of delaying execution. Our results indicate that the actual profitability of traders utilizing a dividend-induced trading strategy are likely to be lower after considering the higher spread and reduced liquidity.

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1. Introduction

Short term-term trading around the ex-dividend day remains a prevalent feature of equity markets worldwide[1], despite Heath and Jarrow (1988) showing that an uncertain price drop between the cum- and ex-dividend days will remove any risk-free arbitrage opportunities. Consideration for liquidity and transaction costs thereby determines the presence and profitability of short-term trading opportunities around the ex-dividend day.[2] However, the empirical literature utilizing the costly arbitrage models of Boyd and Jagannathan (1994) and McDonald (2001) implicitly assumes that the bid-ask spread is constant around the ex-dividend day. This assumption may not be warranted given the recent evidence of Zhang, Russell and Tsay (2008) that bid-ask spreads are time-varying. This study examines the bid-ask spread and liquidity around the ex-dividend day in the limit order book setting of the Australian Stock Exchange (ASX) to formally test this assumption.

The majority of ex-dividend day studies focus on abnormal returns and abnormal volume and do not directly examine the behavior of liquidity and the bid-ask spread around the ex-dividend day, despite its influential role in the ex-dividend equilibrium. An exception is Graham, Michaely and Roberts (2003) who report the average effective spread on cum-dividend and ex-dividend days for NYSE stocks. Their focus is on the impact of changes in the minimum tick size on the ex-dividend premium and they do not directly test whether the ex-dividend and cum-dividend bid-ask spread are statistically different. A cursory look at Table 1 of Graham, Michaely and Roberts (2003) suggests that both the quoted spread and the effective spread are similar between the ex-dividend day and the cum-dividend day for their sample. Koski and Michaely (2000) examine liquidity and the information content of trades around different events, including the ex-dividend

[1] See, for example, Kalay (1982), Eades, Hess and Kim (1984), Lakonishok and Vermaelen (1986), Michaely (1991), Michaely and Vila (1996), Rantapuska (2008), and Ainsworth, Fong, Gallagher and Partington (2010).

[2] See, for example, Kalay (1982), Boyd and Jagannathan (1994), Michaely and Vila (1996), and McDonald (2001).

day. They find that spreads are wider during announcement periods compared to ex-dividend periods, consistent with information asymmetry increasing the adverse selection component of the spread. Again, they do not directly consider differences in bid-ask spreads on ex-dividend days and ordinary trading days. There is however, indirect evidence that bid-asks spreads would differ between ex-dividend days and other trading days. For example, in the US, Koski (1996) finds that there is purchasing pressure in the cum-dividend period and selling pressure in the ex-dividend period for high yield stocks in 1983 and 1988. Koski notes that this dividend-driven buying and selling pressure could impact the size of the bid-ask spread. It is hypothesized that the ex-dividend day attracts both uninformed dividend capture and avoidance traders, as well as market makers and other short-term traders, who are indifferent between capital gains and dividends, and trade against the tax-motivated traders (Kalay (1982)). Market makers, in particular, are primarily concerned with providing liquidity and earning the bid-ask spread by buying at the bid price and selling at the higher ask price.

Utilizing the dynamic models of the limit order book presented by Foucault (1999), Foucault, Kadan and Kandel (2005), and Roşu (2009), we are able to hypothesize how these different trader groups will choose between market and limit orders in Australia's pure order-driven market. These models of symmetrically informed agents show that the cost of delaying execution is likely to affect the spread around the ex-dividend day. With the market being closed by a call auction, there is likely to be little change in the proportion of impatient traders before the ex-dividend day. However, the cost of delaying execution is likely to increase as the ex-dividend deadline approaches. This cum-dividend increase in waiting cost will lead to more aggressively priced limit orders, a more resilient market and a lower bid-ask spread according to these models. After the ex-dividend deadline has passed, there should be a decline in waiting costs for traders in the market, on average. If this is the case, then limit orders will not be priced as aggressively, the market less resilient, and spreads will be higher. Uncertainty about the ex-dividend price drop is also a factor that could lead to a higher spread on the ex-dividend day.

The ASX provides a rich environment allowing us to examine whether the bid-ask spread is affected by the limit order book structure and trading on dividends with franking (imputation) credits. For example, Ainsworth, Fong, Gallagher and Partington (2008) document that buying and selling pressure present around the ex-dividend day in Australia and that these imbalances significantly impact returns. There is also much evidence that the imputation tax credits paid in Australia do have some value, and market participants alter their trading as a result (see, for example, Walker and Partington (1999), Cannavan, Finn and Gray (2004), and Ainsworth, Fong, Gallagher and Partington (2010)). Importantly, dividends in Australia have been increasing (Pattenden and Twite (2008)), rather than decreasing as in the US (Fama and French (2001)) suggesting a growing importance in trading around the ex-dividend day.

Using executed trades and submitted order data for stocks listed on the ASX from 1990 to 2008, we find that the ex-dividend effective half-spread is 0.59 cents or 37% higher than the effective half-spread on the cum-dividend day. It is also 0.48 cents or 28% higher than the average daily effective half-spread in a benchmark period between *t*-50 to *t*-6 relative to the ex-dividend day. The effective spread peaks on the ex-dividend day and returns nearly immediately to the average spread level. This finding is robust across dividend yields, franking level and a non-event benchmark spread. A larger price impact is also present on the ex-dividend day, suggesting that traders view each trade as containing private information about the true value of the dividend. The higher ex-dividend spread is concentrated in the first hour of trading, consistent with uncertainty surrounding the determination of the ex-dividend price and an increase in the proportion of impatient trades that were unable to unwind dividend-induced trading strategies in the opening call auction. However, the spread is persistently higher throughout the ex-day, relative to the cum-dividend day and a non-event benchmark period, suggesting that patient traders have lower expected costs of delaying execution after the ex-dividend deadline has passed. We also find that the availability of tax credits are positively related to the ex-dividend spread after controlling for common determinants. Depth at the best ask quote increases on the cum-dividend day and decreases significantly at both the best bid and ask on the ex-dividend day. This is consistent with more aggressively priced limit orders on the cum-dividend day, and less aggressively priced limit orders on the ex-dividend day. Examination of order aggressiveness on the cum- and ex-day supports this conclusion. In their entirety, the results suggest that valuation differentials and waiting costs are important drivers of the ex-dividend spread.

The remainder of the paper is organized as follows. Section 2 discusses trading on the Australian Stock Exchange and the imputation tax system in Australia. Section 3 outlines the hypotheses based on the literature regarding dynamic models of the limit order book. Section 4 discusses the data and section 5 presents the results on how the bid-ask spread changes around the ex-dividend day, with section 6 concluding.

