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Why Do Stock Prices Drop by Less Than the Value of the Dividend? Evidence From a Country Without Taxes

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ABSTRACT

It is well documented that on average, stock prices drop by less than the value of the dividend on ex-dividend days. This has commonly been attributed to the effect of tax clienteles. We use data from the Hong Kong stock market where neither dividends nor capital gains are taxed. As in the U.S.A. the average stock price drop is less than the value of the dividend; specifically, in Hong Kong the average dividend was HK $0.12 and the average price drop was HK $0.06. We are able to account for this both theoretically and empirically through market microstructure based arguments.

Journal of Economic Literature codes: G12, G35.
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1. Introduction

In a perfect Walrasian market with no taxes or transactions costs, on the ex-dividend day share prices would fall by exactly the value of the dividend that is paid on each share. It is well known that in fact, on average share prices do not fall by the full amount. Following Elton and Gruber (1970) a large literature has developed interpreting this fact as reflecting tax considerations. The complexity of the U.S. tax code has made it difficult to verify whether this interpretation is indeed right.

We avoid the complexities of the American tax code by investigating a market in which there are no applicable taxes. In this market taxes cannot be the driving force. The market we study is Hong Kong. According to the Hong Kong tax code, neither dividends nor capital gains are taxable. Since the marginal trader faces no taxes on either dividends or capital gain income, the Hong Kong market provides an ideal test case. Any less than a one for one price drop on ex-dividend days cannot be driven by taxes. As in the U.S.A., in Hong Kong stock prices drop on average by less than the amount of the dividend on the ex-dividend day. The average dividend is HK $0.12 per share, whereas the average ex-dividend day price drop is HK $0.06 per share.

To explain this phenomenon we develop a model of investor behavior in which there are two prices in the market -- one for buying (ask price) and one for selling (bid price). In this non-Walrasian setting we show that, under certain conditions, rational investors who have decided to buy would prefer to do so on the ex-dividend day instead of on the cum dividend day. They would rather postpone their trade by a day. Those who have decided to sell, on the other hand, would prefer to advance their sale and do so on the cum-day. Hence, on the ex-day the stock price would rise by a small amount relative to what would otherwise have been expected, ceteris paribus. This rise is related to the magnitude of the bid-ask spread and the relative importance of traders who behave in this way. We present evidence showing that this theory does a good job of organizing the facts.

1.1 Related literature

Elton and Gruber (1970) came up with the insightful observation that one could test for tax effects in the pricing of stocks by studying the behavior of stock prices around ex-dividend days. Suppose the one day expected rate of return is sufficiently small relative to the magnitude of the dividend that it can be assumed to be zero. Then absent transactions costs and any tax effects, the stock price should be expected to fall by the amount of the dividend. If, however, there are tax effects, then the average ratio of the ex-day price drop to the amount of the dividend should provide an estimate of the marginal value of a dollar of dividend paid by sacrificing a dollar of capital gain.

They found that on average the ratio of the ex-day price drop to the amount of the dividend was 0.778 during the period from April 1966 to March 1967. Elton and Gruber (1970) interpreted this as evidence in favor of a tax effect in pricing of stocks. Kalay (1982) reported an average ratio of 0.881 for the same period for a different sample of U.S. stocks. Curiously the corresponding numbers for high dividend yield decile stocks were 1.18 and 1.29 in the Elton and Gruber (1970) and Kalay (1982) studies.

Eades, Hess and Kim (1984) studied the ex-date price behavior of preferred stocks that have a higher dividend yield than common stocks. The ex-date excess returns are smaller for such stocks and are sometimes even negative, which suggests that the tax effect is less for such stocks due to the presence of dividend capture trading around ex-dates.[1] Poterba (1986) re-examined the ex-date price drop of the two classes of shares of Citizens Utilities, one of which paid only a cash dividend and the other of which paid only a stock dividend of equal magnitude, that was originally studied by Long (1978). Long found that the cash dividend shares' ex-day percentage price decline was only 77 percent of the dividend yield. The ex-day percentage price decline for stock dividend shares was 97 percent of the dividend yield. On average the price drop was the same as the value of the dividend for stock dividend shares. This can be interpreted as supporting the view that a dollar of dividend is the same as 77 cents of capital gains, other things remaining the same. Taken at face value these results can be viewed as evidence of tax effects on the pricing of stocks.

Starting with the Elton and Gruber (1970) estimates for the high dividend yield deciles of stocks, we found reasons to question the tax interpretation of these findings. As Kalay (1982) and Miller and Scholes (1982) pointed out, transactions costs may be important, since they make certain dynamic tax arbitrage strategies too expensive to actually implement. This view is consistent with the finding by Karpoff and Walkling (1988, 1990) that excess ex-day returns are positively related to transactions costs.

Another complication arises from the complexity of the American tax code. In fact not all investors have a tax-induced preference for capital gains over dividends. Floor traders, pension funds and tax exempt institutions face the same tax rate on dividends and capital gains. Corporate cash managers have an incentive to prefer dividends to capital gains. When there are many different types of traders with many different types of tradeoffs between dividends and capital gains facing different levels of transactions costs, it is no longer possible to interpret the relation between ex-day price drop and the amount of the dividend. Boyd and Jagannathan (1994) show that in such an economy, the type of investor who will be at the margin will depend on the dividend yield. At lower dividend yields, ordinary investors who value capital gains more than dividends will be more likely to be at the margin. At higher dividend yields, dividend capturers and floor traders will be more likely to be at the margin. The exact distribution of the different types at the margin will depend on the type of stock, its associated trading costs, the marginal tax rates prevailing at that point in time, and the supply and demand conditions. As Eades, Hess and Kim (1995) point out, all these characteristics vary over time. This is particularly true of the characteristics of the marginal investor for high dividend yield stocks.

1.2 Summary of current views

In view of all this, it is not clear how we should interpret the observed empirical relation between ex-day price drop and the amount of the dividend. All that one can safely conclude, as Michaely (1991) does, is that any change in the relative pricing of dividends and capital gains one observes in the data can be interpreted as evidence of changing importance of the different trading groups. The consensus opinion seems to be that it is hard to interpret the relation between ex-day price drop and the amount of the dividend in the presence of heterogeneous investors who face different transactions costs as well as taxes.[2]

However, there is also general support for the view expressed by Allen and Michaely (1995) that "Differential taxes affect both prices (at least around the ex-dividend day) and investors' trading decisions. On average, in most periods examined the price drop is less than the amount of dividend paid, *implying a negative effect on value* [emphasis added]." In contrast our view is that there is no need to appeal to tax based arguments in order to account for the fact that stock prices do not fall by the full amount of the dividend on the ex-dividend day. We empirically demonstrate that the microstructure of the stock market influences ex-dividend day pricing. Our findings are supportive of the views of Kalay (1982) and Miller and Scholes (1982), who questioned the degree to which taxes were actually driving the observed ex-day pricing.

In section 2 we discuss some important features of the Hong Kong market for the issues being studied. We present a simple theoretical model in section 3 to help motivate our empirical approach. We present the empirical results for cash dividends in section 4. The importance of the existence of a tick is studied in section 5. Stock dividends are examined in section 6. We conclude in section 7.

2. The Hong Kong market

The primary objective of this study is to understand the trading behavior of investors around ex-dividend days. Hong Kong provides an interesting setting for this purpose, since it is perhaps the simplest possible investment environment. There are very few tax induced distortions in Hong Kong. Neither capital gains nor dividends are taxed at the individual level. Individual as well as corporate taxes are less complex than in other countries.

