Post-Announcement Return Volatility and Takeover Outcomes: Evidence of Differential Information Arrival

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Abstract

This paper focuses on the effects of information arrival on asset return volatility. Rather than examine aggregate patterns in daily variances, this paper exploits the information rich circumstances of merger and tender offer bids to generate hypotheses of varying information arrival, and tests those hypotheses. The results reveal that differing bid circumstances, such as the presence of competing bids, do generate different levels of volatility, and these differences are consistent with the hypothesized information arrival differences.

I. Introduction

The relationship between asset prices and information arrival is of fundamental importance in financial economics. Much recent research investigates this relationship, as well as the behavior of intraday and interday returns volatility. Karpoff (1987) argues that such analysis provides insights regarding the structures of financial markets - what is the rate of information flow? how is information disseminated? to what extent do prices convey information? The empirical evidence from these studies supports the hypothesis that the rate of information arrival and return volatility are positively related. Rather than examine aggregate patterns in daily variances, this paper exploits the information rich circumstances of merger and tender offer bids to generate hypotheses of varying information arrival, and tests

those hypotheses. The results reveal that differing bid circumstances do generate different levels of volatility, and these differences are consistent with the hypothesized information arrival differences.

Merger and tender offer bids are an interesting focus for analyzing the information arrival - volatility relationship because they require the market to process the information conveyed by an announcement itself, and also to consider the potential arrival of additional information. This could range from announcements of target resistance to the bid, to the announcement of a competing bid or bids, to announcements of revisions in bid terms. Thus, these events present complex and evolving information sets. This makes such events rich sources for testing return variances for evidence of the market's anticipation and incorporation of new information.

Readers with comments or questions are encouraged to contact the author via e-mail.

Because of the "life cycle" of a bid, there are natural divisions of time for examining changing information arrival and changes in returns variability. This paper looks at the period from the announcement to the outcome date. Previous research using price changes (Lewellen and Ferri (1983), Brown and Raymond (1986), and Samuelson and Rosenthal (1990)) also looks at this period. These papers focus on predictability of the bid's outcome based on target share price changes over the bid's life. This paper focuses on returns volatility - presenting hypotheses about information arrival differences across different bid circumstances and testing these hypotheses using realized return variances. Additionally, the paper relates the variance measures to a Lewellen and Ferri type price measure.

An Information Arrival - Return Variance Framework

The literature examining the information, prices, volume, and volatility relationships - both theoretical and empirical - is extensive. Theoretical work such as Kyle (1985) and Foster and Viswanathan (1993) yields models where information is incorporated into prices through the trading of informed agents. Karpoff (1987) provides a comprehensive summary of the price and volume literature, and finds a positive relationship between the absolute value of the price change and volume is generally supported, across a wide variety of market settings. He concludes that the positive correlation between price changes and volume is based on their common ties to flows of information.

French and Roll (1986), using NYSE and AMEX data, and Barclay, Litzenberger, and Warner (1990), using Tokyo Stock Exchange data, investigate the interday and intraday behavior of returns volatility. Intraday variances are documented to be several multiples of the interday levels. The results from both papers suggest differences in the rate of information arrival are the major determinants of returns volatility. French and Roll hypothesize that it is the actions of privately informed traders that most contribute to the higher intraday volatility.

More recently, Berry and Howe (1994), hereafter BH, and Mitchell and Mulherin (1994), hereafter MM, have explored the question of whether properties of the information flow affect the price-volume relationship. Both of these papers focus on publicly available information (which, unlike private information, does not require trading to affect prices), using different proxies for the rate of information arrival. BH find that the rate of public information arrival is non-constant, exhibiting definite patterns of higher and lower rates of information arrival, and that there is a "positive, moderate relationship" between information arrival and volume. Though the patterns in information arrival and volatility are consistent, they find no significant relationship. Similarly, MM find that the number of news announcements and market activity are directly related.