2. Institutional Background

The ASX is the only domestic stock exchange in Australia. Stocks are traded using the electronic limit order book system called the Stock Exchange Automated Trading System (SEATS). This system commenced operation on October 19, 1987 and it fully replaced the trading floor system on September 4, 1990 (see Aitken, Brown and Walter (1996)). SEATS operated until October 2, 2006 was until it was replaced by a different electronic trading system called the Integrated Trading System (ITS). There are no designated market makers on the ASX, but brokers are free to trade as principal, or pseudo market makers (see Aitken, Garvey and Swan (1995)). SEATS opens for trading from 10:00 am and it operates in a continuous open limit order book mode until 4:00 pm. The ASX also operates an opening call auction and in 1997 it introduced a closing call auction (Comerton-Forde (1999)). An important feature of the electronic limit order book market on the ASX is that all outstanding orders are cleared from the order book overnight between the cum- and ex-dividend days. This ensures that all ex-dividend day orders have been entered on that particular day and are reflecting cum-dividend stock valuations.

Australia's imputation tax system was introduced on 1 July 1987, replacing the classical tax system. Under the imputation tax system, domestic tax-paying shareholders are eligible to receive a franking (or tax) credit that is attached to certain dividend payments. Where a dividend carries a franking credit, the investor is able to offset this credit against personal income tax liabilities to the extent that Australian corporate tax has been paid on the dividend income. The dividend and the franking credit are then taxed at the investor's marginal tax rate. A company is only able to provide franking credits on the portion of the dividend paid from corporate profits that have been taxed at the Australian corporate tax rate. In effect, the corporate tax paid by corporations is a pre-collection of personal tax from the shareholder. The franking level attached to a dividend can vary between zero percent (unfranked) and 100 percent (fully franked). The after-tax return to an investor is considerably higher when they receive a dividend that has been fully franked, as the corporation has already paid tax on behalf of the investor. However, not all investors are able to offset franking credits against their taxable income. Non-resident investors, for example, cannot utilize franking credits.

3. Theory and Hypothesis Development

Our hypotheses are developed from the dynamic models of the limit order book presented by Foucault (1999), Foucault, Kadan and Kandel (2005), and Roşu (2009). These models do not include informed traders, with trading motivated by liquidity needs. The ex-dividend day provides a natural setting to examine the role of liquidity trading in financial markets as information asymmetry is likely to be lower following earnings and dividend announcements that precede the ex-dividend day. These dynamic models of the limit order book involve traders with subjective valuations above and below fundamental value. In the ex-dividend setting, the subjective valuation could reflect differences between tax rates on capital gains and dividend income, and the ability to utilize tax credits. Dividend capture traders, such as individual investors, will place a high value on the dividend and tax credit and will buy on the cum-dividend date and/or sell on the ex-dividend date. Foreign investors are unable to utilize tax credits and would therefore avoid the dividend payment. Depending on the size of the subjective valuation, certain investors could be indifferent to the dividend.

Foucault (1999) focuses on the risk of being picked off and the risk of non-execution. The risk of being picked off increases on the ex-dividend day, given the uncertainty surrounding the ex-dividend price. Foucault shows that the spread has a reservation component related to adverse selection and an execution risk component that is related to non-competitive behavior. The bid-ask spread will increase when the execution risk of limit orders increases as limit order traders capture a larger share of the differences in the subjective valuations (e.g. tax credits). Foucault notes that impatience will increase if there is an increase in the relative number of traders who place a higher subjective value on the stock. In the ex-dividend setting, this equates to an increase in the proportion of traders who place a higher value on the dividend and tax credit. Traders will need to increase their bid prices to offset the decline in execution probability because of more competition on the buy side of the order book. Traders who do not value the dividend and tax credit as highly will switch to using sell limit orders to capture a greater share of the bid-ask spread, with improved execution probabilities.

Foucault, Kadan and Kandel (2005) and Roşu (2009) formally include trader impatience in their models of limit order book dynamics. Impatient traders have a larger waiting cost per unit of time and the expected total waiting cost is determined by the delay between order submission and execution. Foucault, Kadan, and Kandel show that the market will be more resilient, and the bid-ask spread subsequently smaller, when the population of traders is dominated by patient traders, or if waiting costs are relatively higher. Patient traders will submit aggressive limit orders to reduce their time to execution if there is more competition from other patient traders. Similarly, if the cost of delaying execution increases, then there is an incentive to submit more aggressive limit orders to reduce this cost.

Waiting costs and the risk of non-execution are likely to increase as the ex-dividend day approaches for both dividend-induced short-term traders and long-term traders accelerating their pre-determined purchase or sale decisions to the cum-dividend period. If waiting costs were to increase by a large enough value for a subset of patient traders, then the proportion of impatient traders may also increase as these formerly patient traders switch to submitting market orders. However, there is empirical evidence that this does not occur. Pagano and Schwartz (2003) show that spreads are actually smaller in the last half-hour of trade when the market closes using a call auction. They posit that the closing call auction will lead to the placement of more limit orders instead of market orders. This finding is consistent with the predictions of Foucault, Kadan, and Kandel, as the proportion of impatient traders will not increase. As the ASX operates a closing call auction we anticipate that the proportion of impatient traders would not increase substantially as there exists an opportunity to trade before the close on the cum-dividend day, albeit at an uncertain price. After a stock begins trading ex-dividend, it is likely that waiting costs will be relatively lower in the absence of a trading deadline. Any prediction about the proportion of impatient traders in the ex-dividend period hinges upon whether they are able to fill their orders in the opening auction. Therefore, we are uncertain as to whether the composition of patient and impatient traders will change on the ex-dividend day.

In summary, the model of Foucault, Kadan, and Kandel implies that the bid-ask spread in the cum-dividend period should be lower, and the market more resilient, as patient traders post more aggressively priced limit orders to reduce the time to execution, given higher waiting costs. On the ex-dividend day, limit orders will not be priced as aggressively, spreads will be higher, and the market less resilient, as a result of lower waiting costs. We also anticipate an increase in adverse selection on the ex-dividend day due to the uncertainty regarding the ex-dividend price, and therefore an increase in the bid-ask spread. We expect that differences in the bid-ask spread between the ex-dividend day and the cum-dividend day will be larger in those stocks paying full franked dividends at a high yield, as this is where differences in subjective valuation are hypothesized to be largest. These are also the stocks where long-term traders accelerate trades to the cum-dividend period, and will therefore have reduced trading on the ex-dividend day.