We know that in the American markets over the time period considered, Japanese firms were engaging in dividend capture trading. However we can rule out their presence in the Hong Kong market. There is a stamp duty of 0.15% of the stock price on each stock transaction, which is substantial in relation to the amount of the dividend yield. Short selling of securities is prohibited[3] unless the person has already made arrangements to acquire the security for delivery through stock borrowing. But then the stamp duty of 0.15% each way has to be paid on stock borrowings. This effective duty of 0.3% on stock borrowings combined with the physical delivery of the stock that is required to collect the dividend has effectively prevented dividend capture trading by offshore investors. For practical purposes, almost every trader faces the same (zero) tax on dividend income as well as capital gains (losses). There is hardly any heterogeneity in this respect.

According to the rules of the Stock Exchange of Hong Kong, each stock sale deal must be settled by 3:45 PM on the day following the day of the sale, by physical delivery of the share certificates and a stamped transfer form against a check. If the buyer wishes to exercise shareholder rights, which include receiving dividends, share transfers must be registered. Under the Stock Exchange of Hong Kong rules, registrars have 21 days to register transfers and issue new stock certificates. Shares cannot be sold pending registration because of the 24 hour settlement rule.[4] This means that it is not possible for someone to buy a stock on the last cum-dividend day and turn around and sell it on the ex-dividend date. This further restricts the types of traders who can trade around the ex-date and makes it one of the simplest environments to analyze.

3. Modeling the Trades Around Ex-Dividend Days

The trading mechanism at the Hong Kong Stock Exchange is different from that at the New York Stock Exchange. Unlike NYSE, there are no market makers in HKSE. Trading until 1993 was exclusively by a telephone-based system. Orders are conveyed to the floor by telephone from the brokers' office or directly by customers calling in. Each trading booth is equipped with a terminal.

The broker enters his order in the terminal and when the deal is completed enters the details for registration. The terminal displays the brokers and their outstanding orders by stock. Only the price of the order is shown, not the quantity. If a broker wants to deal, the representative on the floor has to contact the counter party verbally by phone or in person. Deals are confirmed by entering them in the terminal.

Following Boyd and Jagannathan (1994), we model the trading process in Hong Kong around ex-dividend days as follows. There are four types of traders: buyers, sellers, market makers, and noise traders. Buyers are those who for some exogenous reasons have decided to buy a specified quantity of the stock. The only discretion they have is in deciding whether to buy the stock cum-dividend or buy it ex-dividend. Sellers are those who for some exogenous reason have decided to sell a given quantity of the stock. The only decision problem they have is to decide whether to sell the stock cum-dividend or sell it ex-dividend. Both buyers and sellers check the price and then inform their broker to trade the specified number of stocks at the prevailing market prices. Buyers will buy at the prevailing best available ask price, and sellers will sell at the prevailing best available bid. The brokers working for the buyers and sellers then deal by making telephone calls to those whose limit orders are displayed. We use the term market maker to refer to active and sophisticated traders who put in limit orders specifying the quantities and prices. Market makers may be those who maintain a desired level of inventory of a stock and gather information about the security. Based on their analysis they decide on the price below which the stock is a good buy and a price above which the stock is not worth holding.

Let $t = 0$ denote the last cum-dividend trading date and $t = 1$ denote the first day on which the stock is traded ex-dividend. There are two types of orders that are allowed: limit orders and market orders. Market makers (M) place limit orders while buyers (B) and sellers (S) place "market orders." Actually a market order is a limit order at the current best ask or bid price. We assume that there are also those who trade for a variety of other reasons which we do not fully understand and who are referred to as "noise traders" (N). Noise traders are those for whom it is not worth spending their time keeping track of ex-dividend days and hence do not evaluate whether it is worth shifting their trade by a day, as buyers and sellers do. Noise traders always place market orders.

On each trading date, nature chooses whether a noise trader initiates the last trade of the day. When noise traders initiate the last trade of the day, they are equally likely to place an order at the BID price or at the ASK price when they come to the market. We represent this with the binary random variable, I_t. If nature decides that $I_t = 1$, then the closing price will be the BID price for that day, P_{BIDt}, and the noise trader will trade at the BID. If $I_t = 0$, the closing price will correspond to the ASK price for that day, P_{ASKt}, and so the noise trader will trade at the ASK. We assume that these events occur with equal probability. Accordingly, conditional on the last trade being initiated by a noise trader, the closing price is given by

$$P_t = I_t P_{BIDt} + (1-I_t)P_{ASKt}.$$

Buyers come to the market and decide whether to place an order at the ASK on date $t = 0$ or on date $t = 1$. Sellers come to the market and decide whether to place an order at the BID on date $t = 0$ or on date $t = 1$. The closing price will be $P_t = P_{BIDt}$, the bid price if the last trader was a seller, and $P_t = P_{ASKt}$ if the last trader was a buyer. Both buyers and sellers use their discretion to decide whether to trade on date 0 or date 1. To determine which date they will choose we need to work out how prices are determined on each of these days.

Assumption about Limit Order Book Prices

We assume that the market maker who places a limit order at the ASK is indifferent between receiving the cum-dividend price P_{ASK0} at date 0 or receiving the random ex-dividend price P_{ASK1} on date 1 plus the dividend D. Let δ_{MASK} be the value of a dollar of dividend to the market maker who will be trading at the ASK.[5] Then we have the natural condition that

(1) $$P_{ASK0} = E[P_{ASK1}] + \delta_{MASK}D.$$

Let δ_{MBID} be the value of a dollar of dividend to the market maker who will be trading at the BID. Then by the same reasoning,

(2) $$P_{BID0} = E[P_{BID1}] + \delta_{MBID}D.$$

A key idea is that market makers, being regular active market participants, are better set up to handle the collection and reinvestment of the dividends. Buyers and sellers find dividends much more of a nuisance.[6] For the market maker collecting the dividend involves at least zero cost so that

$$0 < \delta_{MASK}, \delta_{MBID} \leq 1.$$

Buyer

The buyer will postpone the trade to $t = 1$ if it is cheaper to do so. Formally this is written as $P_{ASK0} - \delta_B D > E[P_{ASK1}]$, where δ_B denotes the value of a dollar of dividend for the buyer. From the perspective of the buyers this means that $\delta_B < \delta_{MASK}$. Since $P_{ASK0} = E[P_{ASK1}] + \delta_{MASK}D$, the buyer will postpone to date 1 if the market maker, M, values the dividend more than the buyer,

$$[\delta_{MASK} - \delta_B]D > 0.$$

But this is true by assumption, and so the buyer will always postpone the trade to the ex-dividend day.

Seller

To specify the seller's actions, let δ_S be the seller's valuation of a dollar. The seller will advance the trade to $t = 0$ if

$$P_{BID0} - \delta_S D > E[P_{BID1}].$$

Again we have the central assumption that $\delta_S < \delta_{MBID}$ to reflect the idea that collecting dividends has more of a nuisance value to the seller than it does for the market maker. Since $P_{BID0} = E[P_{BID1}] + \delta_{MBID}D$, the seller will advance the trade to date 0 if

$$[\delta_{MBID} - \delta_S]D > 0.$$

Again this is true by assumption, and so the seller will always advance the trade to the cum-dividend date.

A central point in our approach is that dividend checks need to be cashed and decisions need to be made regarding how best to handle those funds. If they involve a small enough sum of money, an investor might basically ignore the dividends when making his portfolio decisions and simply allow the small amount of money to be added to his bank account. However as the amount of money increases, more and more of the investors will give careful consideration to how best to redeploy that money. For a high enough dividend, most investors will be taking the dividend into account when making their decisions. In our model we get at this idea through a distinction between "noise traders," who ignore dividends, and "buyers" and "sellers," who take them into account.

