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Reduction of Constraints on Arbitrage Trading and Market Efficiency: An Examination of Ex-Day Returns in Hong Kong after Introduction of Electronic Settlement

PALANI-RAJAN KADAPAKKAM*

ABSTRACT

Previous research documents positive ex-dividend day returns in excess of one percent in the unique institutional setting of Hong Kong, where neither dividends nor capital gains are taxed. Short-term arbitrage trades around the ex-day were hampered by physical settlement procedures. After the recent switch to an electronic settlement system, which enables such trades, ex-day abnormal returns have declined to an insignificant 0.17 percent. This drop is more pronounced for high-yield stocks, which are more likely to attract dividend capture trading. The evidence points to the crucial role of short-term traders in ensuring the pricing efficiency of financial markets.

THE ROLE OF SHORT-TERM TRADERS IN FINANCIAL MARKETS is a matter of considerable controversy. The debate on this issue has heightened in the wake of the recent Asian currency crisis, which some governments blamed on the activities of short-term traders. Critics contend that short-term traders engage in speculation, leading to excessive and debilitating volatility in market prices. Others argue that short-term traders perform a useful role by increasing valuable liquidity. Berkman and Eleswarapu (1998) report that regulatory changes on the Bombay Stock Exchange curbing short-term trading had a measurably adverse impact on asset values.

Supporters of short-term traders also argue that these traders make a key contribution to the efficiency of financial markets by constantly scouring the markets for arbitrage opportunities. This study examines the impact of the introduction of electronic settlement on ex-dividend day returns in Hong Kong. The electronic settlement system lowered costs for arbitrageurs by reducing their minimum holding period for trades around ex-dividend days. The evidence supports the argument that relaxation of constraints on short-term trading improves the pricing efficiency of financial markets.

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The Hong Kong market is a particularly appealing setting for the examination of ex-dividend return behavior, because both dividends and capital gains are not taxed. Thus, ex-dividend returns can be studied in the absence of confounding tax effects present in other markets. Frank and Jagannathan (1998) examine ex-dividend day stock prices in Hong Kong during the period from 1980 to 1993. They report that the price drop on the ex-day is, on average, only 43 percent of the dividend, leading to an ex-day return of 1.33 percent. This return is much larger compared to the 0.17 percent ex-day return reported by Bali and Hite (1998) in the United States.

Such a large return should have been exploited and eliminated by short-term traders. However, Frank and Jagannathan (1998) report that for much of their sample period, short-term trading around the ex-day was not feasible in Hong Kong, due to settlement procedures. Prior to the switch to electronic settlement initiated in 1992, a sale required physical delivery of the share certificates within a day. To obtain dividends, shareholders need to be registered with the firm, a process which could lock up share certificates for 21 days. Investors could not sell their shares during the registration period, as they could not fulfill the requirement of physical delivery. Hence, quick turnaround trades to arbitrage the positive ex-day returns were not possible.

The Stock Exchange of Hong Kong switched to an electronic clearing and settlement system (the Central Clearing and Settlement System (CCASS)) during a phased transition in 1992 and 1993. Under the new system, settlement is done by electronic book entries, obviating the need for physical delivery of shares. Thus, the switch to an electronic settlement system enabled short-term arbitrage trades around ex-days for the first time. The relaxation of constraints on short-term trading in a tax-free setting provides a unique opportunity to study the role of arbitrage activity in eliminating profits.

Test results reveal that the introduction of electronic settlement has significantly altered ex-day stock price behavior in Hong Kong. During the 1990 to 1995 period examined in this study, ex-day returns drop to an insignificant 0.17 percent after the switch to electronic settlement, compared to a highly significant 1.13 percent before the switch. For high-dividend-yield stocks, which are most likely to attract potential arbitrageurs, the drop in returns is more pronounced. The drop in ex-day returns occurs soon after the switch to electronic settlement, rather than as a gradual decline over time. Under electronic settlement, trading activity is enhanced prior to the ex-day, but is normal after the ex-day. This evidence suggests that the mere potential for arbitrage trades under electronic settlement was sufficient to reduce ex-day returns.

The rest of the paper is organized as follows. Section I provides a brief review of relevant aspects of the Hong Kong market. Section II describes the data and methodology. Section III presents the results of the paper, and Section IV contains the conclusions.

I. Background of Ex-day Returns in Hong Kong

The zero taxation of dividends and capital gains in Hong Kong provides an ideal opportunity to examine ex-dividend returns without any ambiguity regarding effective marginal tax rates on dividends and capital gains.¹ Zero abnormal returns in Hong Kong will be consistent with the conclusion that in the absence of tax effects, stock prices drop by the full amount of the dividend. Thus, understanding the behavior of ex-day returns in a tax-free environment is beneficial in studying ex-day returns in other settings.

Another major advantage of studying Hong Kong ex-day returns is that the confounding effect of stock price discreteness on ex-day returns is smaller compared to U.S. markets. The coarseness in U.S. price data hinders the evaluation of the magnitude of ex-dividend day price drop relative to the typically small quarterly dividends. Bali and Hite (1998) argue that stock price discreteness can induce positive ex-day returns. Price discreteness is less of a problem in Hong Kong, because the minimum permissible price changes are adjusted in relation to the level of the stock price. Furthermore, dividends are often declared semi-annually rather than quarterly. Both these factors increase the size of the dividends relative to the minimum tick size for the stock compared to U.S. markets.²

Frank and Jagannathan (1998) report that the ex-day price drop in Hong Kong is only 43 percent of the dividend, on average. In the absence of tax induced effects, they propose an explanation based on the costs associated with reinvesting the dividend amount. To avoid these costs, sellers seek to trade cum-dividend, whereas buyers prefer to wait till the ex-day. Such preferences will generate selling pressure immediately before the ex-day and buying pressure on the ex-day, leading to positive ex-day returns. This argument implies that investors are willing to forego 57 percent (100 percent less the 43 percent price drop) of the dividend amount to avoid reinvestment costs. Such a high shadow cost for reinvestment costs is surprising. Reinvestment costs should not be a major concern for active traders and institutional investors, who are constantly reinvesting funds. Similarly, cum-dividend sellers have to deal with reinvesting sale proceeds anyway. Further, the reinvestment cost argument should apply to other countries as well, but the observed price-drop-to-dividend ratio is much higher in the United States.