4. Data

We obtain intraday trading data from the Securities Industry Research Centre of Asia-Pacific (SIRCA) for the period February 19, 1990 to December 31, 2008. This data captures all order submissions, cancellations, and trades that took place on the ASX electronic trading systems where all trading by member brokers are reported. Each transaction in the dataset consists of the timestamp to the nearest millisecond, stock ticker, price, volume, bid and ask quotes, bid and ask depth, and trade flags indicating whether the trade was buyer or seller initiated, an opening or closing auction trade, technical crossing, an off-market trade, or an odd-lot trade. We also source closing day prices from SIRCA. Dividends, ex-dividend dates, capitalization adjustments, and month-end share market capitalization data are sourced from the Australian School of Business' Centre for Research in Finance Share Price and Price Relative Database (CRIF SPPR). Similarly to Bell and Jenkinson (2002) we limit the sample to the largest 250 stocks by market capitalization at the end of the prior month in order to remove thin trading stocks. Furthermore, we remove dividend events where the cum-dividend day stock price is below $1 and exclude foreign stocks such as US depositary receipts.

We focus on three measures of the absolute level of transaction costs in this study following Huang and Stoll (1996) and Bessembinder (2003). We do not utilize proportional measures of transaction costs given the ex-dividend day decline in price. The effective half-spread at time *t* in stock *i* is measured as the absolute value of the traded price less the midpoint of the bid and ask:

$$\textit{Effective spread}_{it} = (P_{it} - M_{it})\delta_{it}, \qquad (1)$$

where P_{it} is the traded price, M_{it} is the midpoint price immediately prior to the trade occurring and δ_{it} equals +1 if the trade is a market buy order (traded at the ask price), or equals -1 if the trade is a market sell order (traded at the bid price). The realized half-spread measures the price movement unrelated to information after a trade is executed, from the perspective of the limit order, and is calculated as:

$$Realized\ half-spread_{it} = (P_{it} - M_{it+n})\delta_{it}\ , \tag{2}$$

where M_{it+n} is the midpoint price after 30 minutes have passed. The price impact captures the informativeness of a trade from the perspective of the market:

$$Price\ impact_{it} = (M_{it+n} - M_{it})\delta_{it} \tag{3}$$

The price impact is also defined as the difference between the effective spread and the realized spread.

We calculate abnormal market depth utilizing the method that Michaely and Vila (1996) apply to abnormal volume in ex-dividend studies. Daily bid (ask) market depth is measured as the time-weighted ratio of daily depth divided by the total shares outstanding ($Depth_i$). The expected time weighted bid (ask) depth ($EDepth_i$) for a dividend event is the average daily time-weighted number of shares at the best bid or ask price between *t*-45 and *t*-6 and *t*+6 to *t*+45:

$$EDepth_i^d = \frac{\sum_{t-45}^{t-6} Depth_{it}^d + \sum_{t+6}^{t+45} Depth_{it}^d}{T}\ , \tag{4}$$

where *T* is the number of days the stock was able to be traded in the 80-day estimation window and *d* indexes bid and ask orders. Abnormal time-weighted bid (ask) market depth ($ADepth_i$) is calculated as the daily number of shares at the best bid (ask) price divided by the number of shares outstanding over the expected time weighted daily number of shares at the best bid (ask) price divided by the number of shares outstanding:

$$ADepth_{i,t} = \frac{Depth_{it}}{EDepth_i} - 1 \tag{5}$$

5. Results

5.1 Descriptive Statistics

Table 1 reports the descriptive statistics for the 6,382 dividend payments that occur in the sample from 1990 to 2008. As we are focusing on the dollar spread, it is important to note that the mean dividend is 14 cents and median dividend is substantially smaller at eight cents. Any changes in the effective spread will be eroding an amount of these dividend values. The dividend yield is calculated as the cash dividend divided by the closing cum-day price, and has a mean of 2.27%. The median franking level of 100% shows that most companies pass on tax credits to investors, although the average is around 64%. There are 3665 dividend events that are fully franked, 665 are partially franked, and 2052 do not carry any tax benefits for investors.

[INSERT TABLE 1]

5.2 Transaction Costs around the Ex-Dividend Day

Table 2 reports our baseline results showing that the effective half-spread is statistically higher on ex-dividend days than both the cum-day and days prior to the ex-dividend day. For comparison to the effective half-spread on the ex-dividend day, we use the spread on the cum-dividend day and a benchmark that is the average daily spread from *t*-50 to *t*-6 relative to the ex-dividend day. As shown in Panel A for the entire sample, the ex-dividend day half-spread of 2.177 cents is 0.48 cents higher than the average spread from *t*-50 to *t*-6 and 0.59 cents higher than the cum-dividend day spread. Both differences are statistically significant at the one percent level. This represents a 28 to 37% increase in the average cost of trading using market orders. To compare the magnitude of the ex-dividend day spread to other days, Figure 1 presents the daily average spread between *t*-45 to *t*+45, relative to the ex-day. The spread is at its peak on the ex-dividend day, suggesting that the ex-dividend deadline does affect trading costs.

[INSERT TABLE 2]

[INSERT FIGURE 1]

The results in Table 2 show that the spread premium is positive and mostly statistically significant when sorting by stock characteristics. Table 2 Panel B sorts dividend events into three equally sized groups by dividend yield. The 'Ex-Cum' column shows the half-spread premium increases across all three groups by between 0.38 and 0.59 cents, though in percentage terms the average difference between the cum- and ex-dividend days is 30% in the low dividend yield group and 44% in the medium and high yield groups. We find similar results for the franking level (Panel C) and three equally sized groups sorted by the benchmark effective percentage half-spread (Panel D). The increase in the spread varies from high spread stocks 0.2 cents or 18% for low spread stocks to 1.23 cents or a 51% rise for stocks with a high benchmark period effective spread. Similar conclusions hold for the difference between the cum- and ex-dividend days.[3] Our results clearly show that the ex-dividend effective spread is higher than on other days, supporting our hypotheses. We find that that percentage increase in the spread between the cum- and ex-dividend days is higher for fully franked stocks and high yield stocks. These observations are consistent with our predictions regarding changes in waiting costs from theoretical models of an order-driven market, as the spread varies inversely with waiting costs

To determine why spreads increase on the ex-dividend day we decompose the effective spread into a realized spread and price impact components. Focusing firstly on the realized spread results in Table 3, it is evident that the realized spread does not comprise a statistically significant portion of the effective spread. However, the change in the realized spread on the ex-dividend day is predominantly negative relative to the cum-dividend day and the *t*-50 to *t*-6 average benchmark. The negative realized spreads on the ex-day are concentrated in the high yielding dividends paying some level of franking credits with a high benchmark percentage spread. This suggests that compensation paid to liquidity suppliers in the limit order book is not greater on the ex-dividend

[3] We undertake robustness tests on our main results by dividing dividend events into two groups depending on whether the dividend is a fraction of one cent and the stock is trading with a minimum tick of one cent. We find that the increase in spread is not driven by dividend payments that are not a multiple of the tick size.

and that prices are not reversing following executed trades. Therefore, anti-competitive behavior from market makers is not responsible for the increase in spread and they are not exploiting the need of short-term traders to unwind their positions.

