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Corporate Events, Trading Activity, and the Estimation of Systematic Risk: Evidence From Equity Offerings and Share Repurchases

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ABSTRACT

We investigate the relation between trading activity, the measurement of security returns, and the evolution of security prices by examining estimates of systematic risk surrounding equity offerings and share repurchases. In contrast to prior studies, we find no evidence of changes in systematic risk following either equity offerings or share repurchases after correcting for biases caused by infrequent trading and price adjustment delays. Moreover, changes in ordinary least squares beta estimates are significantly related to contemporaneous changes in trading activity. Our results have implications for studies interested in the properties of security returns, particularly those examining periods in which trading activity changes.

RECENT STUDIES HAVE LINKED corporate events with permanent changes in the trading activity of a firm's shares. For example, equity offerings are associated with increases in trading volume and number of trades per day, and decreases in bid-ask spreads (Loderer and Sheehan (1992) and Lease, Masulis, and Page (1993)). Similarly, additions to the S&P 500 are associated with increases in trading volume (Harris and Gurel (1986) and Shleifer (1986)) and the listing of a firm's shares on the New York Stock Exchange (NYSE) is followed by a decrease in bid-ask spreads (Kadlec and McConnell (1994)). Conversely, share repurchases are associated with increases in bid-ask spreads (Barclay and Smith (1988), and Conroy, Harris, and Benet (1990)).

The market microstructure literature predicts that the aforementioned changes in trading activity will affect the accuracy with which security returns are measured, the process of price discovery, and, thus, estimates of systematic risk. For example, Scholes and Williams (1977) and Dimson (1979) demonstrate how nonsynchronous trading introduces return measurement error, causing estimates of systematic risk to be downward biased. In a similar vein, Cohen *et al.* (1980, 1983a) demonstrate how frictions in the trading process lead to price adjustment delays, also causing estimates of

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systematic risk to be downward biased. Consequently, an increase in trading activity following an event should lead to an increase in estimates of systematic risk, while a decrease in trading activity should lead to a decrease in estimates of systematic risk.

We test these predictions by examining the relation between changes in trading activity and changes in estimates of systematic risk surrounding seasoned equity offerings and share repurchases. Equity offerings and share repurchases are particularly well suited for this for several reasons. First, as noted above, recent studies document significant changes in trading activity surrounding equity offerings and share repurchases. Second, other studies document significant changes in estimates of systematic risk surrounding these events. Healy and Palepu (1990) and Lease, Masulis, and Page (1993) document significant increases in beta estimates following equity offerings, while Bartov (1991), Dann, Masulis, and Mayers (1991), and Hertzel and Jain (1991) find significant decreases in beta estimates following share repurchases.[1] Finally, the fact that equity offerings and share repurchases are characterized by opposite changes in trading activity and estimates of systematic risk allows us to test the robustness of the predictions of the market microstructure literature.

Our samples consist of 433 NYSE/American Stock Exchange (AMEX) and 359 National Association of Securities Dealers Automated Quotation (NASDAQ) equity offerings and 81 NYSE/AMEX and 31 NASDAQ share repurchase tender offers completed between 1984 and 1989. Consistent with prior studies, we find significant increases in trading activity following equity offerings and significant decreases in trading activity following share repurchases. More specifically, equity offerings are associated with significant increases in share turnover, number of trades per day, and the fraction of days with trades. Conversely, share repurchases are associated with significant decreases in the number of trades per day and the fraction of days with trades. Also consistent with prior studies, we find significant increases in estimates of systematic risk following equity offerings and significant decreases in estimates of systematic risk following share repurchases when daily returns with no leads or lags are used (ordinary least squares (OLS) betas).

To test our hypothesis regarding the effect of trading activity on the measurement of security returns and the evolution of security prices, we reestimate systematic risk using the aggregated coefficient method (AC) proposed by Dimson (1979) and modified by Fowler and Rorke (1983). Specifi-

[1] With the exception of Lease, Masulis, and Page (1993), prior studies have not attempted to explain why estimates of systematic risk change following these events and typically attribute changes in beta estimates to changes in underlying firm risk. Lease, Masulis, and Page (1993) report significant increases in beta estimates even after adjusting for infrequent trading using the Scholes-Williams (1977) technique. They also examine changes in operating and financial leverage following a sample of equity offerings and find significant increases in operating leverage following equity offerings but no change in inflation-adjusted financial leverage. They conclude that the increases in equity betas and operating leverage following equity offerings are consistent with increased risk in the issuing firm's real asset portfolio.

cally, we regress security returns on leading, contemporaneous, and lagged market returns. Consistent with our hypothesis, we find a substantial reduction in the magnitude of changes in beta estimates following equity offerings and share repurchases when this corrective technique is employed. In fact, as predicted by Hamada (1972), we find that beta estimates decrease following equity offerings and increase following share repurchases when systematic risk is estimated using a 15-day lead-lag structure.

As a more direct test of our hypothesis, we examine the cross-sectional relation between changes in trading activity and changes in standard estimates of systematic risk. Our results indicate that changes in OLS beta estimates (no leads or lags) are significantly related to changes in trading activity. Moreover, we do not find significant changes in OLS beta estimates for firms that do not exhibit changes in trading activity.

The remainder of the article is organized as follows. Section I summarizes the literature linking returns measurement and price discovery to the estimation of systematic risk and describes our hypotheses relating changes in trading activity to changes in estimates of systematic risk surrounding equity offerings and share repurchases. Section II describes our sample selection process and presents descriptive statistics for our samples of equity offerings and share repurchases. Section III presents our main empirical results relating changes in trading activity to changes in estimates of systematic risk. Section IV summarizes our findings and discusses the implications of our results for other studies.

I. Trading Activity and the Estimation of Systematic Risk

The potential for measurement error when security returns are calculated using closing transaction prices is well known. Nonsynchronous trading—the tendency for prices recorded at the end of a day to represent the outcome of a transaction that occurred earlier in that day—is perhaps the most widely recognized source of error. The presence of nonsynchronous trading causes serial cross-correlations in security returns, which leads to biased estimates of systematic risk. Scholes and Williams (1977) and Dimson (1979) show that beta estimates for stocks whose shares are infrequently traded will be negatively biased, while those for frequently traded stocks will be positively biased. Scholes and Williams (1977) propose an aggregated coefficient methodology to correct for this bias that involves regressing the security's return on one lagging, the contemporaneous, and one leading market return. However, a drawback of their technique is that it does not make full use of available data as it requires returns for which there are no trades on either of the adjacent days to be discarded. Dimson (1979) proposes an alternative methodology that does not require nontrading returns to be discarded. The technique is similar to the AC methodology of Scholes and Williams, but requires a greater number of lead and lag terms.

In addition to nonsynchronous trading, Cohen *et al.* (1980, 1983a) argue that frictions in the trading process cause delays in the price-adjustment

process that can be relatively protracted. First, specialists or dealers may impede the adjustment of price quotations because of exchange stabilization obligations or temporary inventory imbalances.[2] Second, with positive transactions costs, it is optimal for investors to accumulate "news bits" until their value exceeds the cost of transacting (Goldman and Sosin (1979)). Cohen *et al.* (1983a) demonstrate how these delays in the evolution of security prices will also cause serial cross-correlations in security returns and, thus, lead to biased estimates of systematic risk.[3] In particular, beta estimates for stocks whose shares are subject to relatively low market frictions will be positively biased, while those for stocks whose shares are subject to relatively high market frictions will be negatively biased. In addition to price-adjustment delays, oscillation in transaction prices between bid and ask quotes reduces the measured correlation between the security's return and that of the market index, also causing estimates of systematic risk to be biased.