To formalize this basic idea, we assume that the ratio of the number of buyers and sellers to noise traders in the population increases as the dividend increases and that it will become a constant when the dividend involved becomes sufficiently large. We further assume that the number of buyers equals the number of sellers in the population. This means that when the dividend under consideration is sufficiently large, the probability of nature picking a noise trader to be the last trader of the day will not depend on the dividend involved in the transaction. In that case, let the chance that the last trader is a noise trader be $1-\pi$. Hence when the dividend involved is sufficiently large, the probability that the last trader on day 0 is a seller is π. Similarly the probability that the last trader on day 1 is a buyer is π.

Define an indicator random variable J_t, $t = 0, 1$ that takes the value of either *0* or *1*. Nature is randomly choosing what type of trader is the last to arrive during the trading day. If $J_0 = 1$ then the seller has been chosen to trade at the close of date 0. If the seller is chosen, the trade is at the BID. Otherwise the noise trader is chosen to be last trader on date 0. If $J_1=1$, then the buyer is chosen to trade at the close of date 1. If the buyer is chosen the trade is at the ASK. Whenever the noise trader is chosen, the trade is at the BID when the indicator binary random variable $I_t = 1$ and at the ASK if $I_t = 0$.

The relation between the closing price at date 0 and date 1 and the corresponding bid and ask prices depends on two kinds of randomness. First is the issue of whether a noise trader will be the one to initiate the final trade of the day. Second is the issue of whether the noise trader is on the BID or the ASK side of the market. Bringing these together we have

$$P_0 = J_0\, P_{BID0} + (1-J_0)\, [I_0 P_{BID0} + (1-I_0)P_{ASK0}].$$

This means that

$$\text{(3)} \qquad E[P_0] = E[\frac{P_{ASK0} + P_{BID0}}{2} - \pi\left(\frac{P_{ASK0} - P_{BID0}}{2}\right)]$$

and $P_1 = J_1 P_{ASK1} + (1-J_1)[I_1 P_{BID1} + (1-I_1)P_{ASK1}]$.

This in turn means that

$$\text{(4)} \qquad E[P_1] = E[\frac{P_{ASK1} + P_{BID1}}{2} + \pi\left(\frac{P_{ASK1} - P_{BID1}}{2}\right)].$$

It is likely, but not certain, that $\delta_{MASK} = \delta_{MBID}$. We can easily allow them to differ, in which case, to simplify the expressions, we define $\delta_M = (\delta_{MASK} + \delta_{MBID})/2$. From equations (1) and (2) we then have

$$\text{(5)} \qquad \frac{P_{ASK0} + P_{BID0}}{2} = E\left(\frac{P_{ASK1} + P_{BID1}}{2}\right) + \delta_M D.$$

Substituting equation (5) into equation (4) and making use of equation (3) gives

$$E[P_0 - P_1] = -\pi\left(\frac{P_{ASK0} + E[P_{ASK1}]}{2} - \frac{P_{BID0} + E[P_{BID1}]}{2}\right) + \delta_M D.$$

From this we have

$$\text{(6)} \qquad P_0 - P_1 = -\pi\left(\frac{P_{ASK0} + E[P_{ASK1}]}{2} - \frac{P_{BID0} + E[P_{BID1}]}{2}\right) + \delta_M D + u$$

where u is an error term. It is expected that u will exhibit conditional heteroscedasticity. We assume that the proportional spread, $(P_{ASK0} - P_{BID0})/E[P_0]$, is a constant. To a first order we can assume that $(P_{ASK0} - P_{BID0})/P_0$ is a constant. Dividing both sides of the above equation by P_0 gives

(7) $$\frac{P_0 - P_1}{P_0} = -\pi\left(\frac{P_{ASK0} + E[P_{ASK1}]}{2P_0} - \frac{P_{BID0} + E[P_{BID1}]}{2P_0}\right) + \delta_M \frac{D}{P_0} + e.$$

Define $R \equiv \frac{(P_0 - P_1)}{P_0}$, $\alpha \equiv -\pi\left(\frac{P_{ASK0} + E[P_{ASK1}]}{2P_0} - \frac{P_{BID0} + E[P_{BID1}]}{2P_0}\right)$, $\beta \equiv \delta_M$, and the yield is $d =$ D/P_0. Using these definitions in (7) gives

(8) $$R = \alpha + \beta d + \varepsilon.$$

In Hong Kong the proportional spread, $(P_{ASK0} - P_{BIB0})/P_0$, is roughly a constant across stocks. However the relative number of buyers, sellers and noise traders is likely to depend on the dividend associated with a trade. This implies that α and β will vary across stocks. In light of this when we pool the observations the average values of α and β may also be affected.

As already indicated, the buyers and sellers exercise their discretion about whether to trade on the cum date or the ex-date. Noise traders do not exercise such discretion. The number of buyers and sellers relative to the number of noise traders is an increasing function of the total dollar amount of the dividend involved in a particular trade. We further assume that when the dividend per share exceeds a certain critical value, this ratio becomes a constant that does not depend on the dividend and that the numbers of buyers and sellers are equal.

When the dividend per share, or the dividend yield per share, is sufficiently high, then by assumption, α and β are the same across stocks. Hence we can estimate them by cross sectional regression. The cross sectional ordinary least squares estimates will converge almost surely to their population counterparts as the number of observations at each level of dividend yield becomes very large.

What empirical predictions are generated by the theory? Under our assumptions, the intercept α should be negative and, furthermore, $|\alpha| = \pi$(bid-ask spread). The theory also implies that β is the value of a dollar of dividend to the market makers. As such we expect that β should be close to unity.

Suppose that the theory just presented is applicable, but that there is no bid-ask spread. In that case $\alpha = 0$, and the analysis reduces to the standard model as in Elton and Gruber's (1970) approach *but* with taxes known to be zero. Given the presence of a bid-ask spread, if one simply compares the average price drop to the average dividend, then one is mixing together the value of the dividends and the size of the bid-ask.

Consider plotting the expected percentage price drop on the vertical axis and the percentage dividend yield on the horizontal axis. In a perfect Walrasian market, the relation between the expected percentage price drop and the percentage dividend yield is the 45 degree line through the origin. This will be the relation if there is a bid-ask spread as in the Hong Kong market and if there are no buyers or sellers but only noise traders. In that case $\alpha = 0$ and $\beta = 1$. The intercept term α will become more and more negative as the number of buyers and sellers relative to the number of noise traders increases -- but β will remain the same at 1. Consider then pooling observations that are drawn from these different linear relations with different α values but with the same β value of 1. If we estimate one single linear relation, the intercept will be negative and the slope will be strictly less than unity. If the variation in α across the different cases is sufficiently large and the dividend value involved with a trade is sufficiently positively correlated with the dividend yield, then the fitted single linear relation could well be substantially flatter than the 45 degree line.

We have hypothesized that α and β become constants independent of the dividend yield when the value of the dividend becomes sufficiently large. The idea is that at low dividend levels, for many investors it is not worth paying attention, while at sufficiently high dividend levels almost all investors pay attention. To implement this idea empirically, we divide stocks into two groups -- high and low dividends. Our analysis predicts that the fitted linear relation should be flatter and the intercept term should be larger for the low dividend group and the slope should be almost unity and the intercept term should be negative for the larger dividend group.

Hayashi and Jagannathan (1990) and Boyd and Jagannathan (1994) arrived at the empirical specification given in (8) based on somewhat different arguments. In their framework, too, the slope coefficient, β, is interpreted as the relative value of a dollar of dividend income when compared to a dollar of capital gains. However their framework assumes that securities are traded in a Walrasian market. They ignore the fact that there is a bid-ask spread, and so there is one price for buying and a different price for selling. In their framework, the absolute value of the intercept equals twice the one way transactions cost.