[INSERT TABLE 3]

The price impact component of the spread measures the information content of the trade as assessed by the market. Given the negative realized spreads it is not surprising that the price impact is positive and statistically significant. The results in Table 4 show that the market views the information content of ex-dividend trades as significantly greater than those on the cum-dividend day. In the full sample (Panel A), the average price impact of a trade increases by over one cent between the cum- and ex-days from 1.2 cents to 2.3 cents, respectively. This represents an 89% increase in price impact from the cum-day to the ex-day. The change in price impact varies by stock characteristics. Higher yield stocks and those paying fully franked dividends experience large and significant increase in price impact of 1.16 cents (127%) and 1.43 cents (110%), respectively. Stocks that are normally trading at the lowest proportional effective spread have a small but significant increase in price impact of 0.17 (18%) between the cum-day and the ex-day. The price impact for stocks with higher transaction costs in the benchmark period is 4.59 cents on the ex-day, compared to 1.82 cents on the cum-day. This increase is likely to reflect uncertainty regarding the fair value of the ex-dividend security, or more precisely the value of the dividend and any associated tax credit that has detached from the stock.

The results on the three measures of transaction costs show that the increase in the effective spread is driven by a combination of rising price impact and declining realized spreads. This reflects an absence of anti-competitive behavior and suggests that pseudo market makers are not capturing the differences in subjective valuations on the ex-dividend day. There is evidence that the perceived information content of the average trade increases, reflecting increased adverse selection and uncertainty regarding the market's valuation of dividends and franking credits.

[INSERT TABLE 4]

5.3 Intraday Transaction Costs

To further understand the potential causes of the ex-dividend spread increase, we examine the hourly effective spreads throughout the trading day. The hourly spreads will allow us to determine whether uncertainty about the value of the dividend is resolved after trading has begun leading to a decline in the ex-dividend spread premium over the trading day. Table 5 shows that the greatest difference in the spread is concentrated in the first hour of trade after the market opens on the ex-dividend day. However, the ex-dividend spread is consistently higher than both the cum-dividend spread and the benchmark spread throughout the day, albeit declining during the middle of the day. This pattern of spread behavior is pervasive across all stock characteristics, although we omit these results for brevity.[4] It suggests that two factors could potentially be driving the ex-dividend spread premium early in the trading day. Firstly, uncertainty surrounding the ex-dividend price drop after the opening auction could lead to a widening of spreads that is resolved as the trading progresses. Secondly, impatient traders who do not execute their orders in the opening call auction are likely to submit market orders. As a result, there could potentially be an increase in the proportion of impatient traders early in the trading day that declines after they unwind their dividend trading strategies. The larger bid-ask spreads early in the trading day could arise as a result of a temporary increase in trader impatience coupled with the decline in waiting costs for patient traders after the ex-dividend day.

Table 5 also contains information on the hourly realized spreads and price impact. The results for the hourly realized spreads mirror the daily result, with no significant changes on the ex-dividend day present. The price impact is positive across all trading hours of the day. Both measures do not exhibit any trend over the course of the day and as such do not provide any evidence over and above that concluded from the effective spread.

[4] These results are available on request from the authors.

[INSERT TABLE 5]

5.4 *Determinants of the Effective Spread*

Although the decomposition results provide an insight into how the components of the spread change between the cum- and ex-dividend days, it is important to ascertain what observable factors are driving the change in spreads. The determinants of the spread are estimated using common factors contained in the literature (Stoll (2000) and Comerton-Forde and Tang (2009)) as well as dividend-related factors:

$$\begin{aligned} ES_{it} = \alpha_0 + \alpha_1 D_{it}^{Ex} + \alpha_2 Volume_{it} + \alpha_3 Volume_{it} D_{it}^{Ex} + \alpha_4 \sigma_{it} + \alpha_5 \sigma_{it} D_{it}^{Ex} + \alpha_6 Tick_{it} \\ + \alpha_7 Tick_{it} D_{it}^{Ex} + \alpha_8 Frank_{it} + \alpha_9 Frank_{it} D_{it}^{Ex} + \alpha_{10} DY_{it} + \alpha_{11} DY_{it} D_{it}^{Ex} + \varepsilon_{it} \end{aligned} . \quad (6)$$

ES_{it} is the effective spread, D_{it}^{Ex} is a dummy variable equal to one for ex-dividend days and zero for cum-dividend days, $Volume_{it}$ is the natural logarithm of daily trading volume, σ_{it} is the stock return variance over the same time interval, $Tick_{it}$ is the minimum tick size for each stock based on its ex-dividend price, $Frank_{it}$ is the percentage to which the dividend carries tax credits, and DY_{it} is the dividend as a percent of the cum-dividend day closing price. The ex-day dummy variable is interacted with explanatory variables to assess whether they exert different influences on the spread once a stock beings trading ex-dividend. We report *t*-statistics based on standard errors clustered by stock and ex-dividend date.

Table 6 contains the regression results. Column 1 contains the spread determinants, excluding dividend yield and the percentage level of franking. The volume, volatility, and tick size all have the expected signs and are statistically significant on the cum-dividend day. On the ex-dividend day, the effect of volume on the spread decreases significantly from -0.83 to -1.06 per unit of log volume. Interestingly, these cross-sectional variables are unable to explain the difference in spread, with the ex-dividend effective spread three cents higher than the cum-dividend day after controlling for common determinants. These coefficients are broadly similar when we include franking, dividend yield, and their interaction with the ex-dividend day dummy variable (column 2).

Higher yielding stocks generally have lower effective spreads, with this relationship unaffected on the ex-dividend day. However, the effective spread for fully franked stocks differs between the cum- and ex-day, consistent with differences in valuation affecting trading. Fully franked stocks experience a 0.35 cent increase on the ex-dividend day, relative to the cum-dividend day. Despite this relationship, the ex-dividend dummy variable remains significant.[5]

[INSERT TABLE 6]

Increases in waiting costs are likely to be more important in stocks where valuation differences amongst traders are greatest. If this is the case then we would expect differences in spreads to be larger for fully franked, high yield stocks and for increases to be smaller for stocks paying unfranked and low yield dividends. Furthermore, the particular functional form in which dividend yield and franking enter into Equation 5 is unknown. To address these issues, we estimate Equation 5, omitting franking and dividend yield, for three groups ranked on franking credit yield (FCY). This measure of yield reflects the dollar value of the tax credits as a percent of the cum-dividend price. The results are presented in columns 3 to 5 of Table 6. Where significant, all coefficients have the expected sign.[6] The low franking credit yield group (column 3) is more sensitive to changes in volume and volatility, with these effects not changing significantly on the ex-dividend day. For these stocks with the lowest tax-induced differences in valuation there is not significant increase in spread on the ex-day. This is consistent with predictions from limit order book models, as waiting costs for these stocks are unlikely to change around the ex-dividend day, and therefore, we do not observe a spread increase. However, for those dividend events with a higher franking credit yield, and therefore, greater variation in subjective valuations, the ex-dividend spread premium persists.