One way to correct for biases due to price adjustment delays is to use the AC methodology proposed by Scholes and Williams (1977) and Dimson (1979) to correct for the effects of nonsynchronous trading. However, as Cohen *et al.* (1983a) demonstrate, serial cross-correlations decay only gradually as the return measurement interval is extended beyond the maximum length of the delay.[4] As a result, an extensive lead-lag structure may be necessary to eliminate the bias in estimates of systematic risk even when the security trades every day. Since price-adjustment delays are not directly observable, it is not possible to specify a priori the number of leads and lags that will be necessary. However, previous empirical work does provide some benchmarks. For example, using daily data, Reinganum (1982) finds significant coefficients on 15-day lagged market returns for six of ten NYSE/AMEX size-based portfolios. Similarly, Mech (1993) finds that portfolios returns are significantly autocorrelated for lags of at least three weeks for NASDAQ stocks.

The above discussion suggests that any event that significantly alters the trading activity of a firm's shares will also affect return measurement and price evolution, and, thus, lead to changes in standard estimates of systematic risk. More specifically, events that increase trading activity will increase OLS beta estimates, while those that decrease trading activity will decrease OLS beta estimates. We report the results of three related tests of this hypothesis using samples of equity offerings and share repurchases. First, because equity offerings and share repurchases are associated with opposite changes in trading activity, they should be associated with opposite changes in OLS beta estimates. Second, the magnitude of changes in estimates of

[2] Hasbrouck and Sofianos (1993) report that adjustment lags in inventories for New York Stock Exchange specialists vary across stocks and can be as long as one or two months. Similarly, Madhavan and Smidt (1993) find that it takes an average 7.3 trading days for an imbalance in specialist inventory to be reduced by 50 percent.

[3] Mech (1993) presents evidence consistent with the hypothesis that autocorrelations in portfolio returns are due primarily to transactions costs slowing the process of price adjustment.

[4] Cohen *et al.* (1983b) find that some bias in estimates of systematic risk remains for return intervals of several weeks.

systematic risk surrounding equity offerings and share repurchases should decrease when estimation techniques that correct for the effects of return measurement error and price-adjustment delays are employed. Finally, changes in OLS beta estimates following equity offerings and share repurchases should be positively related to changes in trading activity.

II. Sample Selection and Description

In this section, we describe our sample selection procedure and present descriptive statistics for our samples of equity offerings and share repurchases. Throughout the article, we report results separately for NYSE/AMEX firms and NASDAQ firms for two reasons. First, some of the trading activity measures we use are not directly comparable across markets. For example, NASDAQ volume is reported differently from NYSE/AMEX volume, and there is no precise (or even approximate) algorithm for converting one definition to the other (see Atkins and Dyl (1992)). Second, by reporting results separately for NYSE/AMEX and NASDAQ firms, we can examine the robustness of previous findings as well as test our own predictions across different markets. Previous studies of equity offerings have documented increases in trading activity for both NYSE/AMEX and NASDAQ firms but have documented changes in beta estimates only for NYSE/AMEX firms. Similarly, changes in beta estimates have been reported following repurchase tender offers for NYSE/AMEX firms but not for NASDAQ firms. To our knowledge, no study has examined changes in trading activity following share repurchase tender offers.

A. Equity Offerings

Our initial sample of equity offerings is obtained from the *Investment Dealer's Digest* and consists of all 984 primary seasoned equity offerings completed between 1984 and 1989 by firms whose shares are traded on the NYSE, the AMEX, or the NASDAQ's National Market System (NMS). We restrict the NASDAQ sample to NMS firms because of the availability of daily number of trades on the Center for Research in Security Prices (CRSP) NMS tape. Our measures of trading activity for NYSE/AMEX firms are obtained from the transactions data tapes of the Institute for the Study of Securities markets (ISSM). We require that stock returns be available for at least 260 trading days prior to and 260 trading days following the equity offering.

The above process results in a final sample of 433 NYSE/AMEX and 359 NASDAQ seasoned equity offerings. The offerings are somewhat clustered in 1985 and 1986 with 47 percent of the NYSE/AMEX offerings and 59 percent of the NASDAQ offerings taking place in those years. The number of offerings ranges from 42 in 1987 to 111 in 1986 for the NYSE/AMEX sample and from 10 in 1984 to 123 in 1986 for the NASDAQ sample.

Panel A of Table I presents additional descriptive statistics for our samples of equity offerings. The NYSE/AMEX firms issue a median 1.8 million shares

and raise a median $41 million in new capital. The median NYSE/AMEX offering amounts to a 13 percent increase in shares outstanding. By way of comparison, Lease, Masulis, and Page (1993) report a median issue size of $41 million and a median increase in outstanding shares of 11 percent for an equity offerings sample of NYSE industrial firms over the period 1981 to 1983. Our NASDAQ firms issue a median 1.1 million shares and raise a median $18 million. The median NASDAQ offering amounts to a 19 percent increase in shares outstanding. By way of comparison, Loderer and Sheehan (1992) report a median issue size of $20 million and a median increase in shares outstanding of 21 percent for a sample of 284 NASDAQ NMS offerings over the period 1980 to 1986. Thus, our sample offerings appear to be comparable to those of previous studies.

B. Share Repurchases

Our initial sample of repurchase tender offers is drawn from the Appendix of Comment and Jarrell (1991). Their sample is obtained from a key-word search of the *Dow Jones News Retrieval* database and consists of all 166 repurchase tender offers announced between 1984 and 1989. We search the *Wall Street Journal Index* and the *Dow Jones News Retrieval* for each of these 166 repurchase offers and eliminate any that are clearly associated

Table I

Descriptive Statistics for the Equity Offerings and Share Repurchases

The samples include 433 NYSE/AMEX and 359 NASDAQ equity offerings and 81 NYSE/AMEX and 31 NASDAQ share repurchase tender offers completed between 1984 and 1989. All dollar values are expressed in millions of dollars. Shares outstanding and number of shares issued/repurchased are expressed in thousands.

	NYSE/AMEX Firms				NASDAQ Firms			
	Mean	Median	Min.	Max.	Mean	Median	Min.	Max.
Panel A: Equity Offerings								
Market value of equity	1,022	296	5	30,466	167	84	3	1,965
Shares outstanding	36,237	13,670	795	990,546	7,914	5,401	499	52,918
Number of shares issued	2,971	1,750	170	90,351	1,345	1,100	149	9,000
Issue value	72	41	1	1,006	25	18	2	255
Shares issued/ shares outstanding	0.17	0.13	0.01	1.26	0.24	0.19	0.02	2.62
Panel B: Share Repurchases								
Market value of equity	1,743	728	3	12,500	123	48	10	1,173
Shares outstanding	38,629	19,231	498	284,090	9,537	5,392	1,141	90,217
Shares repurchased	4,917	2,200	138	40,000	1,563	721	200	8,300
Repurchase value	209	80	0.9	1,280	23	10	0.4	156
Shares repurchased/ shares outstanding	0.14	0.13	0.03	0.50	0.20	0.20	0.04	0.54

with corporate control contests.[5] As with our equity offerings, daily trading activity data are obtained from the ISSM transactions tapes for NYSE/AMEX firms and from the CRSP NMS file for the NASDAQ firms. We again require that stock returns be available for at least 260 trading days prior to and 260 trading days following the repurchases.

The above process leaves us with 81 NYSE/AMEX and 31 NASDAQ share repurchase tender offers. Unlike the equity offerings, the repurchases do not exhibit obvious clustering through time. The number of repurchases per year ranges from 14 in 1985 to 28 in 1989. This lack of clustering is noteworthy in light of Comment and Jarrell (1991) who report that 473 exchange-listed firms announced *open-market* share repurchases in the fourth quarter of 1987 as compared with an average of 48 for all other quarters in the 1985 to 1988 period. In our sample, there are only 11 repurchase tender offers completed in the fourth quarter of 1987.