¹ Interpretation of ex-dividend returns in the United States is clouded by controversies regarding the impact of taxes (see Elton and Gruber (1970), Kalay (1982), Miller and Scholes (1982), Eades, Hess, and Kim (1984, 1994), and Boyd and Jagannathan (1994)). Recent studies analyze ex-dividend returns in other tax settings such as Britain (Lasfer (1995, 1996)), Italy (Michaely and Murgia (1995)), and Japan (Kato and Lowenstein (1995)). However, unique institutional effects impact ex-day returns in each of these countries. Conclusions regarding the impact of taxation remain ambiguous.

² Bali and Hite (1998) report that the mean dividend in the United States is about \$0.25 or two ticks. In comparison, the average dividend in Hong Kong is 3.64 ticks during the period covered in this study.

Given an average dividend yield of 2.508 percent and a price drop of only 1.174 percent reported by Frank and Jagannathan (1998), short-term traders can make gross profits of around 1.3 percent. This ex-day return in Hong Kong is very high compared to ex-dividend returns of about 0.2 percent observed in the United States. Frank and Jagannathan (1998) point out the unique trading restrictions in Hong Kong, existing during much of their sample period, that prevented the high ex-day returns from being arbitrated away by short-term traders. To receive dividends, stockholders need to be registered with the firm. Cum-dividend buyers would have to wait up to 21 days to get their shares registered, and get their share certificates back. Sale of stock required settlement by physical delivery of share certificates on the following day. Thus, buyers on the last cum-day could not immediately sell their shares on the ex-day, because they would not have physical possession of the shares.³ These traders are constrained from liquidating their position until they receive the share certificates back from the firm. The holding period of up to 21 days exposes dividend capture traders to a considerable amount of unsystematic risk. An excess return of around one percent over a 21-day period is unlikely to attract much arbitrage activity, in view of the attendant risk exposure.

In the United States, Brown and Lummer (1986) and Grammatikos (1989) point out that the risk of dividend capture trading can be hedged by writing covered call options. However, this strategy was not feasible in Hong Kong during the sample period considered by Frank and Jagannathan (1998). The first option was listed on the Hong Kong exchange only in August 1995. Currently, there are only 17 stocks with listed options.

In June 1992, the Hong Kong Securities Clearing Company Limited initiated a transition to an electronic bookkeeping system. Sellers and buyers could arrange to have individual trades settled electronically by mutual agreement for admitted stocks. In October 1992, the clearing company implemented continuous net settlement under CCASS, wherein details of all transactions on the stock exchange were automatically transmitted to the electronic settlement system and processed. Under this system, the settlement period is two days. Stocks were admitted to the continuous net electronic settlement system in batches. The transition was essentially completed by June 1993 for all existing listings. Subsequent listings were admitted immediately to the electronic settlement system. In December 1994, rules of the stock exchange were amended to make admission to CCASS mandatory for new listings.

Under the physical settlement system, stockholders could not sell their shares during the registration process because they could not satisfy the requirement of physical delivery. The new settlement system, relying on elec-

³ Further, Frank and Jagannathan (1998) argue that regulations and transaction costs severely curtailed short selling on the ex-day. At the end of 1995, only 17 stocks were designated by the exchange as being eligible for short selling. As of November 1998, this list has been expanded to 195 securities. Also, see Frank and Jagannathan (1998) for further details on the structure of the Hong Kong market.

tronic book entries for settlement, removes this restriction. Thus, traders can buy the shares on the last cum-day and sell shares on the ex-day, without giving up the dividend.⁴ This change cuts the minimum holding period for dividend capture traders to less than a day, compared to 21 days previously. The consequent reduction in risk exposure lowers the costs faced by arbitrageurs, and enables them to actively exploit positive ex-day returns. Excess returns of around one percent over a one-day holding period should be extremely attractive to such traders. The rest of the paper documents the impact of the switch to electronic settlement on ex-day returns.

II. Data and Methodology

A. Data

The sample period analyzed in this paper covers the years from 1990 to 1995. Given the transition to electronic settlement in 1992 and 1993, the sample period allows for roughly three years of data in both the physical and electronic settlement systems. The stock market data for Hong Kong are obtained from the Pacific Basin Capital Markets (PACAP) database compiled at the University of Rhode Island. The database contains daily stock returns, closing transaction prices, and volume data for all exchange-listed firms. It also contains requisite information on dividend payments and associated dates. The sample is screened to include only ex-dividends for pure cash dividends. For instance, if there is a simultaneous stock dividend or split, this event is excluded. All cash dividends on a single day (regular and bonus) are aggregated.

For the analysis of ex-day returns, the sample was screened for nonmissing closing prices on the ex-day and the prior day to ensure a valid return on the ex-day.⁵ To reduce the impact of dividend outliers, the sample was restricted to observations with dividend yields of less than 10 percent.⁶

B. Methodology

Abnormal returns are assessed using a market model estimated over a control period of 50 days beginning 55 days before the ex-day. Observations are required to have a minimum of 25 nonmissing returns during this period to estimate the market model parameters. Reported mean and median abnormal returns are based on all individual observations. The test statistics for the abnormal returns are assessed using the calendar-time portfolio methodology to account for the impact of event clustering. All observations falling

⁴ Koski (1996) finds evidence of such trading in the United States.

⁵ One ex-day return outlier of -75 percent, likely associated with a major firm-specific event, is excluded to avoid distortion of results. For the remaining sample, the minimum and maximum ex-day returns are -15.4 percent and 17.6 percent, respectively.

⁶ There were 21 observations (about one percent of the sample) excluded due to this screen. Only the regression estimates reported in Table V are marginally sensitive to the inclusion of these events, as noted in Section IV. E.

on the same calendar day are first grouped into a portfolio, and the average portfolio return is calculated for each calendar day with an ex-day event. The cross-sectional average and standard deviation of these calendar day portfolio abnormal returns are used to compute reported t -statistics.

In addition to ex-day returns, the tests also examine liquidity changes around the ex-day. Stocks that did not trade on the ex-day or the previous day are retained for this analysis, unlike the sample used to analyze returns. This procedure precludes imparting an upward bias in observed liquidity on these days. Abnormal volume around the ex-day is assessed using the following market model estimated over the control period used for returns:

$$V_{i,t} = \alpha + bV_{m,t} + e_{i,t}, \quad (1)$$

where $V_{i,t}$ and $V_{m,t}$ are daily volume measures for the individual stock and the entire market, respectively.