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[5] The inclusion of stock fixed effects does not have a substantial impact on the magnitude of the coefficients and the ex-dividend day dummy variable remains positive and significant.

[6] The results are qualitatively similar if stock fixed effects are included.

5.5 Market Depth

The results so far indicate that effective spreads and price impact increase substantially on the ex-day. This section looks at whether reduced market depth could explain the difference between the spread on the ex-dividend day and other trading days. If waiting costs increase then limit order traders are likely to improve upon the best quotes to ensure quick execution, so we anticipate more aggressively priced limit orders. For stocks already trading at the minimum spread this could lead to an increase in depth at the best bid and ask during the cum-dividend period. On the ex-dividend day, a decline in waiting costs will reduce the aggressiveness of orders and a decline in the depth is expected given the reduced need for the majority of traders to have quick execution.

We calculate an abnormal market depth measure for the first level of bid and ask depth separately. The results in Table 7 show that on the cum-dividend day the ask depth is 9.5% higher than expected for the entire sample, 24.7% larger for high dividend yield stocks, 10.7% higher for fully franked events and 7.6% greater for low spread stocks. These groups of stocks are those where the gains from trade are greatest and where we hypothesized that more patient traders would be concentrating their trading. It is interesting that the greater depth only occurs on the ask side of the order book. Given that the majority of the trading population is able to utilize franking credits, then the increase in the number of cum-dividend buyers coupled with higher waiting costs could force traders to switch to using market orders.

On the ex-dividend day the abnormal bid and ask depth is negative and statistically significant for the entire sample, with the depth 12% lower than expected at the bid and just over 9% lower at the ask. (Panel A). The abnormal depth is also negative and statistically significant at either the bid or ask across dividend yields (Panel B), franking levels (Panel C) and the benchmark effective percentage spread (Panel D). Although the lower depth is not consistent across the different sorts on stock characteristics, the results show that patient liquidity suppliers do become less aggressive. Therefore, the changes in the depth are consistent with our predictions regarding changes in the waiting costs faced by patient traders.

[INSERT TABLE 7]

5.6 Order Aggressiveness

The results on market depth provide evidence that liquidity suppliers are less aggressive on the ex-dividend day. We are able to directly examine order aggressiveness to determine whether changes are consistent with our hypotheses. Following Ranaldo (2004) and Comerton-Forde and Tang (2009) we are able to classify orders into six groups of aggressiveness, with 1 representing the least aggressive orders and 6 representing the most aggressive orders. The order types from least aggressive to most aggressive are: cancelled orders, limit orders outside the prevailing quotes, limit orders at the best quotes, limit orders at a price better than best quote, market orders that are fully executed immediately at the prevailing best quote and market orders with volumes greater than that available at the prevailing best quotes.

We first calculate the proportion of all orders that fall into each of the six categories for each dividend event. Table 8 provides the cross-sectional averages of these proportions.[7] The choice of order types are similar across both bid and ask orders. There is a decline in the proportion of market orders (ranks 5 and 6) consistent with a reduction in waiting costs on the ex-day and a shift to using less aggressive orders. Limit orders priced at the best quotes and cancellations also decrease on the ex-day. The decline in these orders is offset by an increase in orders priced outside the best quotes and orders that improve upon the best quotes. These results are consistent with our predictions. Although the proportion of limit orders that improve the best quotes increases, we know that depth falls on both sides of the order book, so orders are not being price more aggressively on average. The increase in limit orders outside of the quotes also reflects a reduction in waiting costs and potential uncertainty about the true value of the ex-dividend security.

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[7] The proportions are similar if we examine volume of each order rather than number of orders.

[INSERT TABLE 8]

To control for factors that may be impacting upon the choice of order type, we estimate an ordered probit model following Ranaldo (2004). We estimate a separate model for bid and ask trades for each dividend event in our sample:

$$OA_t^d = \gamma_0 + \sum_{j=1}^{k} \gamma_j x_{jt-1} + v_t , \tag{7}$$

where *OA* is the order aggressiveness from 1 (least aggressive) to 6 (most aggressive), *d* indicates whether the order is a buy or a sell order. The independent variables are based upon Ranaldo (2004): the standard deviation of the lagged 20 mid-quote returns, depth prevailing on the opposite of the order book at the best quote, depth prevailing on the same of the order book at the best quote, the quoted bid-ask spread immediately prior to the order submission, the average time difference between the last three submitted orders and a dummy variable for the ex-dividend day to capture any changes in order aggressiveness between the cum and ex-dividend day. We expect that the dummy variable should be negative to reflect the submission of less aggressive orders after controlling for the above factors.

For brevity, we report only the median coefficient for the ex-day dummy variable.[8] We estimate median coefficients based on dividend yield and franking level rankings. Table 9 contains the results. The median coefficients are all negative indicating that order aggressiveness declines on the ex-dividend day (Panel A) after controlling for order-level factors. The aggressiveness of the ask orders does not vary significantly by franking and yield. However, the median coefficients of the bid orders increase monotonically across dividend yield and franking. Panel F shows that order aggressiveness declines by the greatest amount for fully franked, high yield stocks. As noted above, traders placing a higher subjective value on stocks are the majority in the Australian market. These dividend capture traders are targeting fully franked, high yield stocks and are likely to be most sensitive to increases in waiting costs. The change in aggressiveness of orders supports the

[8] The full set of median coefficients and event by event results are available on request from the authors.

hypothesis that increases in the spread are related to a lower cost of delaying execution once a stock begins trading ex-dividend.

[INSERT TABLE 9]

6. Conclusion

We document a substantial increase in the bid-ask spread on the ex-dividend for stocks listed on the Australian Stock Exchange between 1990 and 2008. The ex-dividend day effective half-spread is around 28 to 37% higher than both the cum-dividend day and a non-event benchmark period. The effective spread spikes upwards on the ex-dividend day before returning to its average level. This pattern of spread behavior is pervasive across dividend yields, franking level, and a non-event benchmark spread. Theoretical models of the limit order book (Foucault (1999), Foucault, Kadan and Kandel (2005), and Roşu (2009)) show that adverse selection, trader impatience and the cost of delaying execution are likely to influence the size of the spread in a pure order-driven market. We hypothesize that the cost of delaying execution will increase in the cum-dividend period before declining after the stock begins trading ex-dividend. As a result, patient traders will post more aggressive limit orders in the cum-dividend period leading to lower spreads. After the ex-dividend deadline has passed, patient traders will submit less aggressive limit orders and spreads will be wider. Consistent with these predictions, we find that depth at the best ask quote increases on the cum-dividend day and decreases significantly at both the best bid and ask quote on the ex-dividend day. Order aggressiveness also declines on the ex-dividend day.