Panel B of Table I reports descriptive statistics for the repurchase samples. The NYSE/AMEX repurchases buy back a median 2.2 million shares with a median repurchase value of $80 million. The median reduction in outstanding shares as a result of the NYSE/AMEX repurchases is 13 percent. This is identical to the median 13 percent reduction in shares outstanding reported in Dann, Masulis, and Mayers' (1991) study of 122 repurchase tender offers completed by NYSE/AMEX firms over the period 1969 to 1978. Our NASDAQ repurchasing firms buy back a median 0.7 million shares with a median repurchase value of $10 million. The median reduction in outstanding shares as a result of the NASDAQ repurchases is 20 percent.

III. Empirical Results

Our empirical analysis focuses on trading activity and estimates of systematic risk. We proceed by first determining whether our sample offerings display changes in trading activity and beta estimates that are similar to those documented in previous studies. Next, we examine whether the magnitude of the change in beta estimates is reduced when corrective estimation techniques are used to address the biases discussed in Scholes and Williams (1977), Dimson (1979), and Cohen *et al.* (1983a). Finally, we directly examine the extent to which changes in trading activity are associated with changes in OLS beta estimates by conducting a cross-sectional analysis relating changes in OLS beta estimates to changes in several measures of trading activity.

A. Changes in Trading Activity

To assess changes in trading activity, we employ three measures—the number of trades per day, share turnover, and the fraction of days on which

[5] Conrad and Niden (1992) document significant changes in bid-ask spreads and trading volume around corporate acquisition announcements. Consequently, the inclusion of defensive repurchases would bias our results towards concluding that the sample repurchases affect trading activity.

the firms' shares trade. In calculating share turnover, we adjust shares outstanding for stock splits and stock dividends. Estimates of pre-offer trading activity are taken to be the average value of each measure over the 250 days prior to the offer date for the sample equity offerings and 250 days prior to the announcement of the share repurchases. Estimates of postoffer trading activity measures are averages over the 250 trading days immediately following the equity offerings and over the 250 trading days immediately following the expiration of the repurchase tender offers.[6] Throughout the article, we exclude the 2-week period centered on October 19, 1987 and the one-week period centered on October 13, 1989 to avoid any effects associated with the unusually large stock market declines during these periods. Table II reports descriptive statistics for each measure of trading activity prior to and subsequent to the offerings. Panel A reports the results for the sample of equity offerings, and Panel B reports those for the sample of share repurchases.

Consistent with Loderer and Sheehan (1992) and Lease, Masulis, and Page (1993), equity offerings are associated with a significant increase in trading activity. In particular, NYSE/AMEX firms average 38 trades per day (median = 24) prior to the sample offerings and 50 trades per day (median = 30) following the offerings. Similarly, average share turnover increases from 64 percent (median = 50 percent) prior to the offerings to 84 percent (median = 66 percent) following the offerings, and the average percentage of days with trades increases from 98.7 percent (median = 100.0 percent) in the preoffer period to 99.6 percent (median = 100.00 percent) following the offer. For the NASDAQ firms, there is an average of 23 trades per day (median = 14) prior to the offerings and 38 trades per day (median = 22) following the offerings. Average share turnover increases from 89 percent (median = 58 percent) prior to the offerings to 162 percent (median = 115 percent) following the offerings.[7] Finally, the average percentage of days with trades increases from 94.3 percent (median = 100.0 percent) to 98.6 percent (median = 100.0 percent) following the offerings. All of these changes in trading activity for NYSE/AMEX and NASDAQ firms are significant at the 0.01 level.

[6] We exclude the period between the announcement and the expiration of the repurchase in our tests for two reasons. First, since the repurchases offer a fixed price for tendered shares during the announcement to expiration interval, this produces a biased measure of the correlation between the repurchasing firm's stock returns and those of other firms. Second, Lakonishok and Vermaelen (1990) document that repurchases are associated with unusual trading activity (perhaps due to portfolio rebalancing considerations) in the period between announcement and expiration. Inclusion of this period would therefore lead to a biased inference regarding changes in trading activity following repurchases. In contrast, since the results in Lease, Masulis, and Page (1993) and Loderer and Sheehan (1992) indicate that unusual trading activity is concentrated primarily in the period following the offer date for equity offerings, we include the period between the announcement and offer dates as part of the preoffer period. Our results are not sensitive to this choice, however.

[7] The fact that share turnover is substantially higher for the sample of NASDAQ equity offerings than for the NYSE/AMEX equity offerings is undoubtedly due in part to differences in the manner in which trading volume is reported for NMS versus NYSE/AMEX firms. See Atkins and Dyl (1992).

Table II

Changes in Trading Activity for the Samples of Equity Offerings and Share Repurchases

Alternative measures of trading activity for the samples of 433 NYSE/AMEX and 359 NASDAQ equity offerings and 81 NYSE/AMEX and 31 NASDAQ share repurchase tender offers completed over the period 1984–1989. The trading activity measures are defined as follows: Number of trades is the average number of trades per day. Share turnover is annualized trading volume expressed as a percentage of continuously-adjusted shares outstanding. For equity offerings, pre-offer measures are averaged over the 250 trading days ending one day prior to the offering, while post-offer measures are averaged over the 250 trading days beginning one day after the offer. For repurchases, pre-offer measures are calculated over the 250 trading days ending one day prior to the announcement of the offer, while post-offer measures are estimated over the 250 trading days beginning one day after completion of the repurchase. Means are listed with medians below. Significance is measured using the standard t-test for means and the z-value from the nonparametric Wilcoxon signed ranks test for medians.

	NYSE/AMEX Firms				NASDAQ Firms			
Variable	Preoffer Period	Postoffer Period	Change	*t*-Statistic *z*-Value	Preoffer Period	Postoffer Period	Change	*t*-Statistic *z*-Value
Panel A: Equity Offerings								
Number of trades	37.5	49.6	11.9	8.96	22.6	37.8	15.1	10.06
	24.1	29.9	6.5	11.96	14.0	22.3	6.8	12.88
Share turnover	63.8%	83.7%	19.9%	8.18	89.0%	162.0%	73.3%	8.29
	49.6%	65.8%	14.1%	11.03	58.0%	115.4%	38.2%	8.22
Percentage of days with trades	98.7%	99.6%	0.8%	5.75	94.3%	98.6%	4.3%	7.21
	100.0%	100.0%	0.0%	8.03	100.0%	100.0%	0.0%	7.66
Panel B: Share Repurchases								
Number of trades	45.7	40.7	−5.2	−2.68	15.9	14.6	−1.3	−0.38
	19.8	22.4	−2.1	−2.53	6.0	4.7	−0.4	−1.35
Share turnover	55.2%	54.3%	−0.9%	−0.29	62.5%	66.6%	4.1%	0.47
	45.9%	45.9%	−2.2%	−1.10	42.1%	37.3%	−2.2%	0.19
Percentage of days with trades	98.1%	95.9%	−2.2%	−3.27	88.3%	84.9%	−3.4%	−1.95
	100.0%	100.0%	0.0%	−3.99	93.8%	91.5%	−1.1%	−2.14

In contrast to the equity offerings, there is weak evidence of a decrease in trading activity following share repurchases. In particular, NYSE/AMEX firms average 46 trades per day (median = 20) prior to the repurchase and 41 (median = 22) following the repurchase. Similarly, average daily share turnover decreases from 55 percent (median = 46 percent) prior to the repurchase to 54 percent (median = 46 percent) following the repurchase. Additionally, prior to the repurchase, shares of the NYSE/AMEX repurchasing firms trade on 98.1 percent of trading days, on average (median = 100.00 percent). Following the repurchase, this percentage decreases to 95.9 percent, on average (median = 100.0 percent). With the exception of changes in share turnover, these reductions in trading activity for NYSE/AMEX firms are

significant at the 0.01 level. For NASDAQ firms, changes in number of trades and share turnover are in the predicted direction but are not statistically significant, perhaps reflecting the small sample size for NASDAQ repurchases. The percentage of days with trades decreases from a mean of 88.3 percent (median = 93.8 percent) prior to the repurchase to 84.9 percent (median = 91.5 percent) following the repurchase; the mean and median change are significant at the 0.04 and 0.01 levels, respectively.