Bessembinder, Chan, and Sequin (1996) extend this analysis, looking at price changes, volume, and volatility. The authors argue that trading volume will be larger when traders have more diffused opinions about the value of the asset. They use open interest on the S&P 500 futures contract as a proxy for this divergence of opinion, and find an asymmetric relationship between open interest and volume for both the futures contract and spot equities trading (volume is larger when open interest increases, but there is no significant change in volume when open interest falls). Further, the authors use volatility as a proxy for information flow, and find that the volume-volatility relationship depends on the type of firm and the type of information. That is, volume in individual equities is more closely related to firm specific information flows, while the volume for a "market basket" of equities is more closely related to market information. The difference in volume effect is greater for smaller stocks, where market information has no significance in explaining volume. The authors also find that among their set of large firms, membership in the S&P 500 led to a stronger relationship with marketwide information, and that large firms not in the S&P 500 exhibited a weaker volume relationship with market news. These results suggest that informed

traders prefer to trade in individual equities, rather than in a basket. Further, the positive relationship between volume and firm specific proxies is consistent with informed trader models like those of Kyle (1985) discussed above.

The theoretical models and empirical evidence outlined above hold that variances are positively related to the rate of information arrival. This suggests the framework for the line of questioning followed here: do variances change at information events, and if so, are the changes consistent with expected or predicted changes in rates of information arrival? More explicitly, if the event is such that the rate of information arrival increases, then returns variability should increase, while if the event leads to a decreased arrival rate, return variability is predicted to decline.

The following section discusses merger and tender offer bid announcements in this information arrival - return variance framework and develops hypotheses about cross-sectional differences in information arrival after the announcements. Section III outlines the data, while Section IV presents the test methodologies and results. Section V concludes.

II. Merger and Tender Offer Announcements in the Information Arrival - Return Variance Framework

Perhaps the most direct tests of merger and tender offer activity involve "event study" methodology to examine the effects of the announcements on the stock prices of the bidder and target firms. There exists a large set of studies that examine just this issue. Regardless of the study considered, target shareholders earn significantly positive excess returns at announcement (and even in the days just prior). However, bidder return results are less certain, ranging from significantly positive to significantly negative (see, for example, Bradley, Desai, and Kim (1983, 1988), Jennings and Mazzeo (1990), and Jarrell and Poulsen (1989)).

Most generally, this paper falls into this

literature. More specifically, the research seeks to answer questions about the relationship between information arrival and return variances. The use of residual analysis focuses attention on *if* information is reflected in prices, and if so, to what extent. That is, the existing extensive empirical evidence documents the "information effects" on returns, but rarely looks beyond these first order effects to examine higher order effects.

Merger and tender offer bids are quite unlike some other announcements made by firms. In fact, they could be called "irregular" in many ways when compared to other announcements. For example, for most firms, they do not occur regularly, like a firm's earnings releases. Additionally, their dollar magnitude and complexity certainly dwarf many other announcements. Further, the announcements may cause the market to anticipate the arrival of additional information and evaluate its impact when determining prices at the time of the bids.¹ The literature suggests that these complex events should have effects on target return variances. The discussion that follows sets forth the anticipated effects.

What happens after a bid announcement is made? An announcement does resolve the uncertainty of whether or not a takeover offer is forthcoming. But, conditional on a bid being made, the market's views on further information arrival may differ across bids. That is, information arrival rates will be affected differently across firms by the announcements. After an announcement, those bids that are viewed as very certain to be completed should be accompanied by reduced expectations of further valuation-related information arrival relative to the pre-announcement level and thus reduced return variances. Those bids that are viewed at their announcements as less certain to be completed are likely to be accompanied by a continued high expected rate of information arrival, and thus a large decrease in return variances should not occur.

Prior research (Lewellen and Ferri

(1983), Samuelson and Rosenthal (1986), and Brown and Raymond (1986)) has attempted to measure the market's views of bid outcomes as an "implied probability of success." Denote this measure as π which is defined as

$$\pi = \frac{P_T^A - P_T^B}{P_O - P_T^B} \quad (1)$$

where

P_T^B = the target's price before the announcement, P_T^A = the target's price after the announcement, and P_O = the offer price for the target's shares.

Lewellen and Ferri argue that "immediate post-offer-announcement stock prices will typically contain some 'discount' for the possibility that the deal may not go through," so that π can be viewed as an implied probability measure. Samuelson and Rosenthal (1986) and Brown and Raymond (1986) empirically examine the ability of π to correctly predict outcomes, and find that the market is able to predict relatively accurately the outcomes of offers.