The individual volume measure, $V_{i,t}$, is measured as $\log(100 * (n_t/N_s) + 0.01)$, where n_t is the value of shares traded on day t , N_s is the value of shares outstanding at the end of the month s corresponding to day t .⁷ Both values are assessed using closing transaction prices for day t , and the measure essentially captures percentage shares traded. To prevent distortions in daily percentage trading volume (V_{it}) due to changes in outstanding shares during a month, the sample used in analyzing volume excludes observations with changes of greater than five percent in the number of outstanding shares during the months covering the control and event periods. The logarithm transformation removes the pronounced skewness that is characteristic of trading volume data, and the constant 0.01 is added to avoid taking the logarithm of zero.

Some prior studies measure individual daily stock volume using dollar values, rather than as a percentage of outstanding shares. However, the ex-day price drop will induce a spurious reduction in the dollar value measure after the ex-day, and this reduction will be correlated with the dividend amount/yield. In contrast, the percentage shares traded measure is unaffected by the ex-day price drop. Furthermore, when dollar volume measures are aggregated across the sample, a few big firms with large dollar trading volumes will essentially determine the sample average, to the exclusion of most other stocks with considerably lower dollar volumes. Using fraction of outstanding shares avoids this problem.

The data indicate that trading volume in the entire market significantly affects volume on individual stocks. Hence, it is important to control for market volume while assessing abnormal volume in individual stocks. The percentage daily market trading volume ($V_{m,t}$) is measured as $\log(100 * (m_t/M_s) + 0.01)$, where m_t is the dollar value of trading in the entire market on day t . Dollar value of shares traded is preferred to the alternative measure of number of shares traded in the entire market, because the latter fails to distinguish between

⁷ The PACAP database provides only end-of-the-month figures for outstanding number of shares.

Table I
Descriptive Statistics of the Sample

The sample consists of pure cash dividend ex-days for Hong Kong stocks during the period from January 1990 to December 1995. The stock price (P_{-1}) denotes the stock price on the day prior to the ex-dividend day. Stocks were admitted in batches to the electronic settlement system during 1992 and 1993. Prior to electronic settlement, quick turnaround dividend capture trading was not feasible.

	Pre-electronic Settlement ($N = 847$)		Electronic Settlement ($N = 1,148$)	
	Mean	Median	Mean	Median
Dividend (D , \$HK)	0.110	0.050	0.128	0.050
Stock price (P_{-1} , \$HK)	4.678	2.100	7.004	2.495
Yield $\%(D/P_{-1})$	2.662	2.381	2.367	1.951
Dividends/tick size	3.469	3.000	3.772	3.000

volume increases in high-priced versus low-priced stocks. Daily values are not available for market capitalization. To account for changes in listings during the month, M_s is measured as the average of the market capitalization at the beginning and the end of the month s corresponding to day t .

C. Descriptive Statistics

The dates on which each stock was admitted to continuous net settlement under the electronic CCASS are obtained from the Hong Kong Securities Clearing Company. An ex-date occurring before the particular stock was switched to electronic settlement is classified as occurring during the pre-electronic settlement period. Of the total of 1,995 observations that met the sample criteria for ex-dividend returns during the period from 1990 to 1995, 847 observations are during the pre-electronic settlement period. The remaining 1,148 ex-dates occur after the stocks were switched to electronic settlement. Of 334 observations in 1992, 13 occurred after the stock was switched to electronic settlement. Correspondingly, of the 418 observations in 1993, there were 33 observations before the switch to electronic settlement.

Table I presents descriptive statistics separately for the periods before and after the switch to electronic settlement procedures. The average dividend is HK \$0.11 during the pre-electronic settlement period, and HK \$0.128 during the electronic settlement period. The mean dividend yield of 2.662 percent during the pre-electronic period is similar to the mean dividend yield of 2.367 percent during the electronic settlement period. When dividends are assessed in terms of the minimum permissible price changes for the stock, the average dividend size is 3.469 ticks before the switch to electronic settlement, and 3.772 ticks after the switch.⁸

⁸ Tick sizes were reduced on July 1, 1994. For stocks with prices less than HK \$10, original tick sizes were restored in October 1994. Such stocks account for 80 percent of the listings.

Table II
Stock Price Behavior on Ex-dividend Day

This table presents ex-day statistics before and after the switch to electronic settlement, which occurred in Hong Kong during 1992 and 1993. Electronic settlement enabled arbitrage trading around ex-days. The sample period is 1990 to 1995. Tick size is the minimum permissible price change, and is measured accounting for changes in 1994.

	Pre-electronic Settlement (<i>N</i> = 847)		Electronic Settlement (<i>N</i> = 1,148)	
	Mean	Median	Mean	Median
Raw return (%)	1.215	0.930	0.167	0.000
Price drop/dividend (%)	47.106	62.500	90.092	100.000
Price drop/tick size	2.014	2.000	3.673	3.000
(Price drop – dividends)/tick size	–1.454	–1.000	–0.099	0.000

III. Results

A. Stock Price Behavior on Ex-dividend Day

Table II presents key measures of stock price behavior on the ex-dividend day before and after the switch to electronic settlement procedures. The potential for arbitrage trading enabled by the electronic settlement procedures should reduce ex-dividend day returns. The results strongly support this hypothesis. The mean return on the ex-day drops dramatically from 1.215 percent during the pre-electronic settlement period to 0.167 percent during the electronic settlement period. The median return of zero percent during the electronic settlement period indicates a full price adjustment relative to the dividend. Statistical tests of significance using abnormal returns are reported later.

Prior to electronic settlement, the average price-drop-to-dividend ratio is only 47.106 percent. This number is very similar to the ratio of 43.243 percent reported by Frank and Jagannathan (1998) for their sample period from 1980 to 1993. With electronic settlement, the average price-drop-to-dividend ratio is 90 percent, whereas the median ratio is 100 percent. In terms of tick sizes, the average price drop is less than the dividend by 1.454 ticks before the switch to electronic settlement. After the switch, the mean and median differences between the price drop and the dividend are only –0.099 and zero ticks, respectively.⁹

B. Abnormal Returns On and Around Ex-dividend Day

Investor reaction to the ex-day event may affect trading decisions immediately before and after the ex-day and, therefore, returns on these days. Table III presents the mean and median abnormal returns during the 11-day

⁹ Price discreteness should affect both settlement periods. Thus, the larger return during the pre-electronic settlement period cannot be attributed to price discreteness.