In sum, our sample equity offerings are associated with large increases in trading activity, while our sample share repurchases are associated with small decreases in trading activity. A possible explanation for the difference in magnitude is that equity offerings and share repurchases have different effects on share ownership. In an equity offering, new shares are issued to buyers who may or may not be current shareholders of the firm. Consequently, there is, on average, an expansion of the firm's ownership base (Loderer and Sheehan (1992)). In contrast, repurchase tender offers are typically pro rata repurchases of the existing shareholders' shares. Thus, a repurchase is less likely to result in a change in the firm's ownership base and, consequently, may be associated with smaller changes in trading activity.

B. Changes in Estimates of Systematic Risk

Given the above changes in trading activity, the market microstructure literature predicts that we should observe increases in OLS beta estimates following equity offerings and decreases in OLS beta estimates following share repurchases. To determine whether our samples exhibit these hypothesized changes, we estimate betas by regressing daily stock returns on the contemporaneous return of either the CRSP NYSE/AMEX equally weighted index or the NASDAQ Composite Index, depending on the trading locale of the firm's shares.[8] Table III reports cross-sectional descriptive statistics of beta estimates prior to and subsequent to the offerings. Panel A reports beta estimates for the samples of equity offerings, while panel B reports those for the samples of share repurchases.

Consistent with previous studies, the equity offerings are associated with a significant increase in OLS betas. From Panel A, OLS beta estimates increase from a mean of 1.06 (median = 1.00) prior to the offering to a mean of 1.15 (median = 1.09) following the offering for NYSE/AMEX firms and from a mean of 1.01 (median = 0.92) to a mean of 1.18 (median = 1.06) for NASDAQ firms. These differences are all significant at the 0.01 level and are similar to the beta changes documented in Healy and Palepu (1990) and Lease, Masulis, and Page (1993) for NYSE/AMEX firms.

By contrast, the repurchases of NYSE/AMEX firms are associated with significant decreases in OLS betas. From Panel B, OLS beta estimates decline from an average of 1.04 (median = 1.06) prior to the repurchase to

[8] We replicated the analysis of Table III using the CRSP value-weighted index and found no qualitative differences in the results.

Table III

Changes in Systematic Risk for the Samples of Equity Offerings and Share Repurchases

Alternative estimates of preoffer and postoffer systematic risk (beta) for the samples of 433 NYSE/AMEX and 359 NASDAQ equity offerings and 81 NYSE/AMEX and 31 NASDAQ share repurchase tender offers completed over the period 1984 to 1989. For equity offerings, preoffer betas are estimated over the 250 trading-day period preceding the offers, while postoffer betas are estimated over the 250 days following the equity offerings. For repurchases, preoffer betas are estimated over the 250 days prior to the repurchase announcement, while postoffer betas are estimated over the 250 days following completion of the repurchase. Beta estimates involving lead and lagged coefficients are computed using the technique detailed in Fowler and Rorke (1983). Means are listed with medians below. Significance of changes in betas are measured using a standard t-test for means and the Wilcoxon signed ranks test for medians.

	NYSE/AMEX Firms				NASDAQ Firms			
Beta Estimator	Preoffer Period	Postoffer Period	Change	t-Statistic z-Value	Preoffer Period	Postoffer Period	Change	t-Statistic z-Value
Panel A: Equity Offerings								
OLS	1.06	1.15	0.08	3.76	1.01	1.18	0.16	5.52
	1.00	1.09	0.06	3.96	0.92	1.06	0.16	5.72
Daily (2 lead, 2 lag)	1.04	1.14	0.09	3.68	1.06	1.19	0.13	3.34
	0.99	1.09	0.12	3.97	1.00	1.09	0.16	4.01
Daily (5 lead, 5 lag)	1.01	1.08	0.07	1.80	1.14	1.25	0.12	2.22
	0.89	0.99	0.08	2.41	1.12	1.21	0.13	2.58
Daily (10 lead, 10 lag)	0.99	1.00	0.01	0.19	1.20	1.27	0.06	0.89
	0.88	0.90	0.01	0.39	1.18	1.14	0.04	0.66
Daily (15 lead, 15 lag)	1.01	1.01	−0.01	−0.08	1.19	1.19	0.00	0.05
	0.88	0.84	−0.04	−0.37	1.13	1.04	−0.03	−0.07
Panel B: Share Repurchases								
OLS	1.04	0.93	−0.11	−2.12	0.68	0.61	−0.07	−0.53
	1.06	0.90	−0.16	−3.00	0.60	0.60	0.04	0.08
Daily (2 lead, 2 lag)	0.96	0.92	−0.03	−0.45	0.51	0.73	0.22	1.21
	0.96	0.78	−0.07	−0.54	0.57	0.53	0.25	0.12
Daily (5 lead, 5 lag)	0.96	0.91	−0.05	−0.63	0.52	0.71	0.18	1.01
	0.96	0.79	−0.08	−0.76	0.54	0.59	0.22	1.48
Daily (10 lead, 10 lag)	0.92	0.97	0.06	0.58	0.41	0.73	0.32	1.59
	0.92	0.88	0.09	0.60	0.26	0.75	0.27	1.37
Daily (15 lead, 15 lag)	0.91	1.02	0.11	0.89	0.45	0.59	0.14	0.36
	0.86	0.90	0.11	1.25	0.57	0.92	0.33	0.54

0.93 (median = 0.90) following the repurchase. The differences in mean and median OLS beta estimates are significant at the 0.04 and 0.00 levels, respectively. These differences are similar to those found in Dann, Masulis, and Mayers' (1991) sample of repurchase tender offers of NYSE/AMEX firms

over an earlier time period. The NASDAQ repurchasing firms also exhibit decreases in OLS beta estimates; however, these changes are not statistically significant.

If the above changes in beta estimates are due to changes in the accuracy with which returns are measured or the speed by which prices adjust to new information, we would expect the magnitude of the change around the capital structure events to decrease as corrective estimation techniques are employed. However, if the changes in beta are more than just a statistical artifact, we should still observe significant beta changes after correcting for estimation biases.