4. Empirical Results

4.1 Description of the Data

We use data on stock prices, dividends and ex-dividend dates for the period January 1980 to December 1993 from the PACAP Database[7] at the Hong Kong University of Science and

Technology. Firms listed in the Hong Kong Stock Exchange typically pay dividends twice a year. We restricted attention to cash dividend payments by firms in this sample period, for which there were no simultaneous distributions of stock to the shareholders. We also required a complete trading record from ten trading days prior until ten days after the ex-day.[8] This resulted in 1896 payments involving only cash dividends. The average share price was HK \$6.46. The average dividend value was HK \$0.12, and the average price drop on the ex-dividend day was HK \$0.06.[9]

The average dividend yield on any payment date was 2.51%, which is about twice that of the corresponding number for the U.S.A. The corresponding price drop was 1.17%. The mean value of the ratio of the price drop to dividend is 0.43. The 10th percentile is at -1.43, the 25th percentile is at -0.29, the median value is at 0.50, the 75th percentile is at 1.00, and the 90th percentile is at 1.78.

The relation between the dividend yield and the percentage price drop on the ex-date is likely to be the same across stocks only when the dividend is sufficiently large. Theory does not define "sufficiently large." We implemented the distinction by splitting the sample into two parts at the midpoint -- dividend payments that were less than HK \$0.07 and dividend payments that were greater than or equal to HK \$0.07.[10]

Table 1 gives descriptive statistics. The average dividend yields are similar between the two groups. The average dividend yield is 2.68% for the high dividend class and 2.33% for the low dividend class.[11] The average value of the dividend was HK \$0.205 per share for the larger dividend class, which is about six times as high as the HK \$0.033 per share for the smaller dividend class. This reflects the differences in share prices of HK \$1.90 and HK \$10.98 in the low and high classes, respectively. The respective average ratios of dividend to last cum day share price are very similar between the two groups at 0.017 and 0.019, respectively.

4.2 Evaluation of the Model Specification

In order to study equation (8), it is convenient to rewrite it as,

$$R_{it} = \alpha_{it} + \beta_{it} d_{it} + \varepsilon_{it} \quad (9)$$

where the subscripts i and t stand for stock i that goes ex-dividend on date t. Let α and β denote the average values of α_{it} and β_{it}, respectively, across the different stocks that go ex-dividend at different points in time. Then we can rewrite (9) as

$$\begin{aligned} R_{it} &= \alpha + \beta d_{it} + \varepsilon_{it} + (\alpha_{it} - \alpha) + (\beta_{it} - \beta) d_{it} \\ &= \alpha + \beta d_{it} + v_{it}. \end{aligned} \quad (10)$$

Notice that (α_{it} - α) is positively related to -π. We may suspect that the probability, π, of the closing trades being due to either the seller or the buyer will to some extent be positively related to the dividend yield, d_{it}, in the cross section. Hence (α_{it} - α) is likely to be negatively related to the dividend yield. To the extent that there are fixed costs involved with collecting the dividends, (β_{it} - β) will also be negatively related to the dividend yield. This means that the composite error term v_{it} in equation (10) will, if anything, be likely to be negatively related to the right side variable, d_{it}. As a result the estimated value of the slope coefficient will be biased downward and the intercept term will be biased upward. In other words, both the estimates will be biased towards zero. However the magnitudes of these biases are likely to be small for the large dividend subsample. As already indicated, we used the midpoint value of a dividend of \$0.07 to divide the data into the two subsamples.

The estimated values of the coefficients α and β in equation (10) are given in Table 2. For the full sample, the estimated intercept is -0.94 percent and the estimated slope is 0.77. These numbers can be compared to -0.96 percent (for March Dummy) and 0.94 (average slope) for high volume stocks reported in Hayashi and Jagannathan (1990).

The estimated value of the intercept for the low dividend yield class is -0.51, and it is significantly different from 0. The estimated slope is 0.46, which is significantly different from unity. This suggests that the parameters in equation (9) probably vary substantially across different stocks, and the variations are related to the dividend yield. The relation between the dividend yield and the percentage price drop for this subsample is significantly flatter than the 45 degree line.

For the high dividend subsample, the estimated value of the slope coefficient, 0.98, is not statistically significantly different from 1. This is consistent with the idea that at the margin a dollar of dividend and a dollar of capital gains are valued the same in Hong Kong.

In our estimation we took into account the fact that the Ordinary Least Squares standard will be biased. This problem is due to more than one stock going ex-dividend on the same calendar date. When that happens the residuals in equation (10) may not be uncorrelated. In view of this, we formed a portfolio of stocks that went ex-dividend on the same calendar date and estimated the parameters of equation (10) using the percentage price drop and the percentage dividend yield on these portfolios.[12]

5. Tick-Size Effects[13]

Thus far the analysis has abstracted from an important aspect of reality – prices are only allowed to adjust in discrete ticks. Boyd and Jagannathan (1994) and Bali and Hite (1996) have shown that the tick size is often large relative to the value of a dividend. In Hong Kong the tick is a piecewise linear approximation to 1% of the value of the shares. This is in contrast to the American markets, such as the NYSE, in which the tick is often independent of the share price.

Having a tick that is roughly proportional to the share price is useful. It means that we can measure shares in tick units instead of dollar units. Doing so will tend to adjust for the spurious differences in volatility levels associated with different base dollar values. When measured in tick units the shares are roughly all equal. Thus the variance of stock prices when expressed in tick units will be about the same for all shares. The tick size changed slightly on April 2, 1986. The actual values of the tick are reported on Table 3. It is worth mentioning that on July 1, 1994, (which is after our sample period ends) the tick was revised to narrow the spreads. This generated significant controversy, and the spreads were revised yet again on October 3, 1994.

Ticks raise a potential valuation problem. Suppose that the dividend is not an integer multiple of the tick size. Then when a stock goes ex-dividend it cannot adjust by exactly the amount of the dividend. The market will need to either round the price up or round down to the nearest tick. Such rounding might introduce noise into any estimations. Bali and Hite (1996) hypothesized that the market systematically rounded the dividend down to the nearest tick. If this were the case, it would be one explanation of the average observed ex-day price drop being less than the full amount of the dividend. If the market systematically rounded the dividend down and so rounded the ex-day stock price up,[14] then the average observed ex-day price drop might be less than would be otherwise expected.

To see the possible implications of ticks, consider a stock that has been trading at an average price of \$10, and suppose that the tick is \$0.10. Suppose that the current bid and ask are \$10.10 and \$9.90 and that liquidity shocks are causing noise traders to arrive evenly on both sides of the market. Then the average transaction price that is observed will be \$10. Let the distribution of the valuations held by the buyers and sellers be uniform in the region [9.90, 10.10].

First suppose that the firm pays a dividend of \$0.05. The region of buyer and seller valuations is now [9.85, 10.05] with a mean of \$9.95. To once again reestablish the equilibrium without gains from further trade being available, the bid will be \$9.80 and the ask is \$10.10. The mean of the bid-ask is \$9.95. By assumption the only trades left are initiated by the noise traders.

With evenly arriving noise traders we get equal numbers of transactions on either side of the market. If we then study a population of such stocks nothing will appear to be anomalous. The average price drop will equal the average dividend value. Even though trades are confined to be in prices that are restricted to move in integer ticks, the change in intrinsic value can be measured using observations on a large cross section of stocks. The average price drop will equal the dividend amount that may be a fraction of a tick.

Next suppose that the firm pays a dividend of \$0.01. The region of buyer and seller valuations is now [9.89, 10.09] with a mean of \$9.99. Again the bid will be \$9.80 and the ask will be \$10.10. Due to the \$0.10 tick, no market maker can gain by offering a higher bid or a lower ask. Since any new trades are initiated by noise traders, the average ex-dividend price will be \$9.95. Thus the average price drop is \$0.05 when the dividend is \$0.01.