Table III
Abnormal Returns around Ex-dividend Day

Abnormal return is assessed using a market model estimated during the 50 days beginning 55 days before the ex-dividend date. The sample period is 1990 to 1995. Stocks were admitted in batches to the electronic settlement system during 1992 and 1993. There are 847 events during the pre-electronic settlement period, and 1,148 events during the electronic settlement period. Average abnormal return is reported for each day based on nonmissing returns. The test statistics are computed by using calendar-time portfolios to account for the impact of event clustering.

	Pre-electronic Settlement			Electronic Settlement		
	Mean Abnormal Return (%)	Median Abnormal Return (%)	<i>t</i> -statistic for mean AR	Mean Abnormal Return (%)	Median Abnormal Return (%)	<i>t</i> -statistic for mean AR
Day -5	-0.016	-0.101	-0.52	-0.055	-0.137	-0.37
Day -4	-0.140	-0.139	-1.03	0.114	0.007	0.12
Day -3	-0.110	-0.165	-0.36	0.146	0.031	0.93
Day -2	-0.094	-0.145	-1.27	0.140*	0.019	2.48
Day -1	0.009	-0.043	0.22	0.361*	0.329	4.64
Ex-day	1.127*	0.874	12.80	0.169	0.071	1.65
Day 1	0.064	-0.068	1.31	-0.050	-0.206	0.63
Day 2	0.182	-0.054	1.94	-0.040	-0.129	-0.26
Day 3	0.075	-0.195	0.14	-0.086	-0.230	-0.10
Day 4	-0.041	-0.180	-0.55	-0.041	-0.156	-0.02
Day 5	0.053	-0.105	1.30	0.050	-0.161	0.53

* denotes significance at the 5 percent level using a two-tailed test.

period surrounding the ex-day. During the pre-electronic settlement period, the average abnormal return on the ex-day is 1.127 percent, which is highly significant with a t -statistic of 12.80. The median abnormal return is 0.874 percent. After the switch to the electronic settlement, the average abnormal return on the ex-day drops to an insignificant 0.169 percent (t -statistic = 1.65). The corresponding median abnormal return is only 0.071 percent.

None of the abnormal returns on the surrounding days are significant during the pre-electronic settlement period. After the switch in settlement procedures, there are significant positive average abnormal returns on the two days immediately before the ex-day. On day -2 , whereas the average abnormal return is 0.14 percent, the median abnormal return is less than 0.02 percent.¹⁰ In contrast, abnormal returns on day -1 are more robust. The median abnormal return of 0.329 percent on day -1 is very similar to the mean abnormal return of 0.361 percent, which is highly significant (t -statistic = 4.64). These positive returns are puzzling.¹¹

C. Examination of Time Trends in Ex-day Abnormal Returns

The previous results reveal a marked reduction of ex-day returns during the electronic settlement period. Nevertheless, questions may arise regarding whether the reduction can be attributed to the change in settlement procedures, or whether it is the result of a gradual decline over time, which is not necessarily related to the switch in settlement systems. The ex-day return of 1.215 percent reported in Table II for the pre-electronic settlement years from 1990 to 1992 is very similar to the implied ex-day return of 1.334 percent over the much longer 1980 to 1993 period examined by Frank and Jagannathan (1998). These numbers provide a clue that the ex-day returns did not decline much over the pre-electronic settlement period.

Table IV presents direct evidence that the drop in ex-day returns coincides with the switch to electronic settlement procedures. Panel A presents the results of regressions examining whether there is a time trend in ex-day

¹⁰ Outliers do not drive the reported positive average. The maximum return is 15.32 percent, which is not unusual in comparison to returns on neighboring days. Moreover, only three observations have abnormal returns in excess of 10 percent. Similarly, the positive average return on day -1 is not caused by outliers. Further, the positive mean return on days -2 and -1 cannot be attributed to errors recording the ex-day as day 0 instead of one of these two days. Such errors will induce a spurious positive return on day 0 and a *negative* return on the correct ex-day.

¹¹ Although positive returns prior to the ex-day may be due to increased buying by dividend capture traders, the evidence is not entirely consistent. The returns on day -1 and day -2 are not significantly positively correlated with dividend yield. Furthermore, if these returns are generated by buying pressure, they should be reversed subsequently. However, abnormal returns on days -2 and -1 are not negatively correlated with ex-day returns or the cumulative abnormal returns over the next five days.

Table IV
Examination of Time Trends in Ex-dividend Abnormal Returns

These tests distinguish the impact on ex-day abnormal returns of time versus the switch to electronic settlement. Panel A presents the estimates of the following model:

$$\text{EXRET}_i = \alpha + \beta_1 \text{TIME}_i + \beta_2 \text{SWITCH}_i + e_i.$$

EXRET is the ex-day abnormal return. TIME is measured as 1,000 times number of trading days since January 1, 1990. SWITCH is a dummy variable that takes a value of 1 during the electronic settlement period, and 0 otherwise. The numbers in parentheses below the coefficients are the corresponding *t*-statistics. The number below the *F*-statistic is its *p*-level. Panel B examines the year-to-year change in abnormal returns. Only the change coinciding with the switch to electronic settlement is statistically significant. Abnormal returns in each of the pre-electronic settlement years are significant. The *t*-statistics are computed by using calendar-time portfolios to account for the impact of event clustering.

Panel A: Impact on Ex-day Abnormal Returns of Time versus Switch in Settlement Procedures					
	Intercept	Time	Switch	Adj. R ²	F-statistic
Entire sample	1.137 (9.01)	-0.023 (-0.098)	-0.942* (-4.82)	0.04	42.83 (0.0001)
Pre-electronic settlement	0.998* (6.08)	0.309 (0.89)	—	-0.0002	0.81 (0.37)
Electronic settlement	0.489 (1.334)	-0.285 (-0.89)	—	-0.0002	0.79 (0.37)

Panel B: Ex-dividend Abnormal Returns by Year				
Year	N	Mean Abnormal Return (%)	Median Abnormal Return (%)	T-test for Difference in Mean Abnormal Returns (Year <i>t</i> - Year <i>t</i> - 1)
Pre-electronic settlement years				
1990	239	1.122*	1.015	—
1991	254	0.873*	0.614	-0.68
1992†	354	1.313*	0.995	1.04
Electronic settlement years				
1993†	398	0.237	0.134	-3.47*
1994	400	0.184	0.166	-1.12
1995	350	0.074	-0.065	0.91

* denotes significance at the 5 percent level using a two-tailed test.