To examine this issue, we reestimate pre- and postoffer betas for our samples of equity offerings and share repurchases using the AC method proposed by Dimson (1979) and modified by Fowler and Rorke (1983). Specifically, we regress daily stock returns on lagged, contemporaneous, and leading market returns. The AC beta estimate is then computed as a weighted sum of the coefficients on the market returns.[9]

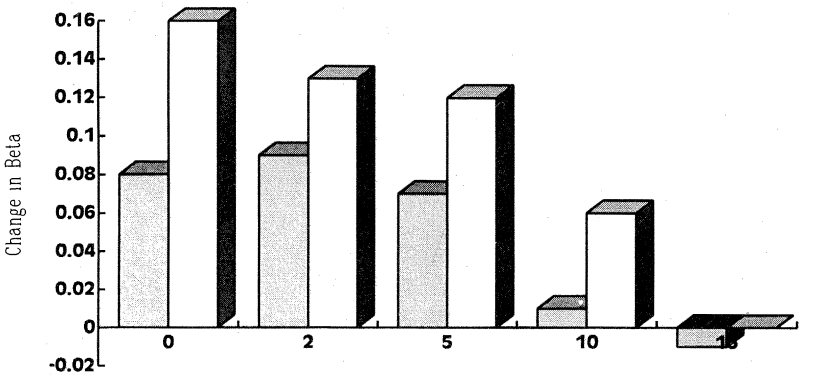
As Dimson (1979) observes, there is a tradeoff between bias and efficiency when using the AC methodology. In particular, as the number of lead and lagged terms used to estimate beta (n) increases, there is a reduction in the biases caused by measurement error and price-adjustment delays. However, because the coefficients of the leading and lagged market returns are estimated with error, the efficiency of the AC beta estimates declines as n increases. As mentioned previously, price-adjustment delays are unobservable, and thus, it is not possible to know a priori how many leads and lags are necessary to eliminate the bias. However, previous empirical work has documented significant lagged coefficients up to 15 days.

To avoid the appearance of data mining, we use symmetric leads and lags in each estimation and do not experiment with asymmetric lead and lag structures. The relative importance of leading and lagged coefficients will, in general, be sample specific and will depend on the distribution of trading frequencies in the sample. Leading coefficients will tend to be more important for frequently traded securities, while lagged coefficients will be more important for infrequently traded securities. We also employ the same 250-day preoffer and postoffer periods for all beta estimates. The results are reported in Table III and depicted graphically in Figure 1.

From Panel A of Table III, the use of 5-day (2 lead, 2 lag) betas appears to have little effect on estimates of pre- and postoffer betas in the equity offering samples. Mean and median changes in beta remain significant at the 0.01 level in both the NYSE/AMEX and NASDAQ samples. These results suggest that changes in OLS betas following equity offerings are not caused solely by a reduction in short-term price-adjustment delays. These findings also con-

[9] Fowler and Rorke (1983) show that unweighted AC betas are biased when the market index return is autocorrelated. They propose a procedure to correct for this bias that involves weighting the lead and lag beta coefficients by a decaying weighted average of market index autocorrelations. For additional details, see Fowler and Rorke (1983).

Panel A: Equity Offerings



Panel B: Share Repurchases

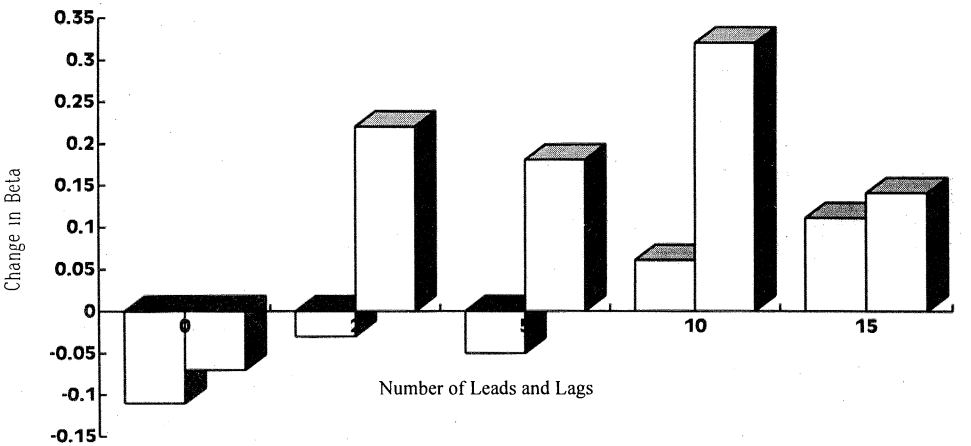


Figure 1. Mean changes in estimates of systematic risk (beta) following equity offerings and share repurchases. For equity offerings, preoffer betas are estimated over the 250 trading-day period preceding the offers, while postoffer betas are estimated over the 250 days following the equity offerings. For repurchases, preoffer betas are estimated over the 250 days prior to the repurchase announcement, while postoffer betas are estimated over the 250 days following the completion of the repurchase. Daily betas involving lead and lagged coefficients are computed using the technique detailed in Fowler and Rorke (1983). *Shaded bars* are NYSE/AMEX firms, and *open bars* are NASDAQ firms.

form with the finding in Lease, Masulis, and Page (1993) that equity offering firms exhibit significant increases in Scholes-Williams betas following the offering. By contrast, in the repurchase sample (Panel B) changes in 5-day betas are statistically insignificant, suggesting that an increase in short-term price adjustment delays is a major component of the decrease in OLS beta estimates following the repurchases of the NYSE/AMEX firms.

When we increase the number of leads and lags used to estimate beta, there is a near monotonic decline in changes in beta estimates following equity offerings and a near monotonic increase in changes in beta estimates following share repurchases.[10] Specifically, from Panel A, mean (median) changes in beta decline from 0.07 (0.08) to −0.01 (−0.04) for NYSE/AMEX firms and from 0.12 (0.13) to 0.00 (−0.03) for NASDAQ firms as the number of leads and lags increases from five to fifteen. In both the NYSE/AMEX and NASDAQ samples, the changes in beta are statistically indistinguishable from zero when more than five leads and lags are used. In Panel B, mean (median) changes in beta increase from −0.05 (−0.08) to 0.11 (0.11) for NYSE/AMEX firms and from 0.18 (0.14) to 0.14 (0.33) for NASDAQ firms as the number of leads and lags increases from 5 to 15. None of these changes in beta estimates are statistically significant.[11]

B.1. Changes in Betas and Changes in Leverage

That we observe decreases in beta estimates following equity offerings and increases in beta estimates following share repurchases (15-day lead-lag structure) is consistent with Hamada (1972). In particular, Hamada's model predicts that equity betas are an increasing function of financial leverage; i.e.

$$\beta_e = \beta_a + (\beta_a - \beta_d)(D/E) \tag{1}$$

where: β_e, β_a, and β_d represent the systematic risk of the firm's equity, assets, and debt, respectively; and D/E represents the ratio of debt to equity.

Under the assumption that the beta of debt is equal to zero and asset betas are unchanged, the change in equity beta associated with a capital structure event is given by

$$\Delta\beta_e = \beta_a \Delta(D/E) \tag{2}$$

Thus, Hamada's model predicts that equity betas will decline following equity offerings and increase following share repurchases due to the changes in financial leverage following these events.

[10] That the magnitude and significance of changes in OLS beta estimates are larger for the NASDAQ sample is consistent with there being a greater incidence of nonsynchronous trading and price adjustment delays for these firms. This in turn suggests that correcting for these biases may be more important in samples containing NASDAQ firms.

[11] Because changes in trading activity occur at the time of the offer, one might expect differences between OLS beta estimates and corrected beta estimates to be confined to the postoffer period. However, the fact that preoffer daily betas are overestimated for frequently traded stocks and underestimated for infrequently traded stocks suggests that both preoffer and postoffer beta estimates may change as corrective estimation techniques are employed.

To determine whether the changes in beta estimates (15-day lead-lag) conform with those predicted by Hamada, we calculate the implied change in beta surrounding each offering using Hamada's model. More specifically, we first estimate each firm's asset beta (β_a) by unlevering the firm's preoffering equity beta.[12] We then compute the change in the debt-equity ratio ($\Delta D/E$) from the year prior to the offering to the year following the offering. From equation (2), the implied beta change is the product of β_a and $\Delta(D/E)$.