Finally suppose that the firm pays a dividend of \$0.09. In this case the region of buyer and seller valuations becomes [9.81, 10.01] with a mean of \$9.91. However the bid is once again at \$9.80 and the ask is once again at \$10.10. Once again, due to the \$0.10 tick size, no market maker can gain by offering a higher bid or a lower ask. Once again the buyer and seller valuations on the ex-day are inside the spread and so the observed trades are driven by noise traders. Since the noise traders are equally likely to be on either side of the market, the average ex-dividend price is once again \$9.95. In this case the average price drop is \$0.05 when the dividend is \$0.09.

The conclusion is that to the extent that the noise traders dominate, the bid price responds to the fractional component by dropping by a tick. The ask price remains unchanged. The average observed price drop is an average of the bid and of the ask. Hence the average price drop for the fractional part will be half a tick, independent of the size of that fractional component.

So far we have supposed that the valuations of the buyers and sellers is such that, given the tick size, they do not wish to trade. This simplifies things because all trading is then driven by the noise traders. Suppose instead that the buyer and seller valuations are broader. In this case pricing will be a weighted average, rather than a simple mean of the bid and ask. To determine the weights would require a deeper theory of buyer and seller activity than we have to offer. However we can still derive some implications.

Suppose once again that the dividend is \$0.05. Consider an investor who has decided to sell. This seller would receive \$9.90 if he sold on the last cum day. If he waits and sells on the ex-day, he will get \$9.80 plus a dividend of \$0.05 for a total of \$9.85. Such an investor is strictly better off selling cum dividend, much as shown above in Section (3).

Next consider an investor who has decided to buy. If he buys cum dividend, he pays \$10.10 and receives a dividend of \$0.05 for a total cost of \$10.05. If he buys ex-dividend, he still must pay \$10.10, but this time he does not get the dividend. This means that the buyer will have an incentive not to postpone. This stands in sharp contrast to the case of continuous pricing. Here we have that both buyers and sellers may wish to avoid trading on the ex-day.

What are the empirical implications of this? First of all, consider equation (10). The intercept will be smaller in absolute value when the dividends are not divisible by the tick unit than when they are integer multiples of the tick. Secondly there ought to be a stronger drop in trading volume when the share was trading newly ex-dividend than when it was still trading cum dividend.

To investigate the potential importance of a tick size effect we proceeded as follows. We divided the share price by the tick size. This means that we express all prices in ticks rather than dollars. We similarly divided the dividends by ticks. However unlike the share prices, dividends are not always integer multiples of the tick. Therefore we separate the securities into the integer cases and the non-integer cases.[15] Let J be the ex-day share price drop in tick units, I is the integer part of the dividend measured in tick units, and F is the fractional part of the dividend measured in tick units. Let the dummy variable, Dum take the value 1 when the dividend is not an integer multiple of the tick and 0 when it is an integer multiple of the tick. Consider the following linear regression relation:

(11) $J_{it} = \alpha_I + \alpha_F \, Dum_{it} + \beta_I \, I_{it} + \beta_F \, F_{it} + \varepsilon_{it}$.

There are four ideas to be considered concerning the implications of ticks. The first hypothesis to be considered is that the tick size does not matter. In that case the theory developed in section (3) still applies. Then the prediction is that $\alpha_I < 0$, $\alpha_F = 0$, and $\beta_I = \beta_F = 1$.

Second, is the suggestion that the market systematically rounds the dividend down to the nearest tick, and so the ex-day price is rounded up. If that effect is present in the Hong Kong market, the prediction is that $\alpha_I = 0$, $\alpha_I + \alpha_F = 0$, $\beta_I = 1$, and $\beta_F = 0$. The reason is that the fractional component is not valued directly at its magnitude, but instead it is rounded to zero. Since that rounding is independent of the numerical magnitude of the fractional component, its effect should be captured by the intercept term.

The third idea is that the tick affects the bid and ask in the manner described in the example we presented above, but that it does not alter the decisions of buyers and sellers concerning what dates on which to trade. On the ex-dividend date, the ask price will drop by the integer amount of the dividend, but the bid price will drop by the integer amount plus one tick whenever the dividend has a fractional part (measured in tick units). Then as in section (3), $\alpha_I = \pi$(Bid-Ask spread) and, furthermore, $\alpha_I + \alpha_F = \pi$(Bid-Ask spread) $+(1-\pi)/2$. Thus in this case we predict that $\alpha_F > 0$, $\alpha_I + \alpha_F < 0.5$, $\beta_I = 1$, and $\beta_F = 0$.

The final idea is that in addition to the pricing effects just described, the effects are sufficiently strong that they also alter decisions of Buyers and Sellers concerning which days to trade. If the effects are sufficiently large then Buyers and Sellers always trade on day 0 when dividends have a fractional component (measured in tick units). In this case the prediction is that $\alpha_I < 0$, $\alpha_I + \alpha_F = 0.5$, $\beta_I = 1$, and $\beta_F = 0$.

From these candidate hypotheses, we see that as argued by Bali and Hite (1996), the tick size has potentially important implications for ex-day studies. The nature of these implications depends on how strong an effect they have on investors.

In our empirical work, there are two issues that need to be considered. As in section 4 one might be concerned about securities that go ex-dividend on the same day. Accordingly we worked with portfolios of stocks that go ex-dividend on a given calendar day and hence estimate the following relation:

(12) $J_t = \alpha_I + \alpha_F\, Dum_t + \beta_I\, I_t + \beta_F\, F_t + \varepsilon_t$,

where J_t is the drop in price of the portfolio of stocks that go ex-dividend on calendar date t. Dum_t, I_t and F_t are defined in a similar way. In Table 4 these results are labeled "portfolio." However one might also be concerned that the formation of daily portfolios will tend to bias F_t towards 0.5. To address that potential we also report results in Table 4 for "individual" ex-dividend dates. As can be seen in Table 4 the inferences to be drawn are not sensitive to the approach taken in this respect.

It is worth noting that the data can be naturally partitioned into high and low dividends and into integer and fractional dividend values. When the data are partitioned this way for high integer dividends, there are 495 observations: high fractional dividends have 444 observations, low integer dividends have 665 observations and low fractional dividends have 273 observations. Recall that we define high and low to split the sample in half. Thus we find that in the lower half of the sample dividends are more likely to be integer valued than in the higher half of the sample. In the upper part of the sample integer and fractional values are roughly equally likely. For the integer valued dividends the mean dividend was HK \$0.0938, while the associated price drop was HK \$0.0551. For the non-integer valued dividends the mean dividend was HK \$0.1898, while the associated price drop was HK \$0.1085.[16]

The results are given in Panels A and B of Table 4. First notice that the estimated values of parameters of equation (10) given in Panel A are similar to those given in Table 2. The slope for the high dividend class is not different from unity after taking sampling error into account, whereas the slope is significantly smaller than unity for the low dividend class. The slope is closer to unity for the integer dividend case, whereas it is less than unity for the fractional dividend case. This suggests that the fractional dividend case may be behaving differently than the integer dividend case. The absolute value of the intercept term both for the high dividend class and for the days with only integer valued dividends is very high at about 3. This means that in contrast to normal trading days, in this case the bid-ask spread must be unusually large.

The estimated values of α_I are negative in all cases considered. This is consistent with the theory we have presented above. Furthermore $\alpha_I + \alpha_F$ is also uniformly negative for all the cases considered. However, we cannot reject the hypothesis that $\alpha_F = 0$ and $\beta_F = 0$ after taking sampling errors into account. The data does reject the hypothesis that $\alpha_I + \alpha_F = 0.5$.