† There were 13 events during 1992 that occurred after the stocks were switched to electronic settlement. These events are grouped with 1993 events. Similarly, there were 33 events in 1993 that occurred before the stocks were switched to electronic settlement. These events are grouped with 1992 events.

abnormal returns after controlling for the switch in settlement procedures. The first row regression includes a dummy variable, which takes on a value of one during the electronic settlement period and zero otherwise. The coefficient for this variable indicates that ex-day returns dropped by 0.942 percent after the switch to electronic settlement. This coefficient is highly significant with a t -statistic of -4.82 . In contrast the coefficient for the time trend variable is virtually zero, with a t -statistic of only -0.098 . These results provide strong evidence that the drop in ex-day returns occur at the time of the switch to electronic settlement, and that the decline cannot be attributed to a gradual decline over time.

The next two rows of Panel A examine the time trend within each of the settlement periods. The results confirm that there is little support for a significant, gradual decline in ex-day returns. In fact, the results for the pre-electronic settlement period indicate an increase in ex-day returns over time during this period. However, the increase is not statistically significant.

Panel B of Table IV provides more details on this issue by reporting a year-by-year breakdown of returns during the sample period. Ex-days in 1993 that occurred before the underlying stock was switched to electronic settlement are grouped together with observations for the year 1992. Similarly, observations in 1992 that occurred after the stock was switched to electronic settlement are clubbed together with observations for the year 1993.

The abnormal returns for each of the years in the pre-electronic settlement period are significant. The mean and median abnormal return for 1992, the last year in this period, are 1.313 percent and 0.995 percent, respectively. In contrast, the corresponding numbers for 1993, the first year in the electronic settlement period, are only 0.237 percent and 0.134 percent, respectively. The ex-day abnormal returns are insignificant for all years in the electronic settlement period. The drop in the mean abnormal return from 1992 to 1993 is highly significant with a t -statistic of -3.47 . None of the other year-to-year changes is significant. These results again point to the drop being associated with the switch to electronic settlement procedures rather than occurring steadily over time.

In the above tests, the underlying sample of firms varies between the time periods due to firms being added or dropped because of listing changes or changes in dividend policy. The next test examines ex-day returns in the physical and electronic settlement periods for the same sample of firms. There are 214 firms with at least one ex-day in each of the settlement periods. For these firms, the average abnormal return on the last ex-day in the pre-electronic settlement period is 1.096 percent, which is statistically significant. In comparison, the average abnormal return is an insignificant 0.173 percent on the first ex-day in the electronic settlement period for the same set of 214 firms. This test provides further confirmation that the switch to electronic settlement led to an immediate drop in ex-day abnormal returns.

Table V
Impact of Switch to Electronic Settlement on High-Yield
versus Low-Yield Stocks

This table presents ex-day statistics for subsamples based on dividend yield. The sample period is 1990 to 1995. Stocks were admitted in batches to the electronic settlement system during 1992 and 1993. Arbitrage traders are perhaps more likely to target high-yield stocks, which had larger returns prior to electronic settlement. The median dividend yield is 2.16 percent for the entire sample of 1,995 observations. This yield is used as the cut-off to classify observations into the two yield groups.

Panel A: High-Yield Sample				
	Pre-electronic Settlement (<i>N</i> = 484)		Electronic Settlement (<i>N</i> = 514)	
	Mean	Median	Mean	Median
Yield % (D/P_0)	3.618	3.251	3.697	3.301
Raw return (%)	1.442	1.126	0.068	0.000
Abnormal return (%)	1.332	1.048	0.010	-0.096
Price drop/dividend (%)	53.520	66.667	95.513	100.000
Price drop/tick size	2.980	3.000	5.906	5.000
(Price drop - dividends)/tick size	-1.749	-1.200	0.125	0.000
Panel B: Low-Yield Sample				
	Pre-electronic Settlement (<i>N</i> = 363)		Electronic Settlement (<i>N</i> = 634)	
	Mean	Median	Mean	Median
Yield % (D/P_0)	1.387	1.389	1.288	1.298
Raw return (%)	0.911	0.685	0.248	0.115
Abnormal return (%)	0.854	0.692	0.298	0.223
Price drop/ dividend (%)	38.554	50.000	87.164	93.135
Price drop/tick size	0.726	1.000	1.862	2.000
(Price drop - dividends)/tick size	-1.061	-1.000	-0.282	-0.160

D. Comparison of Impact of Electronic Settlement on High-Yield versus Low-Yield Stocks

Dividend capture trading, enabled by electronic settlement, is more likely to occur in high-yield stocks rather than low-yield stocks. To study this aspect, the entire sample of 1,995 observations is divided into two groups using the median dividend yield of 2.16 percent as the cut-off. Panels A and B of Table V report the results separately for the low- and the high-dividend-yield groups in each settlement period. For each group, the dividend yield is similar before and after the switch to electronic settlement.

During the pre-electronic settlement period, the average abnormal ex-day return of 1.332 percent (t -statistic = 12.68) is larger for the high-yield group than the 0.854 percent return (t -statistic = 5.91) for the low-yield group. The larger returns should attract more attention from potential arbitrageurs.

Consistent with this proposition, the drop in returns, following the switch to electronic settlement, is more pronounced for the high-yield group. For this group, abnormal returns are fully eliminated after the switch. The mean abnormal return drops to an insignificant 0.01 percent (t -statistic = 0.46), whereas the median abnormal return drops to -0.096 percent from 1.048 percent. For the low-dividend-yield group, the mean abnormal return drops to 0.298 percent (t -statistic = 2.34).¹² Although the mean returns remain positive after the switch to electronic settlement for this group, the drop in returns after the switch is nevertheless significant with a t -statistic of 2.60 .

During the electronic settlement period, in contrast to the earlier period, the average abnormal return is smaller for the high-yield stocks compared to the low-yield group. Other measures of ex-day price behavior consistently indicate a greater impact of electronic settlement for the high-yield group. The immediate effect of the switch to electronic settlement is especially dramatic for the high-yield group. For this group, there are 182 observations before the switch and 166 observations after the switch when observations are restricted to 1992 and 1993, the years immediately around the switch to electronic settlement. Over this period, the average abnormal return drops from 1.70 percent before the switch to -0.18 percent after the switch. The corresponding median returns for the two years are 1.44 percent and -0.37 percent, respectively. This evidence supports the conclusion that excess returns on high-yield stocks were eliminated quickly after the switch to electronic settlement.