With the exception of the NASDAQ repurchase sample, the changes in betas (15-day lead-lag) conform fairly closely with those predicted by Hamada (1972). In particular, from Panel A of Table IV, mean (median) implied beta changes are -0.14 (-0.03) for the NYSE/AMEX equity issuers, -0.05 (-0.02) for the NASDAQ equity issuers, 0.06 (0.03) for the NYSE/AMEX repurchasing firms, and 0.03 (0.01) for the NASDAQ repurchasers.

In Panel B of Table IV, we report coefficient estimates from regressions of 15-day lead-lag beta changes on beta changes implied by Hamada's model. For the NYSE/AMEX and NASDAQ equity offerings samples, there is a significant positive relation between observed and implied beta changes. Moreover, the intercept in these regression models is statistically insignificant, suggesting there are no systematic changes in beta over and above those due to changes in leverage. The results for the repurchase samples are much weaker; we find no evidence of a systematic relation between observed and predicted beta changes.[13]

Overall, the results of Table IV suggest that, after correcting for biases in beta estimates, the magnitude of the change in beta following equity offerings and share repurchases conforms fairly closely with what might be expected given the changes in financial leverage following these events.

B.2. Daily Versus Weekly Returns

A natural question concerns potential tradeoffs from using daily versus weekly returns to estimate systematic risk. On the one hand, the statistical behavior of coefficients from an extensive lead-lag structure is not empirically well understood. On the other hand, aggregating daily returns to weekly returns may introduce its own biases.[14] To examine the robustness of our

[12] Our estimate of total debt is taken to be the average of the firm's total debt (COMPUSTAT #6 − COMPUSTAT #60) for the year ending prior to the offering and the firm's total debt for the year ending following the offering. The market value of equity is taken from CRSP as of the day prior to the offering.

[13] Because our samples are characterized by large outliers for both actual and predicted beta changes, we reestimated the regressions in Table IV excluding those observations with a Cook's D-statistic greater than 0.1. This screen eliminated three NYSE/AMEX equity issues, four NASDAQ equity issues, three NYSE/AMEX repurchases, and four NASDAQ repurchases. The use of these trimmed samples increases the coefficient on the predicted beta change from 0.40 to 0.56 for NYSE/AMEX equity issue, from 0.32 to 0.63 for NASDAQ equity issue, from -0.02 to 0.24 for NYSE/AMEX repurchases, and from -0.57 to 0.00 for NASDAQ repurchases. The coefficients for the repurchase samples remain insignificant, however.

[14] To the extent that daily returns are not independent and identically distributed, aggregation to weekly returns will introduce biases in beta estimates of unknown magnitude and direction (see Hinich and Patterson (1989)).

Table IV

A Comparison of Actual Beta Changes with Predicted Beta Changes for the Samples of Equity Offerings and Share Repurchases

A comparison of beta change estimates using the 15-day lead-lag structure with those predicted from Hamada's (1972) model. To obtain predicted beta changes we first estimate each firm's asset beta, β_a, by unlevering the firm's equity beta via Hamada's approach. The predicted beta change is then the product of β_a and the change in the firm's debt-equity ratio from the year ending just prior to the year following the capital structure change. Panel A reports mean beta change estimates with medians below. Panel B reports estimates of cross-sectional regressions of actual beta changes on predicted beta changes (t-statistic in parentheses). The sample includes 433 NYSE/AMEX and 359 NASDAQ equity offerings and 81 NYSE/AMEX and 31 NASDAQ share repurchase tender offers completed over the period 1984 to 1989.

Panel A: Actual vs. Predicted Beta Changes

	NYSE/AMEX Firms		NASDAQ Firms	
	Actual	Predicted	Actual	Predicted
Equity offerings	−0.02	−0.14	0.02	−0.05
	−0.05	−0.03	0.01	−0.02
Share repurchases	0.05	0.06	0.22	0.03
	0.09	0.03	0.28	0.01

Panel B: Cross-sectional Regressions: *Actual* $\Delta\beta = \gamma_0 + \gamma_1$ (*Predicted* $\Delta\beta$)

	γ_0	γ_1	Adj. R^2	F-statistic
NYSE/AMEX equity offerings	0.038	0.395	0.03	14.82
	(0.58)	(3.85)		
NASDAQ equity offerings	0.040	0.319	0.01	2.91
	(0.44)	(1.71)		
NYSE/AMEX share repurchases	0.055	−0.015	−0.01	0.00
	(0.43)	(−0.03)		
NASDAQ share repurchases	0.238	−0.570	−0.03	0.24
	(0.64)	(−0.48)		

findings with respect to the interval over which returns are measured, we reestimate the beta coefficients of Table III using weekly returns data. Note that using weekly returns with no leads and lags is comparable to using daily returns with two leads and lags. Consistent with this, for equity offerings the mean (median) beta changes using weekly returns with no leads and lags are 0.14 (0.11) for NYSE/AMEX firms and 0.16 (0.15) for NASDAQ firms. Similarly, using weekly returns with three leads and lags is comparable to using daily returns with 15 leads and lags. Consistent with this we find mean (median) beta changes of −0.02 (0.00) for NYSE/AMEX firms and 0.04 (0.04) for NASDAQ firms when weekly data with three leads and lags are employed; all are statistically insignificant. Thus the estimates using weekly returns are qualitatively similar to those using daily returns.

Turning to the repurchases, our estimate using weekly returns are similar to those using daily returns. Neither share repurchase sample exhibits significant beta changes when weekly returns are employed. (Recall from Table III that significant beta changes are observed only for daily returns with no leads or lags in the NYSE/AMEX repurchase sample.) These findings provide some assurance that our estimates using daily returns are not the result of biases from the use of extensive leads and lags.

C. Beta Estimates and Trading Activity

The previous results indicate that equity offerings are associated with significant increases in trading activity and OLS beta estimates, while share repurchases are associated with significant decreases in trading activity and OLS beta estimates. Furthermore, we find that the changes in beta estimates are no longer significant after correcting for estimation biases due to nonsynchronous trading and price adjustment delays. While these results are consistent with our hypothesis linking changes in trading activity with changes in estimates of systematic risk, more direct evidence can be obtained by examining the cross-sectional relation between changes in OLS betas and changes in trading activity.

C.1 Changes in OLS Betas and Changes in Trading Activity

This section presents the results of cross-sectional tests relating changes in OLS beta estimates to changes in share turnover, number of trades, and percentage of days with trades. More specifically, we partition the sample equity offerings and share repurchases into quartiles on the basis of changes in trading activity and examine changes in OLS beta estimates within each quartile. Our hypothesis predicts that changes in OLS beta estimates will be positively related to changes in trading activity. Moreover, in light of our results in Table III, we do not expect to observe significant changes in OLS beta estimates for those firms that do not exhibit substantial changes in trading activity. Table V reports mean and median changes in OLS beta estimates across quartiles of changes in trading activity, where quartile (1) contains those firms with the smallest change in trading activity. Panels A and B report the results for the NYSE/AMEX and NASDAQ equity offerings, while Panels C and D report those for the NYSE/AMEX and NASDAQ share repurchases.