Samuelson and Rosenthal find that the current target price during the offer period is an accurate measure of the discounted stock price expected at the conclusion date. They also find that the probability predictions improve over time. Brown and Raymond also find that the market is able to discriminate early in the offer period that deals will be successful and which will fail. The results reveal that the price response measure (similar to π) is never less than 70 percent for completed offers, and rises as the resolution date draws nearer. This is also true for competitive bids where at least one bid fails. For failed acquisitions, the measure is never above 50 percent and falls as the outcome date approaches. Additionally, non-competitive failed bids look different from competitive bids that ul-

timately fail (these have a higher π), which indicates the market's ability to predict the arrival of a successful bid. Longitudinal analysis reveals that the difference between measures for completed vs. failed acquisitions grows as the resolution date approaches. These changes in π values over time are consistent with the evolving nature of the information set associated with a bid.

How does π relate to variance changes?

As constructed, high values of π have been interpreted to imply a high assessment of likely completion. And, an assessment of a high probability of completion is argued to reduce the expected rate of information arrival and thus lead to a lower variance for targets of such bids. This suggests a strong negative correlation between π and post announcement variance. However, values of π approaching one do not necessarily imply that this particular bid is viewed as highly likely to succeed. It could be that the announcement leads the market to anticipate a competing offer at a higher price than this offer (or that management will make changes such that the offer fails, but the share price goes up), so that π is high (it may exceed one) without meaning this particular offer is viewed as likely to succeed. Note here that expected information arrival is high relative to a "certain" bid. Additionally, equal values of π for different bids may not be interpreted as "equal" views of the likelihood the bids will succeed.

Consider a numerical example. Suppose the current share price of XYZ to be \$25. A tender offer bid is made at \$40 per share; XYZ stock jumps to \$38.50. This implies $\pi = 0.90$. But what information is really in π ? It is driven by P_T^A , which is affected by what the market believes the share price will be in the future. Assume the market anticipates the final price of XYZ to be \$26 if the bid fails, \$40 if this bid succeeds, and \$50 if another firm bids and succeeds. The market assigns probabilities of .35, .31, and .34 to these events, respectively.

This gives $P_T^A = \$38.50$ and $\pi = 0.90$ as above, but with the success of this particular bid viewed by the market as the least likely outcome. Also consider a bid for PQR stock, which is currently trading for \$30. The offer price is \$50, and the post-offer price of PQR shares is \$48. This implies $\pi = 0.90$, as above. But here, the market sees the share price to be \$28 if the offer fails, and \$50 if this offer succeeds. The probabilities associated with these outcomes are .09 and .91 respectively. This gives $P_T^A = \$48$, and $\pi = 0.90$, and here there is very little uncertainty as to the outcome.

The construction of the example shows how the bid announcement can affect expectations of future information arrival. That is, for the bid for XYZ, the market assigns a higher probability to the arrival of a competing bidder than it does to the success of the initial bid. So, the first bid can be viewed as an event that leads the market to expect the arrival of other information. This is not the case for the bid for PQR. Though the value of π is the same, here there is little uncertainty as to the successful outcome of the bid. And, the market's anticipation of future information arrival is consequently lowered.

This suggests moving beyond target price responses to an examination of return variances for insights into the information effects of an announcement. In the extreme case of certainty of completion, the target's share price should move to the offer price and variance should fall to zero. However, most bids are not viewed as certain at the time of the announcement, so nonzero variances will be observed. But, unlike the case of π described above, the level of return variance after the announcement is a clearer reflection of the market's perception of the uncertainties surrounding the bid. That is, bids where there is a strong expectation the offer will be completed, which is argued to be associated with a reduced expectation for future information arrival, should lead to variances approaching zero. Higher variances reflect uncer-

tainties the market holds. For example, competing bids may arise, sometimes due to target management's decision to resist the initial bid, or there could be revisions in the terms of the initial bid (e.g. Jennings and Mazzeo (1990)), or legal proceedings that affect the likelihood of the offer being completed may be initiated after the announcement, with the results not immediately forthcoming. That is, the predicted information arrival rate is higher than for the "certain" bid.