What summary conclusions can be drawn? The hypothesis that ticks do not matter cannot be clearly rejected. However there is some evidence that is consistent with the importance of tick size. Thus it is possible that the constraint on prices to be in discrete ticks may in part explain the less than one for one drop in stock prices on ex-dividend days.

For modeling convenience we assumed that buyers and sellers can trade on the ex-day or on the cum-day. In practice the cum-day really consists of the days immediately preceding the last cum dividend day. Similarly the ex-day consists of the days immediately following the ex-dividend date. Our theoretical analysis predicts that trades are more likely to be at the bid on the last cum-dividend day and for a "few" days immediately preceding. Trades are more likely to be at the ask on the ex-dividend day and for a "few" days immediately following. Our theory has nothing to say about how many days are a "few." Hence it is worth mentioning that the effects that we have documented do not only happen over a one day window around the ex-day.

When we look at longer windows on either side of the ex-date noise becomes a more significant factor. However the intercept remains negative, and we still cannot reject the hypothesis of a unit coefficient on the dividend. This is true whether we measure the prices and dividends in tick units or in dollar units. We tried a wide range of different event windows of up to ten days before and after the ex-day. We also tried a variety of slightly different specifications. Consistent results were found. To illustrate we now report results for the case in which the left hand side variable is the price change between five days prior to the ex-date and five days after, measured in tick units. Let α be the coefficient on the intercept, and let β be the coefficient on the dividend value measured in tick units. Split the sample and run separate regressions for the case in which the dividend is integer valued and the case in which it is not integer valued. Then the R^2 falls, but otherwise similar results are obtained.

Dividend is Integer Valued

Parameter	Estimate	Std. Error	R^2	n
α	-4.152	1.608	3.2%	1122
β	0.887	0.146		

Dividend is not Integer Valued

Parameter	Estimate	Std. Error	R^2	n
α	-4.053	1.105	3.3%	702
β	0.908	0.185		

5.1 Behavior of Trading Volume

The bid-ask spread during an average trading day is about one tick unit, and thus it is not surprising that the tick unit is often referred to as the "spread" in Hong Kong. If our modeling of the trading behavior of investors around ex-dividend days is right, then the relatively large absolute value of the intercept term in Table 4 suggests that the bid-ask spread widens around ex-dividend days and the market is relatively thin around ex-dividend days. This is quite unlike American markets in which trading volume in stocks rises around ex-dividend days. Furthermore if the discrete tick problem affects trading, we predicted that trading volume ought to drop off more when the stock is trading newly ex-dividend relative to the last few days when it is still trading cum dividend.

To examine if these interpretations are right, we examine the trading volume measured in number of shares around these days using the event method as in Lakonishok and Vermaelen (1986). We also tried using the calendar time method and measuring the volume both in dollar terms and in the number of shares traded. The results are very insensitive to these alternatives, and hence we do not report them.

To measure abnormal volume one first needs a measure of the normal volume. To do this we estimated the average daily volume using a 40 day period beginning 64 days before the ex-date and ending 25 days before the ex-date, exactly as in Lakonishok and Vermaelen (1986).

Table 5 gives the results for the event time method, measured in numbers of shares. As in the pricing analysis, we tried analyzing both individual security results, as well as results for portfolios of stocks that go ex-dividend on the same date. The reported results are for portfolios, but the interpretations are not sensitive to this choice. The abnormal trading volume is generally negative during the 10 day window surrounding the ex-dividend days. For the high dividend yield subsample, trading volume decreases substantially and the reduction in trading volume is significantly different from zero even after taking sampling errors into account. As predicted, the drop in trading volume is much stronger when the share is trading newly ex-dividend. This again implies that, as suggested by Bali and Hite (1996), the tick size does have implications for investor behavior.

While this is consistent with our predictions based on the results in the earlier section, it is the opposite of the American pattern documented in Lakonishok and Vermaelen (1986). In the American markets trading volume increases sharply around ex-dividend days.[17]

6. Stock Dividends

The analysis presented in section 3 implies that when taxes are not an issue, the relationship between the expected price drop and the value of the dividend is a 45 degree line with a negative slope. The absolute value of the intercept term is the average of the bid-ask spread on the cum-dividend and the ex-dividend days multiplied by the ratio of buyers and sellers to noise traders. It was argued that this ratio will depend on the value of the dividend. The linear relation between the price drop and the dividend value is estimated using a number of different stocks, and so the estimate is a mix of distinct straight lines. Although each of the straight lines has the same slope of one, they have different intercept values. This in turn implies that the estimated relation will be flatter, with both the slope and the intercept biased towards zero. It was then argued that above a certain point the ratio of noise traders stabilizes. Accordingly for a sufficiently high dividend the relation between the expected price drop and the dividend is a 45 degree line with the same negative intercept for all stocks.

The argument that buyers and sellers would wish to avoid the dividend seems even stronger for stock dividends than for cash dividends. The stock received will create odd lots in the recipient's portfolio. Odd lots are annoying since they cannot normally be sold for as high a price as can a round lot. In Hong Kong the definition of a round lot is security specific, and even for a given security it changes occasionally if a substantial change in the share price takes place.[18]

Following this line of reasoning we repeated the above tests for the full sample of cases in which stock dividends were issued but no other distributions were made by the firm on the same date. Not surprisingly this turns out to be a rather small sample. For the period 1980-93 there were 545 stock dividends in Hong Kong. However almost all stock dividends occurred at the same time as a cash dividend. Removing such simultaneous distributions and deleting cases of missing data, we are left with only 34 such distributions. Accordingly the results in this section need to be interpreted with caution.

In table 6 it can been seen that the stock price, at the time of a stock dividend, is slightly more than double the stock price of a firm that pays a cash dividend. This seems fairly natural given previous results in other markets. Given the smallness of the sample size it is hard to say much about the daily or monthly patterns of such distributions. They seem to be fairly similar to the timing patterns for cash dividends.

As is the case for cash dividends the estimating equation is a simple linear regression. We expect the intercept term to be more negative when compared to the cash dividend case and the slope to equal unity for the reasons already discussed above. The results are given below.

Stock Dividends

Parameter	Estimate	Std. Error	R^2	n
α	-2.954	0.936	0.97	34
β	1.008	0.031		

The results turn out to provide surprisingly strong confirmation for the theory. However we again caution that this reflects a very small sample, since most stock distributions occurred at the same time as a cash dividend and so could not be included.[19]

7. Conclusions

Ex-day share price adjustment in the United States and elsewhere has been commonly interpreted as reflecting taxes. Yet pricing effects are found in the Hong Kong Stock Market similar to those observed in the United States. In the Hong Kong market we know that there are no relevant taxes faced by the marginal trader. Thus the incomplete share price adjustment cannot be due to taxes at least in this case.

We have shown that the ex-day price drop can be accounted for by recognizing that most trades tend to occur at the bid on the last cum-dividend date and at the ask on the ex-dividend day. This results in stock prices rising on average on ex-dividend days quite independent of the amount of the dividend.[20] It appears that market makers step in to take the order imbalance. When this microstructure effect is taken into account, dividends and capital gains are valued the same at the margin. This is true both for cash dividends and for stock dividends.

Even in a simple environment like Hong Kong, where neither dividend income nor capital gains are taxed, we have shown how difficult it can be to interpret the observed relation between the amount of the dividend and the average ex-dividend day price drop. The difficulty arises from (a) the tendency of investors as a group to place relatively more buy orders after the stock goes ex-dividend and place relatively more sell orders when the stock is trading cum-dividend, around ex-dividend days, and (b) the fact that neither the probability with which these actions take place nor the bid-ask spreads are observed in the available data.