Consistent with our hypothesis, there is a near monotonic relation between changes in OLS beta estimates and changes in trading activity.[15] Also consistent with our hypothesis, changes in OLS beta estimates are generally

[15] We are unable to test the relation between changes in the fraction of days with trades and daily beta estimates in Panel A since only 11 of the 433 NYSE/AMEX equity offerings have a reduction in the fraction of days with trades following the offering. Consequently, quartile (3) in Panel A contains only 11 firms and quartile (4) contains 422 firms. Similarly, in Panel B, we combine quartiles (3) and (4) and in Panel C we combine quartiles (1) and (2) for the change in fraction of days with trades since more than 25 percent of the sample repurchases experience no change in this fraction.

insignificant in those quartiles with the smallest changes in trading activity but highly significant in those quartiles with the largest changes in trading activity. For example, in the equity offerings samples (Panels A and B), OLS beta changes are insignificant in quartile (1) for all measures of trading activity except for share turnover in the NASDAQ sample. In contrast, changes in OLS beta estimates are highly significant in quartile (4) for all trading activity measures in both the NYSE/AMEX and NASDAQ samples. Similarly, for share repurchases, changes in OLS beta estimates are statisti-

Table V

The Relation Between Changes in Trading Activity and Changes in OLS Betas for the Samples of Equity Offerings and Share Repurchases

Changes in OLS beta estimates by quartile of changes in trading activity where quartile (1) contains the observations with the smallest absolute change in trading activity. The trading activity measures are defined as follows: Number of trades is the average number of trades per day; Share turnover is annualized trading volume expressed as a percentage of continuously adjusted shares outstanding; Means are listed with medians in parentheses and the median value for the trading activity measure in brackets below. The χ^2 statistic tests for a significant association between changes in trading activity and changes in OLS beta estimates. The sample includes 433 NYSE/AMEX and 359 NASDAQ equity offerings and 81 NYSE/AMEX and 31 NASDAQ share repurchase tender offers over the period 1984 to 1989.

Trading Activity Measure	Quartile of Change in Trading Activity (1)	(2)	(3)	(4)	χ^2
Panel A: Equity Offerings—NYSE/AMEX Firms					
Number of trades	0.05	0.08**	0.02	0.18***	5.4**
	(0.04)	(0.06)**	(0.06)	(0.10)***	
	[−0.12]	[0.19]	[0.53]	[1.21]	
Share turnover	0.02	0.06	0.14***	0.11**	0.8
	(0.04)	(0.05)*	(0.13)***	(0.04)**	
	[−17.2]	[18.3]	[53.4]	[131.6]	
Fraction of days with trades	NA[a]	NA[a]	0.14	0.08***	0.1
			(0.20)	(0.06)***	
			[−0.008]	[0.000]	
Panel B: Equity Offerings—NASDAQ Firms					
Number of trades	0.01	0.04	0.25***	0.35***	20.5***
	(0.00)	(0.05)	(0.29)***	(0.30)***	
	[−0.07]	[0.43]	[0.92]	[1.93]	
Share turnover	0.11*	0.06	0.19***	0.28***	6.8***
	(0.06)	(0.12)*	(0.21)***	(0.28)***	
	[−51.1]	[14.4]	[174.1]	[541.3]	
Fraction of days with trades	0.15	0.17***	NA[b]	0.15***	0.3
	(0.05)	(0.19)***		(0.13)***	
	[−0.07]	[0.000]		[0.18]	

Table V—*Continued*

Trading Activity Measure	Quartile of Change in Trading Activity (1)	(2)	(3)	(4)	χ^2
	Panel C: Share Repurchases—NYSE/AMEX Firms				
Number of trades	0.123 (−0.11) [0.345]	−0.08 (−0.05) [−0.053]	0.15* (−0.18)** [−0.247]	−0.35*** (−0.44)*** [−0.551]	3.0*
Share turnover	0.12 (−0.02) [39.6]	−0.22** (−0.27)*** [1.9]	−0.03 (−0.09) [−17.8]	−0.33*** (−0.40)*** [−52.1]	3.1*
Fraction of days with trades	−0.02 (−0.08) [0.00]	NA[c]	−0.09 (−0.32) [−0.005]	−0.37*** (−0.40)*** [−0.054]	3.9**
	Panel D: Share Repurchases—NASDAQ Firms				
Number of trades	0.14 (0.47) [0.573]	−0.18 (0.04) [0.064]	0.28* (−0.16) [−0.331]	−0.36 (−0.09) [−0.498]	8.0***
Share turnover	0.03 (0.19) [57.5]	0.01 (−0.03) [17.5]	−0.17 (−0.20) [−14.8]	−0.25 (−0.09) [−33.9]	2.3
Fraction of days with trades	0.03 (0.28) [0.026]	−0.06 (−0.10) [−0.000]	0.02 (−0.10) [−0.027]	−0.29 (0.04) [−0.237]	3.2*

[a] Quartiles (1), (2), and (3) are combined since only 11 of the 433 NYSE/AMEX equity offerings have a reduction in the fraction of days with trades. Thus quartile (3) contains 11 firms and quartile (4) contains 422 firms.

[b] Quartiles (3) and (4) are combined since more than 25 percent of the observations experience no change in the fraction of days with trades.

[c] Quartiles (1) and (2) are combined since more than 25 percent of the observations experience no change in the fraction of days with trades.

***, **, and * denote significance at the 0.01, 0.05, and 0.10 levels, respectively.

cally insignificant for all measures of trading activity in quartile (1) for both NYSE/AMEX and NASDAQ repurchasing firms. As was the case with equity offerings, significant changes in OLS beta estimates are confined almost exclusively to quartiles (3) and (4).

To assess the significance of the relation between changes in trading activity and changes in OLS beta estimates, we employ a chi-square test of association. The results, presented in the last column of Table V, indicate that, for NYSE/AMEX equity offerings (Panel A), there is a significant relation between changes in OLS beta estimates and changes in the number of trades (chi-square = 5.4). For share turnover and the fraction of days with trades, the chi-square statistics are insignificant. For NASDAQ equity offer-

ings (Panel B), changes in OLS beta estimates are significantly related to changes in number of trades (chi-square = 20.5, p-value = 0.00) and share turnover (chi-square = 6.8, p-value = 0.01) but unrelated to the change in the fraction of days with trades (chi-square = 0.3, p-value = 0.57).

We obtain similar results for the samples of share repurchases. For NYSE/AMEX repurchases, changes in OLS beta estimates are significantly related to changes in the number of trades (chi-square = 3.0, p-value = 0.09), share turnover (chi-square = 3.1, p-value = 0.08), and the fraction of days with trades (chi-square = 3.9, p-value = 0.05). For NASDAQ repurchases, changes in OLS beta estimates are significantly related to changes in the number of trades (chi-square = 8.0, p-value = 0.01) and the fraction of days with trades (chi-square = 3.2, p-value = 0.08) but unrelated to changes in share turnover (chi-square = 2.3, p-value = 0.13).

C.2 An Alternative Hypothesis

While the results of Table V are consistent with our hypothesis relating changes in estimates of systematic risk to changes in trading activity, they are also consistent with an alternative hypothesis in which both changes in beta and changes in trading activity are related to the economic importance of the event. To address this issue, we regress the change in OLS beta estimate on the relative size of the offering—our proxy for the event's economic importance. The relative size of the offering ($\Delta SHARES$) is defined as the change in shares outstanding as a fraction of preoffer shares outstanding. The estimated coefficients are reported in Table VI. Panels A and B report the results for the NYSE/AMEX and NASDAQ equity offerings samples, while Panels C and D report those for the NYSE/AMEX and NASDAQ repurchase samples.

Under the alternative hypothesis that beta changes are related to the economic importance of the event, changes in OLS beta estimates should be positively related to $\Delta SHARES$. From model (1) of Table VI, there is no evidence that changes in OLS beta estimates are positively related to relative offering size for any of the four samples. By contrast, when we regress the change in OLS beta estimates on the three proxies for changes in trading activity (model (2)), we find that at least one coefficient is significant in each of the four regressions.[16] Most notably, the coefficient of the change in daily number of trades is positive and significant in three of the four samples, suggesting that the number of trades per day is perhaps the most important indicator of the accuracy of closing transaction prices. In addition, the percentage change in the number of days with no trades is significant for the two NASDAQ samples. This is consistent with greater nontrading problems for NASDAQ firms than for NYSE/AMEX firms (Table II).