The preceding discussion highlights several important testable relationships. The first is whether or not bids expected to succeed have lower variances (due to the presumed lower level of information arrival) than those bids that are viewed as less certain. There is also the question of the relationship between π and post-announcement variances. It seems that the two measures should be strongly negatively correlated, but the example showed it is possible for this not to be so. The evidence from the price response tests shows that it is also necessary to consider whether or not competing bids are present in evaluating the behavior of returns variability. These situations are likely to have higher rates of information arrival than non-competitive bids. Additionally, the information arrival framework suggests that the gap between the variances of targets of successful versus failed bids should widen as the outcome date approaches. These points are summarized in the following hypotheses:

H1: Post-announcement target return variances are lower relative to pre-announcement levels for bids that succeed than those of targets of bids that fail.

H2: Price response measures (π and post-announcement returns variances are negatively correlated.

H3: Competitive bidding situations are associated with higher return volatility than non-competitive bids.

H4: As the outcome date approaches, the difference between the variance levels (relative to pre-

announcement levels) for targets of bids expected to succeed and those of targets of bids expected to fail grows larger.

The relationships are all presented in terms of the expected outcome. Ideally, tests would measure variances changes against some measure of this expectation. However, this is problematic. Consequently, changes in variances will be tested against the actual outcomes. This is consistent with the tests on π , where actual outcomes were used to test for differences.

III. Data

Tests of the hypotheses require construction of a sample of acquisition announcements. Besides knowing which firms are involved, tests of the predicted relationships require data on the terms of the offer, the announcement and outcome dates, the existence of competing bids, the market's response to the announcement, and the outcome of the bid. For all the tests, the initial set of proposed acquisitions, containing data on both successful and failed takeover proposals, as well as strategic information about each, is that of Jennings and Mazzeo (1990).²

All of the hypotheses require returns data for calculating variances. Because of this, the initial sample is reduced by the requirement that all firms have sufficient returns data on the CRSP tapes. This leaves 679 targets.³ For tests of involving the price response, the target's closing share prices needed for calculating π are also obtained from CRSP, with P_T^A being the closing price each day from the day of the announcement to the outcome date, while P_T^B is the closing price ten days before.⁴ The announcement and outcome dates, and data on the presence of competing bids and success or failure of the bid are drawn from the JM dataset.

IV. Tests and Results

This chapter translates the hypotheses

developed earlier into statistically refutable statements, and sets out the methodologies used for testing them. Rather than make unsupported distributional assumptions about the variances, many of the tests use non-parametric methods. Results follow the discussion of each test. The order follows essentially the order of hypotheses as presented in Section II.

Post Announcement Return Variances

H1: Post-announcement target return variances are lower for bids that succeed than those of targets of bids that fail.

This is based on the expected relationship between certainty of completion and arrival of additional valuation relevant information. A bid that is announced and is viewed as a "done deal" will likely have little further information arrive that might affect the target, and thus its return variance falls to near zero. On the other hand, less certain bids are more likely to have continued arrival of information affecting target value, and so the variance should not drop so dramatically.

To test **H1**, the sample is divided conditional on the actual success or failure of the bid. Then, for each firm i , $\sigma_i^2(\text{after})$ is calculated over the ten day period from +1 to +10 immediately following the announcement. Then, the ratio of this variance to the variance of returns six months prior (calculated over a 22 trading day month) is computed for each firm. That is, $VR_i = \sigma_i^2(\text{after}) / \sigma_i^2(\text{prior})$. The VR_i are pooled across firms in each sub-sample of successful and unsuccessful offers. The relationship hypothesized in **H1** can be restated now as

$$H_0: VR_{\text{fail}} \leq VR_{\text{success}}$$

$$H_1: VR_{\text{fail}} > VR_{\text{success}}$$

Both parametric and non-parametric tests are used; the standard t-test for equality of means is used in addition to the Wilcoxon rank sums test. The results, summarized in Table 1, are quite strong: targets of failed bids have much

Table 1
Tests of Differences Between Target Variances at Announcement Using VR

A. For All Targets

	Successful	Failed	Difference	
N	404	235		
Mean	0.931	3.615	t = 3.128	p > t = 0.002
Median	0.229	1.118	Wilcoxon Z = 10.007	p > Z = 0.0001
Standard Deviation	2.170	13.049		

B. For Initial Bids

	Successful	Failed	Difference	
N	364	203		
Mean	0.898	3.942	t = 3.083	p > t = 0.0023
Median	0.250	1.125	Wilcoxon Z = 9.510	p > Z = 0.0001
Standard Deviation	2.172	13.412		

The test statistic is $VR_i = \sigma^2_i(\text{after})/\sigma^2_i(\text{prior})$, where $\sigma^2_i(\text{after})$ is the variance of daily returns for target i over the ten trading days after a bid announcement, while $\sigma^2_i(\text{prior})$ is the variance of daily returns for target i over a twenty-two day trading month six months prior to the bid. "Success means that the bid is completed, while "failure" means that for some reason this bid does not result in an acquisition. An initial bid is either one with no competition, or the first bid in a series of competing bids.