E. Cross-sectional Relationship Between Ex-day Price Changes and Dividend Yields

Table VI presents the tests of the cross-sectional relationship between the ex-day percentage price changes and the dividend yields. These tests replicate the analysis of Frank and Jagannathan (1998). In their model, where investors seek to avoid dividends, the intercept term reflects the imbalance in the supply and demand of shares around the ex-dividend day. The coefficient for the yield variable reflects the marginal value of dividends to market makers and is expected to be one. The absolute value of the intercept term in such a regression is proportional to the bid-ask spread and proportion of motivated traders. The authors argue that because the proportion of motivated traders is likely to vary across stocks, the regression parameters will be estimated with bias. To alleviate this problem, they suggest estimating the regressions separately for firms with small and large dividends. The cut-off of HK \$0.07 used by them is retained here.

¹² One reason for the difference between low- and high-yield stocks during the electronic settlement period might be that price discreteness is more important for low-yield stocks. However, fractional dividend yield, measured following the development of the issue in Bali and Hite (1998), is actually slightly smaller for the low-dividend group (0.48 percent) compared to the high-yield group (0.58 percent). Average abnormal return for the low-yield group falls to only 0.013 percent in 1995.

Table VI

Relationship Between Ex-day Price Changes and Dividend Yields

These tests replicate the Frank and Jagannathan (1998) regression tests for the sample period January 1990 to December 1995, separating the observations according to the settlement procedures used. Stocks were admitted in batches to the electronic settlement system during 1992 and 1993. The following regression equation is estimated:

$$\text{PCHG}_i = \alpha + \beta \text{YLD}_i + e_i$$

where PCHG_i is the percentage price drop on the ex-day, and YLD_i is the percentage dividend yield for observation i . The numbers in parentheses in the first two rows of each panel are the t -statistics for the coefficients. The number in the last row is the significance level of the F -statistic.

Panel A: Pre-electronic Settlement			
	All Observations ($N = 847$)	Div. < HK \$0.07 ($N = 500$)	Div. $\geq$ HK \$0.07 ($N = 347$)
Intercept	-1.018* (-5.87)	-1.065* (-4.30)	-0.648* (-2.84)
YLD	0.926 (16.33)	0.836 (9.35)	0.929 (13.96)
Adj. R^2	0.24	0.15	0.36
F -statistic	266.5 (0.0001)	87.5 (0.0001)	194.8 (0.0001)
Panel B: Electronic Settlement			
	All Observations ($N = 1,148$)	Div. < HK \$0.07 ($N = 659$)	Div. $\geq$ HK \$0.07 ($N = 489$)
Intercept	-0.400* (-3.25)	-0.254 (-1.39)	-0.406* (-2.34)
YLD	1.098 (24.42)	0.968 (13.11)	1.162 (20.54)
Adj. R^2	0.34	0.21	0.46
F -statistic	584.5 (0.0001)	171.8 (0.0001)	412.7 (0.0001)

* denotes that the intercept term is significantly different from zero at the 5 percent level using a two-tailed test.

During the pre-electronic settlement period, the intercept term is -1.018 (t -statistic = -5.87) in the regression using the entire sample. In contrast, the intercept term drops to -0.400 during the electronic settlement period (t -statistic = -3.25). In the context of the Frank and Jagannathan (1998) model, this drop can be interpreted as a reduction of the market imbalances. When the regressions are estimated separately for small and large dividends, a similar drop is observed.¹³ However, the drop is more pronounced

¹³ If observations with dividend yields greater than 10 percent are retained, the intercept terms for both subsamples are statistically insignificant. The intercept term for the overall sample remains significant.

for the small dividend sample. Finally, the higher explanatory power for the electronic settlement period regressions is consistent with the ex-day price change being driven to a greater extent by the dividend yield.

F. Relationship between Ex-day Abnormal Returns and Unsystematic Risk

Grammatikos (1989) and Boyd and Jagannathan (1994) argue that risk exposure is a major cost faced by dividend capture traders. Prior to electronic settlement, traders trying to exploit ex-day returns in Hong Kong would have to hold the stock for up to 21 days, and would have considerable exposure to the unsystematic risk of the stock. This exposure would have deterred dividend capture trading. After the switch to electronic settlement, the unsystematic risk of a stock should be of minimal concern to short-term traders, who need to hold the stock for less than a day.

Table VII presents evidence on the relationship between ex-day abnormal returns and unsystematic risk. The reported regressions include yield as a control variable, though its exclusion does not affect results. During the physical settlement period, ex-day abnormal returns are indeed higher for firms with greater firm-specific risk, consistent with risk considerations deterring arbitrage activity. However, unsystematic risk is no longer a significant factor in the electronic settlement period.

To address the possibility that unsystematic risk may be capturing transaction cost effects, the regressions are reestimated using a liquidity variable, the average daily dollar trading volume over the control period. Lakonishok and Vermaelen (1986) argue that this liquidity variable should be inversely related to transaction costs. Conclusions regarding the role of unsystematic risk are unaffected by the inclusion of the liquidity variable. The observed negative relationship between abnormal returns and dividend yield during the electronic settlement period supports the notion that arbitrageurs were active in eliminating excess returns in high-dividend-yield stocks.

G. Behavior of Trading Volume Around Ex-days

Table VIII presents evidence on trading volume patterns around ex-days. Stocks that did not trade on the ex-day or the previous day are retained in the sample, so that there is no upward bias induced in measuring volume on these days. During the physical settlement period, shares locked up in the registration process are unavailable for selling. Because registration is required to receive dividends, the supply of shares should be reduced around ex-days. The evidence reveals that abnormal volume prior to the ex-day is uniformly negative around the ex-day. Prior to the ex-day, abnormal volume is statistically significant only on day -5. However, volume is significantly below normal on the ex-day and on each of the following five days.¹⁴ The significant drop starting on the ex-day indicates that most new shareholders

¹⁴ Abnormal volume remains significantly negative for the next three days, and turns insignificant on days 9 and 10.