[16] Our measures of trading activity are not intended to represent independent influences on beta changes but, rather, alternative proxies for the same unknown factor—the change in trading activity. We obtain similar results in regressions in which just a single trading activity measure is used, but we report only the multivariate specification for the sake of brevity.

Table VI

Cross-Sectional Regressions Relating Changes in OLS Beta Estimates to Changes in Trading Activity and Relative Offering Size

Independent variables are defined as follows: $\Delta TRADE$ = percentage change in the average daily number of trades; $\Delta TURN$ = change in annualized trading volume expressed as a percentage of shares outstanding; $\Delta ZERO$ = percentage change in the number of days with no trades; $\Delta SHARES$ = the change in shares outstanding expressed as a fraction of preoffering shares outstanding. Coefficient estimates are reported with the associated t-statistics in parentheses below. The sample includes 433 NYSE/AMEX and 359 NASDAQ equity offerings and 81 NYSE/AMEX and 31 NASDAQ share repurchase tender offers over the period 1984 to 1989.

	Independent Variables						
Model	Intercept	$\Delta SHARES$	$\Delta TRADES$	$\Delta TURN$	$\Delta ZERO$	Adj. R^2	F-Statistic
			Panel A: Equity Offerings—NYSE/AMEX Firms				
(1)	0.042	0.142				−0.001	0.740
	(1.22)	(0.86)					
(2)	0.024		0.084	−0.021	0.532	0.012	2.571
	(0.85)		(1.79)	(−0.42)	(0.81)		
(3)	0.023	0.009	0.084	−0.021	0.526	0.008	1.364
	(0.62)	(0.05)	(1.77)	(−0.41)	(0.79)		
			Panel B: Equity Offerings—NASDAQ Firms				
(1)	0.161	−0.010				−0.003	0.004
	(3.62)	(−0.07)					
(2)	0.048		0.135	0.021	−0.417	0.053	7.516
	(1.20)		(3.74)	(0.51)	(−1.79)		
(3)	0.035	0.056	0.135	0.023	−0.420	0.050	5.657
	(0.65)	(0.37)	(3.74)	(0.54)	(−1.80)		
			Panel C: Share Repurchases—NYSE/AMEX Firms				
(1)	−0.289	−1.257				0.036	3.905
	(−2.69)	(−1.98)					
(2)	−0.056		0.261	0.473	0.792	0.200	7.482
	(−1.04)		(1.30)	(1.79)	(1.05)		
(3)	−0.202	−1.021	0.282	0.407	0.788	0.222	6.550
	(−2.05)	(−1.77)	(1.43)	(1.55)	(1.06)		
			Panel D: Share Repurchases—NASDAQ Firms				
(1)	−0.093	−0.067				−0.037	0.003
	(−0.31)	(−0.05)					
(2)	−0.130		1.040	−0.352	−3.339	0.124	2.319
	−0.91)		(1.72)	(−0.69)	(−2.45)		
(3)	−0.112	0.094	1.033	−0.347	−3.344	0.088	1.671
	(−0.40)	(0.08)	(1.65)	(−0.66)	(−2.40)		

As a final test, we regress the change in OLS beta estimate on the change in trading activity while controlling for the relative size of the offering. The coefficients of the trading activity variables are very similar to those in model (2), while the coefficient of relative offering size remains statistically insignificant.[17] The results of Table VI suggest that the economic importance of an offering, as measured by its relative size, is not important in explaining the change in the OLS beta estimate following the offering. Because a true change in beta should be invariant to the estimation technique employed, this result is also consistent with our failure to find significant changes in beta estimates after correcting for the biases caused by measurement error and delays in the price-adjustment process (Table III). In other words, alternative explanations for the change in OLS beta estimates surrounding equity offerings and share repurchases must also be capable of explaining why changes in beta estimates are no longer significant when the aggregated coefficient methodology is employed.

Overall, the results in Tables V and VI provide additional support for our hypothesis regarding trading activity and estimates of systematic risk. Changes in OLS beta estimates are directly related to changes in various measures of trading activity. Moreover, firms that do not experience a change in trading activity are generally not characterized by significant changes in estimates of systematic risk. These findings are consistent with the predictions of Dimson (1979), Scholes and Williams (1977), and Cohen *et al.* (1983a) regarding the effect of measurement error and price evolution on the estimation of systematic risk.

IV. Conclusions

In this study, we examine the relation between trading activity, the measurement of security returns, and the evolution of security prices. Previous studies perform cross-sectional analyses of this relation. To our knowledge, our study is the first to employ time-series data. We do so by examining changes in trading activity and estimates of systematic risk following equity offerings and share repurchases. Contrary to existing theory, previous studies have documented increases in systematic risk following equity offerings and decreases in systematic risk following share repurchases. Our results provide an explanation for these anomalous findings by documenting that OLS beta estimates increase following equity offerings and decrease following share repurchases largely because of estimation biases that are affected by changes

[17] We also estimated regressions with the market value of the firm's equity as an independent variable and the cross-product of this variable with the change in shares outstanding and all of our trading activity variables on the notion that our sample events are more likely to be economically important for smaller firms. With the exception of the cross-product of equity value with the change in the fraction of days with no trades in the NASDAQ repurchase sample, none of these variables were significant in any of the regression models and did not materially affect the coefficients of the original independent variables. Consequently, we do not report these results.

in trading activity surrounding these events. After properly controlling for these biases, we find no evidence of changes in systematic risk following either equity offerings or share repurchases.

We emphasize that our results are more general than the specific applications we have chosen to study. Any event that affects trading activity will also impact the accuracy with which returns are measured and the process by which prices evolve. Several other applications come to mind. For example, stock splits are associated with increases in OLS betas (Lamoureux and Poon (1987) and Brennan and Copeland (1988)). However, if they are also associated with an increase in trading activity following the split, our analysis suggests that this increase in trading activity may be responsible for the observed increase in estimated systematic risk. Consistent with this, Wiggins (1992) finds no evidence of increases in post-split betas when longer return measurement intervals and aggregated coefficients techniques are used to estimate beta.

Similarly, Shah (1994) documents a significant decrease in OLS beta estimates following leverage-increasing exchange offers. Because these offers resemble share repurchases in that they predominantly retire common stock, our analysis suggests that there may be decreases in trading activity following the exchange offer. Consequently, the observed decrease in OLS betas may be attributable to the postoffer decrease in trading activity rather than a decline in the systematic risk of the firm's assets.

Finally, our results may explain the apparent increase in estimates of systematic risk following additions to the S&P 500. Vijh (1992) documents a significant increase in beta estimates following S&P listings and attributes it to price pressures caused by S&P 500 trading strategies. However, S&P listings are also associated with increased trading activity. Our analysis suggests that at least part of the changes in postlisting betas are likely to be attributable to biases caused by changes in trading activity.[18]

Although we focus on the estimation of systematic risk, our hypotheses apply to any measure of the security returns process. Our analysis suggests that trading activity will alter measurements of cross-correlations of security returns. This implies that researchers need to be cognizant of the level of trading activity when studying the properties of security returns.

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[18] Vijh (1992) presents evidence that suggests that reductions in nonsynchronous trading are not responsible for the increases in beta estimates following additions to the S&P 500. However, he does not investigate the influence of other aspects of trading activity that require a longer lead-lag structure.

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