The ex-dividend spread increase is concentrated in the first hour of trading, consistent with both uncertainty surrounding the determination of the ex-dividend price and an increase in the proportion of impatient trades that were potentially unable to unwind dividend-induced trading strategies in the opening call auction. However, the spread is persistently higher throughout the ex-dividend day consistent with a decline in waiting costs for patient traders. Analysis of determinants of the spread indicates that the franking level is positively associated with the ex-dividend spread, consistent with tax-induced valuation differentials. The results in this paper have important implications for the presence of profitable short-term trading opportunities, indicating that expected profits are likely to be higher than actual profits for traders utilizing a dividend-induced trading strategy.

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Table 1
Descriptive Statistics

The sample is for dividends paid between February 1990 and December 2008. Panel A reports summary statistics on the dividend events. The cash dividend is the dividend payment in cents. The franking level is the percentage tax credit attached to the cash dividend. The dividend yield is measured as the cash dividend divided by the closing cum-day price. The franking credit yield is the dollar value of the franking credits as a percentage of the cum-dividend closing price.

	Mean	Median	Q1	Q3	Std. Dev.	Min	Max
Cash Dividend (c)	14.05	8.00	4.50	15.00	21.99	0.10	280.00
Franking Level (%)	64.24	100.00	0.00	100.00	45.53	0.00	100.00
Dividend Yield (%)	2.27	2.08	1.53	2.76	1.66	0.06	79.37
Franking Credit Yield (%)	0.34	0.33	0.00	0.55	0.34	0.00	8.40

Table 2
Effective Half-Spreads around the Ex-Dividend Day

This table reports the equally weighted average effective half-spread in cents measures across dividend events. Benchmark is the average effective half-spread from *t*-50 to *t*-6 days prior to an ex-dividend date for a given stock. *t*-statistics using clustered standard errors on the ex-dividend date are reported for the paired differences 'Ex-Benchmark' and 'Ex-Cum'. **, * denote significance at the 1 and 5% level.

Panel A. Entire Sample	Benchmark	Cum	Ex	Ex-Benchmark	T	Ex-Cum	T	N
	1.699	1.584	2.177	0.478**	(10.30)	0.593**	(11.41)	6382
Panel B. Dividend Yield								
0(Low)	2.378	2.285	2.966	0.588**	(5.52)	0.681**	(5.79)	2126
1	1.420	1.308	1.890	0.469**	(6.89)	0.582**	(7.30)	2129
2(High)	1.299	1.159	1.674	0.376**	(6.94)	0.515**	(8.84)	2127
Panel C. Franking Level								
Zero	1.692	1.679	2.037	0.345**	(4.25)	0.358**	(3.67)	2052
Partly	1.189	1.126	1.602	0.414**	(4.02)	0.477**	(4.42)	665
Fully	1.795	1.613	2.359	0.564**	(9.06)	0.745**	(11.22)	3665
Panel D. Benchmark Effective Percentage Half-Spread								
0(Low)	1.114	1.106	1.305	0.191**	(3.61)	0.198**	(3.84)	2127
1	1.239	1.210	1.559	0.320**	(6.70)	0.349**	(5.59)	2128
2(High)	2.744	2.435	3.667	0.923**	(7.70)	1.232**	(9.37)	2127

Table 3
Realized Half-Spreads around the Ex-Dividend Day

This table reports the equally weighted realized spreads in cents across dividend events. 'Benchmark' measures the average realized spread between *t*-50 and *t*-6 days from the ex-dividend day. The realized half-spreads are in cents. The sample period is from Feb 1990 to Dec 2008. *t*-statistics with ex-dividend date clustered standard errors are reported for the paired differences 'Ex- Benchmark' and 'Ex-Cum'. **, * denote significance at the 1 and 5% level.

	Benchmark	Cum	Ex	Ex-Benchmark	T	Ex-Cum	T	N
Panel A. Full Sample								
	0.310	0.358	-0.142	-0.451	(-1.25)	-0.499	(-1.38)	6382
Panel B. Dividend Yield								
0(Low)	0.230	0.449	0.399	0.169	(0.41)	-0.050	(-0.13)	2126
1	0.331	0.379	-0.420	-0.751	(-0.80)	-0.799	(-0.82)	2129
2(High)	0.368	0.245	-0.404	-0.772*	(-2.35)	-0.649	(-1.93)	2127
Panel C. Franking Level								
Zero	0.304	0.477	0.354	0.049	(0.16)	-0.123	(-0.50)	2052
Partly	0.135	0.197	-0.464	-0.599	(-1.17)	-0.661	(-1.29)	665
Fully	0.344	0.320	-0.361	-0.705	(-1.18)	-0.681	(-1.11)	3665
Panel D. Benchmark Effective Percentage Half-Spread								
0(Low)	0.060	0.164	0.189	0.129	(1.40)	0.025	(0.33)	2127
1	0.269	0.291	0.307	0.038	(0.40)	0.016	(0.19)	2128
2(High)	0.600	0.619	-0.921	-1.521	(-1.43)	-1.540	(-1.43)	2127

Table 4
Price Impact around the Ex-Dividend Day

This table presents the adverse selection component of the spread calculated as the effective spread less the realized spread. 'Benchmark' measures the average adverse selection component between *t*-50 and *t*-6 days from the ex-dividend day. The sample period is from Feb 1990 to Dec 2008. *t*-statistics with ex-dividend date clustered standard errors are reported for the paired differences 'Ex-Benchmark' and 'Ex-Cum'. **, * denote significance at the 1 and 5% level.

	Benchmark	Cum	Ex	Ex-Benchmark	T	Ex-Cum	T	N
Panel A. Full Sample								
	1.389	1.226	2.318	0.929*	(2.53)	1.092**	(2.91)	6382
Panel B. Dividend Yield								
0(Low)	2.148	1.836	2.567	0.419	(1.02)	0.731*	(1.99)	2126
1	1.089	0.928	2.310	1.221	(1.26)	1.382	(1.36)	2129
2(High)	0.930	0.914	2.078	1.148**	(3.41)	1.164**	(3.39)	2127
Panel C. Franking Level								
Zero	1.388	1.202	1.683	0.295	(0.95)	0.482*	(2.00)	2052
Partly	1.053	0.928	2.066	1.013	(1.80)	1.138*	(2.02)	665
Fully	1.451	1.294	2.720	1.269*	(2.08)	1.426*	(2.25)	3665
Panel D. Benchmark Effective Percentage Half-Spread								
0(Low)	1.053	0.943	1.116	0.062	(0.74)	0.173*	(2.11)	2127
1	0.970	0.919	1.252	0.282*	(2.53)	0.333**	(3.52)	2128
2(High)	2.144	1.816	4.588	2.444*	(2.26)	2.772*	(2.50)	2127

Table 5
Hourly Measures of Transaction Costs

This table reports the equally weighted average effective half-spread, realized half spread and price impact in cents measured across dividend events for each hour in the trading day. Benchmark is the average half-spread from *t*-50 to *t*-6 days prior to an ex-dividend date for a given stock. *t*-statistics using clustered standard errors on the ex-dividend date are reported for the paired differences 'Ex-Benchmark' and 'Ex-Cum'. **, * denote significance at the 1 and 5% level.