Table VII
Relationship of Ex-dividend Day Return to Dividend Yield
and Stock's Unsystematic Risk

These tests examine the influence of unsystematic risk on ex-dividend day returns. The sample period is 1990 to 1995. Stocks were admitted in batches to the electronic settlement system during 1992 and 1993. In the pre-electronic settlement period, traders had to hold the stock for as many as 21 days while the stock was registered, and had to bear the risk during this period. Electronic settlement eliminates this period. Short-term traders should be attracted to stocks with high dividend yields and low transaction costs. The following regression equations are estimated:

$$\text{Model A: } \text{EXRET}_i = \alpha + \beta_1 \text{YLD}_i + \beta_2 \text{UNSYS RISK}_i + e_i$$

$$\text{Model B: } \text{EXRET}_i = \alpha + \beta_1 \text{YLD}_i + \beta_2 \text{UNSYS RISK}_i + \beta_3 \text{LIQUIDITY}_i + e_i,$$

where EXRET is the ex-day percentage abnormal return, YLD is the percentage dividend yield, UNSYS RISK is a measure of the stock's unsystematic risk assessed from the residuals of a market model regression estimated during the control period of 50 trading days preceding day -5 relative to the ex-day. LIQUIDITY is the average daily volume during the control period expressed in millions of HK\$, and should be inversely related to transaction costs. The numbers in parentheses below the coefficients are the t -statistics. The number in parentheses in the last row is the significance level of the F -statistic.

	Pre-electronic Settlement ($N = 847$)		Electronic Settlement ($N = 1,148$)	
	Model A	Model B	Model A	Model B
Intercept	0.631* (2.94)	0.757* (3.24)	0.359 (1.74)	0.544* (2.44)
YLD	0.061 (1.19)	0.033 (0.62)	-0.129* (-2.97)	-0.155* (-3.40)
UNSYS RISK	0.178* (2.42)	0.178* (2.35)	0.052 (0.70)	0.013 (0.17)
LIQUIDITY	—	-0.007 (-1.37)	—	-0.005* (-2.30)
Adj. R^2	0.01	0.01	0.01	0.02
F -statistic	3.45 (0.0323)	3.00 (0.0300)	4.69 (0.0094)	4.99 (0.0019)

* denotes significance at the 5 percent level using a two-tailed test.

wait till just before the ex-day to send their share certificates for registration. The subsequent drying up of shares available for selling adversely affects trading volume on the following days. The volume patterns are similar for high-yield and low-yield stocks.

During the electronic settlement period, there is a significant increase in volume during each of the five days before the ex-day, consistent with investors acquiring the stock ahead of the ex-day. The increase in volume is larger for high-yield stocks. On the day prior to the ex-day, the mean abnormal volume measure for high-yield stocks is 0.299, with a t -statistic of

Table VIII

Abnormal Trading Volume around Ex-dividend Day

Volume is measured as the log of percentage of outstanding shares traded. Abnormal volume is assessed using a market model estimated during the 50 days beginning 55 days before the ex-dividend date. Stocks for which the outstanding shares changed by more than 5 percent during the control and event period are omitted, to prevent distortion of abnormal volume calculations. Stocks that did not trade on the ex-day or the previous day are retained in the sample to avoid upward bias on these days. The sample period is 1990 to 1995. Stocks were admitted in batches to the electronic settlement system during 1992 and 1993. The *t*-statistics, in parentheses, are computed by using calendar-time portfolios to account for the impact of event clustering.

	Pre-electronic Settlement			Electronic Settlement		
	All Observations (<i>N</i> = 909)	High Yield (<i>N</i> = 530)	Low Yield (<i>N</i> = 379)	All Observations (<i>N</i> = 1,130)	High Yield (<i>N</i> = 513)	Low Yield (<i>N</i> = 617)
Day -5	-0.072* (-2.63)	-0.074* (-2.96)	-0.070 (-1.17)	0.077* (2.21)	0.082* (1.96)	0.072 (1.89)
Day -4	-0.033 (-1.60)	-0.026 (-1.15)	-0.043 (-1.24)	0.125* (3.43)	0.134* (2.74)	0.117* (2.74)
Day -3	-0.018 (-0.67)	0.005 (-0.38)	-0.051 (-1.30)	0.099* (2.02)	0.179* (2.98)	0.033 (1.11)
Day -2	-0.014 (-0.25)	0.032 (0.53)	-0.078 (-1.22)	0.139* (2.91)	0.201* (3.30)	0.088* (1.97)
Day -1	-0.049 (-1.86)	-0.003 (-0.39)	-0.112* (-2.12)	0.172* (4.59)	0.299* (6.28)	0.066 (1.49)
Ex-day	-0.225* (-5.67)	-0.255* (-5.15)	-0.184* (-3.59)	-0.091* (-2.43)	-0.046 (-1.28)	-0.128* (-2.25)
Day 1	-0.173* (-4.63)	-0.195* (-4.64)	-0.142* (-2.76)	-0.050 (-1.29)	-0.054 (-1.81)	-0.046 (0.06)
Day 2	-0.128* (-3.45)	-0.152* (-3.81)	-0.096 (-1.65)	-0.033 (-0.57)	-0.067 (-1.82)	-0.006 (0.94)
Day 3	-0.135* (-3.40)	-0.145* (-3.70)	-0.121* (-2.01)	0.010 (1.07)	0.015 (0.22)	0.007 (0.76)
Day 4	-0.126* (-2.81)	-0.152* (-3.06)	-0.091 (-1.47)	-0.041 (-0.58)	-0.013 (0.05)	-0.066 (-0.51)
Day 5	-0.165* (-4.08)	-0.118* (-2.70)	-0.232* (-4.26)	0.029 (0.99)	0.043 (1.69)	0.018 (0.48)

* denotes significance at the 5 percent level using a two-tailed test.

6.28. This compares with an insignificant value of 0.066 for the low-yield stocks. This evidence suggests that dividend capture traders focus their buying in high-yield stocks.

On the ex-day itself, there is a significant reduction in volume. However, this drop is driven mainly by the low-yield group. In sharp contrast to the physical settlement period, there is no significant drop in volume after the ex-day. All shares continue to be available for trading after the ex-day under electronic settlement, and consequently, trading volume is not affected significantly.

Table IX

Relationship between Abnormal Trading Volume and Dividend Yield

Cumulative abnormal volume is measured during the five days prior to the ex-day (PREVOL), and on the ex-day and the five days after the ex-day (POSTVOL). Dividend yield (YLD) is measured using the first available price preceding the ex-day. The following models are estimated:

$$\text{PREVOL}_i = \alpha + \beta \text{YLD}_i + e_i$$

$$\text{POSTVOL}_i = \alpha + \beta \text{YLD}_i + e_i$$

Stocks that did not trade on the ex-day are retained in the sample. The sample period is 1990 to 1995. Stocks were admitted in batches to the electronic settlement system during 1992 and 1993. The numbers in parentheses in the first two rows of each panel are the *t*-statistics for the coefficients. The number in parentheses in the last row is the significance level of the *F*-statistic.