We think that these results have significance beyond the example of the Hong Kong market. Taking these effects into account may help resolve some of the empirical puzzles documented in the literature. For example, in some further work we found that our theoretical perspective can help to account for the well known case of Citizens Utilities. As a further example, Kato and Lowenstein (1995) find that stock prices rise on average on the ex-dividend day as well as on the first day of the fiscal year in Japan. Our results suggest that this ex-day and fiscal year "abnormal" return in Japan may also be due to similar microstructure effects.[21]

Our findings also have potentially important implications for the interpretation of some event studies. In most of these studies it is implicitly assumed that the trading pattern does not change around event days. Trades are assumed to be equally likely to occur at the bid or at the ask, and hence the bid-ask spread can be ignored. Such an assumption may not be innocuous.

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Table 1. Descriptive Statistics

P_0 denotes the last cum dividend trading day, P_1 denotes the ex-dividend day, and D denotes the dollar amount of the dividend per share. When there are other payments in addition to cash dividends associated with the stock on the same ex-dividend date, such observations are omitted. Data are for stocks traded in the Hong Kong Stock Exchange during the period January 1980 to December 1993, from the Pacific Basin Capital Markets Research Center.

A. Entire Sample, Observations = 1896				
Variable	Mean	Std. Dev.	Minimum	Maximum
D	0.119	0.146	0.00045	1.6
P_0	6.459	10.023	0.029	134
$P_0 - P_1$	0.065	0.279	-2	4.75
$(P_0 - P_1)/D \times 100\%$	43.243	305.610	-1200	7916.67
$(P_0 - P_1)/P_0 \times 100\%$	1.174	3.610	-21.21	48.99
$D/P_0 \times 100\%$	2.508	1.600	0.1266	17.8571

B. Dividend Value < $0.07, Observations = 944				
Variable	Mean	Std. Dev.	Minimum	Maximum
D	.033	.017	.00045	.1786
P_0	1.899	1.759	.029	20.4
$P_0 - P_1$	.017	.187	-.600	4.75
$(P_0 - P_1)/D \times 100\%$	40.363	4.052	-1200.00	7916.67
$(P_0 - P_1)/P_0 \times 100\%$	.759	4.000	-13.580	48.986
$D/P_0 \times 100\%$	2.334	1.422	.127	10.34

C. Dividend Value >= 0.07, Observations = 952				
Variable	Mean	Std. Dev.	Minimum	Maximum
D	.205	.166	.07	1.6
P_0	10.981	12.489	.94	134
$P_0 - P_1$	.113	.341	-2	3
$(P_0 - P_1)/D \times 100\%$	46.100	152.526	-875.000	1571.428
$(P_0 - P_1)/P_0 \times 100\%$	1.585	3.124	-21.212	20.536
$D/P_0 \times 100\%$	2.68	1.739	.32	.179

Table 2. Regression Results for Percentage Price Drops and Percentage Dividend Yields

The following equation was estimated using data for stocks traded in the Hong Kong Stock Exchange during the period January 1980 to December 1993, from the Pacific Basin Capital Markets Research Center.

$$R_{it} = \alpha + \beta d_t + e_{it},$$

where R_t is the percentage price drop from the last cum-dividend day to the ex-dividend day and d_t is the percentage dividend yield on the portfolio of stocks that go ex-dividend on calendar day t. When there are other payments in addition to cash dividends associated with a stock for ex day t, then they are included in the portfolio. There may be no stocks going ex-dividend on some calendar days.

	full sample	dividend < \$0.07	dividend >= \$0.07
α	-0.94	-0.51	-1.17
(S.E.)	(0.17)	(0.25)	(0.18)
β	0.77	0.46	0.98
(S.E.)	(0.06)	(0.09)	(0.06)
Adj-R^2(%)	13	3	30
observations	1141	687	690

Table 3.
Historical Tick Sizes in Hong Kong

share price ($ HK)	Tick before 2 April 1986	Tick as of 2 April 1986
from 0 to 0.25	.001	.001
from 0.25 to 0.50	.005	.005
from 0.50 to 1.00	.010	.005
from 1.00 to 2.00	.010	.010
from 2.00 to 5.00	.025	.010
from 5.00 to 10.00	.050	.010
from 10.00 to 30.00	.100	.100
from 30.00 to 50.00	.250	.100
from 50.00 to 100.00	.500	.500
from 100.00 to 200.00	1.000	1.000
from 200.00 to 500.00	2.000	2.000
from 500.00 to 1000.00	2.500	2.500
above 1000.00	5.000	5.000

Source: Jeffrey Sun, Circular 6/86, "New Spread Rules," Research, Planning and Development, The Stock Exchange of Hong Kong.

Table 4. Regression Results in Tick Units

Data are for stocks traded in the Hong Kong Stock Exchange during the period January 1980 to December 1993. When there are other payments in addition to cash dividends associated with the stock on the same ex-dividend date, such observations are omitted. Type of the regression is either "individual" or "portfolio." In the case of "individual," each observation is for an individual ex-dividend date. In the case of "portfolio" the regression was run using averages for all stocks that go ex-dividend on the same calendar date. Prices and dividends are measured in tick units. J_t denotes the price drop for stocks that go ex-dividend on date t, and D_t denotes the cash dividends for those stocks. I_t is the integer part of D_t, and F_t denotes the fractional part of D_t. Dum_t denotes the dummy variable that takes the value of 1 whenever F_t is not zero and takes the value of 0 otherwise.

Panel A.

$J_t = \alpha + \beta D_t + \varepsilon_t$

	full sample	dividend < \$0.07	dividend ≥ \$0.07	Days with only Integer Dividends	Other days
α	-2.60	-0.99	-3.35	-3.47	-1.64
(S.E.)	(0.37)	(0.74)	(0.50)	(0.66)	(0.33)
β	0.93	0.57	0.99	0.98	0.85
(S.E.)	(0.04)	(0.18)	(0.04)	(0.06)	(0.05)
Adj-R^2 (%)	31	1	46	30	34
observations	1096	652	662	573	523
type	portfolio	portfolio	portfolio	portfolio	portfolio

Panel B.

$J_t = \alpha_I + \alpha_F Dum_t + \beta_I I_t + \beta_F F_t + \varepsilon_t$

	full sample	dividend < \$0.07	dividend ≥ \$0.07	full sample	dividend < \$0.07	dividend ≥ \$0.07
α_I	-3.36	-1.79	-4.71	-2.39	-1.99	-2.63
(S.E.)	(0.76)	(1.48)	(0.92)	(1.02)	(2.03)	(1.20)
α_F	0.24	0.79	-0.35	-0.66	0.81	-2.25
(S.E.)	(0.75)	(1.37)	(0.90)	(1.06)	(2.04)	(1.31)
β_I	0.95	0.57	1.05	0.98	0.67	1.06
(S.E.)	(0.04)	(0.18)	(0.04)	(0.03)	(0.17)	(0.04)
β_F	3.53	2.37	5.18	1.54	2.14	1.55
(S.E.)	(1.54)	(2.79)	(1.71)	(1.86)	(3.70)	(2.17)
Adj-R^2(%)	31	1	47	32	2	45
observations	1096	652	662	1780	880	900
type	portfolio	portfolio	portfolio	individual	individual	individual

Table 5.
Abnormal trading volume ten days around the ex-dividend date

Data are for stocks traded in the Hong Kong Stock Exchange during the period January 1980 to December 1993, from the Pacific Basin Capital Markets Research Center. When there are other payments in addition to cash dividends associated with the stock on the same ex-dividend date, such observations are omitted. Normal trading volume is the average of trading volume during the 40 day period beginning 64 days prior to the ex-dividend date. Abnormal trading volume for a stock is the difference between the trading volume on a particular day and the normal trading volume for that stock for that day. Portfolios are formed which average all stocks that go ex-dividend on the same calendar date. The t-statistic for the hypothesis that the average abnormal trading volume for a particular day (t) is zero is computed using the event time method as in Lakonishok and Vermaelen (1986). Day 1 is the ex-dividend day.