Panel A. Effective Spread

Hour of trade	Benchmark	Cum	Ex	Ex-Benchmark	T	Ex-Cum	T	N
10 to 11(first)	1.311	1.245	1.991	0.675**	(11.04)	0.746**	(12.05)	5085
11 to 12	1.151	1.035	1.449	0.297**	(7.95)	0.413**	(9.94)	5061
12 to 1	1.090	0.979	1.220	0.128**	(3.81)	0.241**	(7.13)	4764
1 to 2	0.970	0.944	1.049	0.079**	(2.86)	0.105	(1.82)	4161
2 to 3	1.096	1.031	1.276	0.180**	(4.24)	0.244**	(5.06)	5033
3 to 4(last)	1.246	1.189	1.380	0.135**	(4.81)	0.191**	(5.69)	5465
Last - first	-0.207	-0.180	-0.701	-0.494**	(-10.09)	-0.522**	(-9.98)	4753
Panel B. Realized Spread								
10 to 11(first)	0.154	0.200	0.233	0.079	(0.46)	0.033	(0.19)	5085
11 to 12	0.119	0.173	-0.322	-0.441	(-1.32)	-0.495	(-1.18)	5061
12 to 1	0.282	0.302	0.176	-0.105	(-1.06)	-0.125	(-1.24)	4764
1 to 2	0.343	0.286	0.352	0.009	(0.15)	0.066	(0.97)	4161
2 to 3	0.240	0.187	0.152	-0.088	(-0.58)	-0.034	(-0.22)	5033
3 to 4(last)	0.471	0.370	0.426	-0.044	(-0.77)	0.056	(0.77)	5465
Panel C. Price Impact								
10 to 11(first)	0.997	0.887	1.162	0.165	(0.95)	0.274	(1.54)	5085
11 to 12	1.061	0.888	1.727	0.666	(1.92)	0.839	(1.92)	5061
12 to 1	0.858	0.746	1.130	0.272**	(2.63)	0.384**	(3.60)	4764
1 to 2	0.691	0.686	0.819	0.128*	(2.02)	0.133	(1.75)	4161
2 to 3	0.964	0.928	1.276	0.312*	(2.07)	0.348*	(2.23)	5033
3 to 4(last)	0.815	0.809	1.112	0.297**	(4.86)	0.303**	(3.94)	5465

Table 6
Determinants of Effective Half-Spreads

This table reports results from the estimation of effective spread determinants in Equation 666. Columns 1 and 2 present results for the full sample, while columns 3 to 5 present results for dividend events sorted based on the franking credit yield (FCY), where the FCY measures the dollar value of franking credits as a percent of the cum-dividend closing price. *ExDum* is a dummy variable equal to one for ex-dividend days and zero for cum-dividend days, *Volume* is the natural logarithm of average daily trading volume between *t*-50 and *t*-6, relative to the ex-dividend day, *Volatility* is the stock return variance over the same time interval, *Tick* is the minimum tick size for each stock based on its ex-dividend price, *Franking* is the percentage to which the dividend carries tax credits, and *DY* is the dividend as a percent of the cum-dividend day closing price. We report the absolute value of *t*-statistics based on standard errors clustered by stock and ex-dividend date in parentheses. **, * denote significance at the 1 and 5% level.

	(1)	(2)	(3)	(4)	(5)
	Full Sample	Full Sample	Low FCY	Mid FCY	High FCY
Constant	9.897**	10.368**	16.700**	8.058**	4.066**
	(5.36)	(5.25)	(3.95)	(6.23)	(3.45)
ExDum	3.009*	2.989*	1.696	6.038**	2.581*
	(2.45)	(2.36)	(0.67)	(3.48)	(1.97)
Volume	-0.828**	-0.828**	-1.247**	-0.703**	-0.433**
	(6.20)	(6.22)	(4.21)	(7.61)	(7.91)
Volume * ExDum	-0.233**	-0.236**	-0.098	-0.442**	-0.260**
	(2.66)	(2.72)	(0.58)	(4.02)	(2.90)
Volatility	2.795**	2.980**	4.488**	1.364	0.837*
	(3.32)	(3.29)	(2.66)	(1.73)	(2.12)
Volatility * ExDum	-0.755	-0.773	-0.286	-0.592	-0.688
	(1.54)	(1.54)	(0.36)	(0.72)	(1.12)
Tick	1.624**	1.656**	-0.046	2.145*	2.454
	(2.60)	(2.73)	(0.06)	(2.15)	(1.78)
Tick * ExDum	0.294	0.134	-0.425	0.069	1.124
	(0.46)	(0.22)	(0.68)	(0.09)	(0.69)
Franking		-0.301			
		(1.17)			
Franking * ExDum		0.350*			
		(2.19)			
DivYield		-14.430*			
		(2.23)			
DivYield * ExDum		-0.338			
		(0.12)			
Stock fixed effects	No	No			
Obs.	12764	12764	4254	4256	4254
Adj. R^2	0.224	0.227	0.284	0.219	0.192

Table 7
Average Abnormal Time-weighted Bid and Ask Market Depth around the Ex-Dividend Day

This table reports the equally weighted average daily bid and ask market depth, between *t*-5 and *t*+5 of the ex-dividend day. Abnormal time-weighted bid (ask) market depth is calculated as the daily number of shares at the best bid (ask) price divided by the number of shares outstanding over the expected time weighted daily number of shares at the best bid (ask) price divided by the number of shares outstanding. The expected time weighted bid or ask depth for a dividend event is the average daily time-weighted number of shares at the best bid or ask price between *t*-45 and *t*-6 and *t*+6 to *t*+45. The sample period is from Feb 1990 to Dec 2008. **, * denote significance at the 1 and 5% level using *t*-statistics with clustered standard errors on the ex-dividend date.