	Pre-electronic Settlement (<i>N</i> = 909)		Electronic Settlement (<i>N</i> = 1,130)	
	PREVOL	POSTVOL	PREVOL	POSTVOL
Intercept	-0.491* (-2.64)	-0.582 (-2.31)	-0.070 (-0.41)	-0.225 (-1.08)
YLD	0.118 (1.94)	-0.145 (-1.75)	0.294* (4.98)	0.018 (0.25)
Adj. <i>R</i> ²	0.00	0.00	0.02	0.00
<i>F</i> -statistic	3.76 (0.0529)	3.07 (0.0801)	24.83 (0.0001)	0.06 (0.8058)

* denotes significance at the 5 percent level using a two-tailed test.

Table IX reveals that dividend yield is positively related to cumulative abnormal trading volume prior to the ex-day under both settlement periods. However, during the electronic settlement period, the sensitivity is highly significant (*t*-statistic = 4.98) and much greater. The coefficient in this period is more than double the coefficient during the physical settlement period.

During the physical settlement period, volume on and after the ex-day is negatively related to dividend yield, though the coefficient is significant only at the 10 percent level. The negative relationship provides weak evidence that stocks with higher dividend yields were more prone to the drying up of liquidity immediately after the ex-day, as they attracted more buyers just before the ex-day who had to register their shares. During the electronic settlement period, there is no significant relationship between dividend yield and trading volume on and after the ex-day.

During the electronic settlement period, there is an increase in volume both before and after the ex-day in comparison to the physical settlement period. However, the lack of significant positive abnormal volume after the ex-day, especially for high-yield stocks, precludes a definitive conclusion about the presence of short-term traders during the electronic settlement period. It should be emphasized that the reduction in ex-day returns after the switch

to electronic settlement could arise merely from the *potential* for short-term arbitrage trading. It does not necessarily require the manifestation of elevated levels of such trading activity.

IV. Conclusions

Frank and Jagannathan (1998) document positive ex-dividend day returns of about 1.3 percent in the tax-free environment of Hong Kong. During much of the period examined by Frank and Jagannathan, arbitrage trades around ex-days were hampered by settlement procedures, which required physical delivery of share certificates within a day. Shares had to be registered with the firm in order to receive dividends. The registration process locked up share certificates for 21 days, during which they were unavailable for selling.

In 1992, the Stock Exchange of Hong Kong initiated a transition to a new settlement system, under which settlement was done through electronic book entries. This system removed the physical delivery requirements, and enabled quick turnaround arbitrage trades around ex-days. Dividend capture traders could buy on the last cum-day and sell on the ex-day.

Given the increased ease of arbitrage trading under electronic settlement, this paper reexamines ex-day returns in the Hong Kong stock market after the switch in settlement systems. The results demonstrate that positive ex-day returns are virtually eliminated after the switch. They provide powerful evidence that short-term traders looking for arbitrage opportunities erased excess returns soon after the easing of restrictions on their trading. Under electronic settlement, there is increased trading volume immediately before the ex-day, but not after. This evidence is consistent with the interpretation that the mere potential for arbitrage suffices to eliminate profit opportunities. Overall, the evidence supports the argument that regulatory or institutional features that inhibit short-term trading will adversely affect pricing efficiency of financial markets.

REFERENCES

- Bali, Rakesh, and Gailen L. Hite, 1998, Ex dividend day stock price behavior: Discreteness or tax-induced clientele?, *Journal of Financial Economics* 47, 127–159.
- Berkman, Henk, and Venkat R. Eleswarapu, 1998, Short-term traders and liquidity: A test using Bombay Stock Exchange data, *Journal of Financial Economics* 47, 339–355.
- Boyd, John H., and Ravi Jagannathan, 1994, Ex-dividend price behavior of common stocks, *Review of Financial Studies* 7, 711–741.
- Brown, Keith, and Scott Lummer, 1986, A re-examination of the covered call option strategy for corporate cash management, *Financial Management* 15, 13–17.
- Eades, Kenneth, Pat Hess, and E. Han Kim, 1984, On interpreting security returns during the ex-dividend period, *Journal of Financial Economics* 13, 3–35.
- Eades, Kenneth, Pat Hess, and E. Han Kim, 1994, Time-series variation in dividend pricing, *Journal of Finance* 49, 1617–1638.
- Elton, Edwin J., and Martin Gruber, 1970, Marginal stockholder tax rates and the clientele effect, *Review of Economics and Statistics* 52, 68–74.

- Frank, Murray, and Ravi Jagannathan, 1998, Why do stock prices drop by less than the value of the dividend? Evidence from a country without taxes, *Journal of Financial Economics* 47, 161–188.
- Grammatikos, Theoharry, 1989, Dividend stripping, risk exposure, and the effect of the 1984 tax reform act on the ex-dividend day behavior, *Journal of Business* 62, 157–173.
- Kalay, Avner, 1982, The ex-dividend day behavior: A re-examination of the clientele effect, *Journal of Finance* 37, 1059–1070.
- Kato, Kiyoshi, and Uri Lowenstein, 1995, The ex-dividend day behavior of stock prices: The case of Japan, *Review of Financial Studies* 8, 817–847.
- Koski, Jennifer L., 1996, A microstructure analysis of ex-dividend behavior before and after the 1984 and 1986 tax reform acts, *Journal of Business* 69, 313–338.
- Lakonishok, Josef, and Theo Vermaelen, 1986, Tax-induced trading around ex-dividend days, *Journal of Financial Economics* 16, 287–320.
- Lasfer, Meziane A., 1995, Ex-day behavior: Tax or short-term trading effects, *Journal of Finance* 50, 875–897.
- Lasfer, Meziane A., 1996, Taxes and dividends: The UK evidence, *Journal of Banking and Finance* 20, 455–472.
- Michaely, Roni, and Maurizio Murgia, 1995, The effect of tax heterogeneity on prices and volume around the ex-dividend day: Evidence from the Milan Stock Exchange, *Review of Financial Studies* 8, 369–399.
- Miller, Merton, and Myron Scholes, 1982, Dividends and taxes: Empirical evidence, *Journal of Political Economy* 90, 1118–1141.