Stocks with pure cash dividends (Number of observations = 1368)

Day	-5	-4	-3	-2	-1	0	1	2	3	4	5
Number of shares traded (thousands)	232.5	-157.9	-158.4	-97.6	78	-84.5	-143.0	-38.1	-311.9	-281.1	-202.1
t-value	0.62	-2.14	-1.94	-1.14	0.59	-1.03	-0.98	-0.12	-3.33	-3.43	-1.76

Stocks with pure cash dividends, dividend < HK $0.07 (Number of Observations = 684)

Day	-5	-4	-3	-2	-1	0	1	2	3	4	5
Number of shares traded (thousands)	522.6	-293.8	-244.3	-201.7	-13.2	-169.7	-116.9	113.3	-492.5	-430.0	-273.3
t-value	0.70	-2.13	-1.57	-1.31	-0.06	-1.09	-0.41	0.19	-2.78	-2.76	-1.21

Stocks with pure cash dividends, dividend > HK $0.07 (Number of Observations = 684)

Day	-5	-4	-3	-2	-1	0	1	2	3	4	5
Number of shares traded (thousands)	-57.6	-22.2	-72.5	6.6	169.2	0.80	-169.0	-189.5	-131.3	-132.3	-131.0
t-value	-1.14	-0.43	-1.46	0.09	1.02	0.02	-3.32	-3.47	-2.17	-2.65	-2.85

Table 6.
Descriptive Statistics for Pure Stock Dividends

Data is for stocks traded in the Hong Kong Stock Exchange during the period January 1980 to December 1993, from the Pacific Basin Capital Markets Research Center. When there are other payments in addition to stock dividends associated with the stock on the same ex-dividend date, such observations are omitted.

Summary Statistics, Sample Size = 34				
Variable	Mean	Std. Dev.	Minimum	Maximum
Y in %	62.14	159.74	3.33	900.00
P_0	14.91	22.9	0.156	101
$P_0 - P_1$	4.18	9.77	-0.3	46.3
Y/(1+Y) in %	22.26	20.87	3.23	90
$(P_0-(1+y)P_1)/P_0$ in %	-4.02	6.08	3.75	-28.93
$(P_0 - P_1)/P_0$ in %	19.48	21.35	-1.46	89.9

Notes

[1] See Koski (1990) for a documentation of the price effects of dividend capture trading by Japanese insurance companies in the U.S.A.

[2] See Michaely and Vila (1995) for an example showing that even when there are no transactions costs, because of investor heterogeneity, the price-drop on ex-days need not be equal to the dividend amount.

[3] See Securities Ordinance, Hong Kong, Vol. 21, Cap. 333, Part VIII, Trading in Securities, 80. Short selling Prohibited.

[4] The Hong Kong Securities Clearing Company launched its Central Clearing And Settlement System (CCASS) in October 1992. Most stocks in the Hang Seng Index have been admitted for clearing and settlement on a continuous net settlement basis by October 28, 1992. Such a conversion program was completed on June 2, 1993, and a total of 575 securities have been admitted for clearing and settlement under CCASS. Under the CCASS, participants will be able to continue to settle transactions according to their CCASS stock accounts' holdings by book-entry while the physical shares certificates have been submitted to the registrars for registration. Hence stocks can be sold at any time and should increase liquidity around ex-dividend days.

[5]The implicit assumption is that there is no information conveyed by the fact that there was no trade on day 0.

[6] We thank R. Masulis for pointing out that it can also be thought of as a situation in which the market makers are relatively more patient than the buyers and sellers. Accordingly the market makers would discount dividends at a lower rate than would the buyers and the sellers.

[7] This database is supplied by the Pacific Basin Capital Markets Research Center, College of Business Administration, The University of Rhode Island.

[8] We also tried running the tests leaving in shares that had incomplete trading records. This makes for a larger sample size, but has no effect on the interpretations of the results. There was one observation with a dividend ten times as large as any other observed dividend. Our results are not sensitive to whether it is included. In the reported results it has been deleted.

[9] There was little change in the average dividend size over the time period studied. During the first half of the sample the average dividend was just below HK $0.13, and in the second half of the sample it was just above HK $0.11.

[10] We also tried dividing the data into dividend yields above and below 2.5%. The results are the same. To save space we only report results for the split into dividends above and below $0.07.

[11] Of course when we sort by dividend yields rather than by dividend levels we get a large difference between the average dividend yield in the two classes.

[12] To check whether the results were sensitive to the presence of outliers, we tried deleting extreme observations and rerunning the results. In all cases we found a negative intercept and a slope coefficient that could not be distinguished from 1. A more formal approach to the problem is purely statistical. To do this we ran "robust" regressions. See StataCorp (1995). This is a method which uses statistical criteria to downgrade the influence of outlier observations. Doing this for the full data set, we get that α is -1.148 (S.E. is .101) and that β is 0.972 (S.E. is .034). Thus there are also purely statistical grounds for suspecting that there are anomalous observations for small dividend cases that lead one to misinterpret what is really happening.

[13] We thank Cliff Smith and an anonymous referee for drawing our attention to the potential importance of tick-size effects and the original work of Bali and Hite (1996).

[14] There is a potential terminological confusion. In this paper we talk in terms of the price of the stock, and so when we say "rounded up" we mean that the stock price is higher than it would otherwise have been. Another convention would be to describe what happens to the dividend. In that case if the market is "rounding down" the value of the dividend, that is the same thing as saying that the market rounds up the ex-day stock price.

[15] There is a problem as to how best to treat cases in which a firm changed its tick size between the last cum day and the first ex-day. For simplicity we excluded such observations from the regressions. Such events are rare enough that the results are not sensitive to leaving them in.

[16] Measured in tick units the average dividend is 6.38 ticks, the average last cum-dividend day stock price is 264.56 ticks, and the average first ex-dividend day stock price is 260.86 ticks. For the integer valued dividend stocks the corresponding numbers are 7.68, 297.83, and 293.26. For the non-integer valued dividend stocks the corresponding numbers are 4.24, 210.22, and 207.95.

[17] A substantial part of the increased trading volume around ex-dividend days in the American markets is due to dividend capture trading. Such trades are more likely to be executed during the day. To the extent that closing prices are determined by individual investors and not institutional traders, our model is applicable to American markets as well.

[18] Some examples: the Board Lot for Uniworld Holdings is 80,000 shares, and as of April 1996 the share price was HK $0.027. For the Union Bank of Hong Kong a Board Lot is 1000 shares, and the share price was HK $7.97. For Tsingtao Brewery H shares the Board Lot was 2000 shares, and the price of a share was HK $2.15.

[19] Compare this to Kryzanowski and Zhang (1996), who write, "trade direction changes significantly from sell to buy after split ex-dates for all but large trades, where the change is in the opposite direction."

[20] Grinblatt, Masulis and Titman (1984) made a similar observation regarding trading around ex-days for stock dividends. Conroy, Harris and Benet (1990) found empirical evidence that supported the Grinblatt, Masulis and Titman (1984) conjecture.

[21] In contrast to Hong Kong, in U.S. markets institutional investors play a major role. Institutional traders are more likely to behave like noise traders in our model. They are taxed the same on dividends as on capital gains. They are likely to actively trade at the close of the day in stocks that are part of major stock indices, since these stock indices are used to measure their performance. Active trading in stock index baskets at the close of the day is also likely for indices on which futures contracts are traded. Hence closing prices of stocks that are in major stock indices are more likely to fluctuate between the bid and ask with equal probability. Our theory implies that the intercept term in the linear relation between price drop and dividend will be closer to zero for stocks that are in major stock indices.