	Depth	t-5	t-4	t-3	t-2	t-1	Ex-day	t+1	t+2	t+3	t+4	t+5	N
Panel A. Full Sample													
	Bid	-0.071**	0.029	-0.014	-0.004	0.010	-0.117**	-0.058*	-0.019	-0.013	0.023	-0.001	6382
	Ask	-0.011	0.051	0.016	0.061	0.095**	-0.094**	-0.034	0.004	-0.065**	-0.029	-0.074**	6382
Panel B. Dividend Yield													
0(Low)	Bid	-0.103**	-0.038	0.008	-0.038	0.019	-0.113**	-0.023	0.019	-0.066*	0.016	0.050	2126
1		-0.044	0.104	-0.014	-0.003	0.023	-0.126**	-0.052	-0.024	-0.018	-0.010	-0.028	2129
2(High)		-0.066	0.021	-0.037	0.029	-0.012	-0.113*	-0.100*	-0.051	0.044	0.063	-0.025	2127
0(Low)	Ask	0.024	-0.014	0.003	0.037	-0.005	-0.127**	-0.007	0.041	-0.105**	-0.016	-0.008	2126
1		-0.069*	0.032	0.003	0.053	0.043	-0.070	-0.115*	0.008	-0.040	-0.010	-0.099*	2129
2(High)		0.013	0.136*	0.042	0.092	0.247**	-0.087	0.021	-0.038	-0.052	-0.061	-0.114**	2127
Panel C. Franking Level													
Zero	Bid	-0.055	0.018	-0.086	-0.029	-0.006	-0.160**	-0.193**	-0.016	-0.077	0.011	-0.014	2052
Partly		-0.129**	0.236	0.251	0.167	-0.014	-0.003	-0.099*	-0.030	0.077	0.001	-0.146**	665
Fully		-0.070**	-0.002	-0.023	-0.022	0.023	-0.114**	0.024	-0.018	0.005	0.034	0.033	3665
Zero	Ask	-0.034	-0.072**	-0.014	0.050	0.073	-0.067	-0.067	-0.062	-0.098**	-0.097**	-0.104*	2052
Partly		0.001	0.190	0.051	0.055	0.100	-0.128**	-0.034	0.099	0.019	-0.006	-0.098	665
Fully		0.000	0.096*	0.026	0.068	0.107*	-0.104**	-0.015	0.024	-0.063*	0.005	-0.052	3665
Panel D. Benchmark Effective Percentage Half-Spread													
0(Low)	Bid	-0.074**	0.027	0.029	-0.027	0.023	-0.049	0.000	0.035	0.031	0.011	0.012	2127
1		-0.060	0.114	-0.065	0.014	0.050	-0.176**	-0.101	-0.098	-0.039	0.061	-0.011	2128
2(High)		-0.080*	-0.056	-0.006	0.001	-0.043	-0.126**	-0.074	0.009	-0.033	-0.003	-0.003	2127
0(Low)	Ask	0.004	0.103*	0.059*	0.052*	0.076**	-0.060**	0.017	0.020	-0.008	0.016	-0.084**	2127
1		-0.037	0.047	-0.020	0.097	0.116	-0.158**	-0.042	-0.049	-0.088**	-0.088**	-0.134**	2128
2(High)		0.001	0.003	0.008	0.032	0.094	-0.065	-0.077	0.042	-0.101	-0.014	0.001	2127

Table 8
Proportion of Orders Ranked by Aggressiveness

This table contains the cross-sectional averages of the proportion of submitted orders ranked by aggressiveness. The least aggressive orders are ranked 1 and 6 represents the most aggressive orders. The order types from least aggressive to most aggressive are: cancelled orders, limit orders outside the prevailing quotes, limit orders at the best quotes, limit orders at a price better than best quote, market orders that are fully executed immediately at the prevailing best quote and market orders with volumes greater than that available at the prevailing best quotes. The *t*-statistics from a *t*-test for differences in means is in parentheses. **, * denote significance at the 1 and 5% level.

Order	Bid Orders			Ask Orders		
Aggressiveness	Cum-day	Ex-day	Difference	Cum-day	Ex-day	Difference
1 (Least)	11.92	10.59	-1.33***	11.46	11.01	-0.46***
			(8.37)			(2.81)
2	12.83	18.04	5.20***	12.86	17.67	4.81***
			(22.39)			(20.70)
3	26.35	24.84	-1.51***	26.47	24.45	-2.03***
			(6.31)			(8.12)
4	10.97	14.99	4.02***	11.21	14.22	3.01***
			(15.71)			(12.14)
5	27.45	22.41	-5.04***	26.38	22.49	-3.89***
			(18.66)			(13.85)
6 (Most)	10.48	9.14	-1.34***	11.61	10.16	-1.45***
			(7.42)			(7.58)

Table 9
Ex-dividend Day Changes in Order Aggression: Ordered Probit Model

This table presents the median coefficient estimate for each dividend event based on the ordered probit model in Equation 7. The dependent variable is the order aggressiveness of each order on a scale from one to six, with one being the least aggressive. The independent variables are the standard deviation of the lagged 20 mid-quote returns, depth prevailing on the opposite of the order book at the best quote, depth prevailing on the same of the order book at the best quote, the quoted bid-ask spread immediately prior to the order submission, the average time difference between the last three submitted orders and a dummy variable for the ex-dividend day. The Kruskall-Wallis test for differences in medians across groups is reported. **, * denote significance at the 1 and 5% level.

	Bid Orders		Ask Orders	
	Median Coefficient	N	Median Coefficient	N
Panel A: Full Sample	-0.070**	4857	-0.053**	4820
Panel B: Dividend Yield				
Low	-0.047**	1642	-0.057**	1653
Medium	-0.069**	1589	-0.051**	1580
High	-0.102**	1626	-0.056**	1587
Kruskall-Wallis	18.605**		0.842	
Panel C: Franking Level				
Zero	-0.053**	1437	-0.051**	1429
Partly	-0.075**	579	-0.051**	577
Fully	-0.079**	2841	-0.058**	2814
Kruskall-Wallis	7.664*		0.060	
Panel D: Zero Franked				
Low	-0.034*	443	-0.06**	451
Medium	-0.039**	470	-0.05**	470
High	-0.077**	524	-0.038**	508
Kruskall-Wallis	5.098		1.413	
Panel E: Partly Franked				
Low	-0.062**	200	-0.021	200
Medium	-0.076**	203	-0.073**	206
High	-0.091**	176	-0.047**	171
Kruskall-Wallis	1.638		4.705	
Panel F: Fully Franked				
Low	-0.049**	999	-0.062**	1002
Medium	-0.079**	916	-0.049**	904
High	-0.112**	926	-0.068**	908
Kruskall-Wallis	13.630**		4.343	

Figure 1
Average Daily Effective Half-spread around the Ex-Dividend Day

The sample is for dividends paid between February 1990 and December 2008. This figure presents the equally weighted daily average effective half-spread in cents across dividend events from *t*-45 to *t*+45 relative to the ex-dividend date.