Table 2
Descriptive Statistics for π and VR

A. For π

	Mean	Median	Std. Deviation
All Observations (n=287)	0.802139	0.711	1.581977
Outcome is Success (n=213)	0.705366	0.737	0.588401
Outcome is Failure (n=74)	1.081689	0.609	2.94847
If No Competing Bids (n=217)	0.841157	0.684	1.795443
If Competing Bids (n=70)	0.6811857	0.735	0.50221
If No Competing Bids and Success (n=174)	0.71296	0.7375	0.616198
If No Competing Bids and Failure (n=43)	1.359907	0.541	3.830273
If Competing Bids and Success (n=39)	0.671487	0.719	0.448823
If Competing Bids and Failure (n=31)	0.693387	0.743	0.589907

The price response variable is defined as
$$= \frac{P_T^A - P_T^B}{P_0 - P_T^B}$$
 where P_T^B = the target's price ten days before the

announcement, P_T^A = the target's price on the day of the announcement, and P_0 = the offer price for the target's shares. Competition is the presence of existing bids at the time a bid is made; success means this particular bid reaches completion.

Table 2 (continued)

B. For VR

	Mean	Median	Std Deviation
All Observations (n=287)	1.4062	0.350767	3.524662
Outcome is Success (n=213)	0.92148	0.186763	2.398428
Outcome is Failure (n=74)	2.801406	1.002499	5.413622
If Competing Bids (n=70)	1.951214	0.484283	4.472242
If No Competing Bids (n=217)	1.230389	0.301921	3.151633
If No Competing Bids and Success (n=174)	0.812092	0.183548	1.811424
If No Competing Bids and Failure (n=43)	2.923032	0.969747	5.823154
If Competing Bids and Success (n=39)	1.409521	0.228414	4.105492
If Competing Bids and Failure (n=31)	2.632699	1.035251	4.877608

The variance ratio measure is $VR_i = \sigma_i^2(\text{after})/\sigma_i^2(\text{prior})$, where $\sigma_i^2(\text{after})$ is the variance of daily returns for target i over the ten trading days after a bid announcement, while $\sigma_i^2(\text{prior})$ is the variance of daily returns for target i over a twenty-two day trading month six months prior to the bid. Competition is the presence of existing bids at the time a bid is made; success means this particular bid reaches completion.

C. Correlation Between π and VR

Pearson Correlation	prob > r	Spearman Correlation	prob > r
-0.03696	0.5329	-0.22971	0.00001

higher variance ratios than targets of successful bids. Both the t-test and a Wilcoxon test are highly significant. To control for the possibility that later, competing bids may affect the results, the tests are repeated for only initial bids. These are either bids with no competition, or the first bid in a competitive bidding situation. Again, the results are extremely significant.

The discussion in Section II related VR to π , a measure constructed using the market's price response to the offer, and interpreted to reflect the market's view of the bid's likelihood of completion. For the 287 observations that have both VR and π data, Table 2 summarizes the behavior of the variables at the time of the bid's announcement. Further splits of the sample are based on the presence of competing bids *at the time* a bid is made. If no other bids are present, then this is defined as "no competition" (that is, these are initial bids), while if existing bids are present, then the bid is classified as one with

competition. It seems plausible that the information arrival rates may be different based on competition.

The values of π are consistent with results in Brown and Raymond (1986) and Samuelson and Rosenthal (1986). It is important to note that there are seven observations where π exceeds 2.0, and that these values affect the reported means. A check of each of these observations revealed that the data are correct. In the earlier studies mentioned above, the values were constrained to be less than or equal to unity. This constraint is not imposed on the data in these tests because the possibility that VR is a better measure of the market's views regarding a bid than π is actually to be tested, and so the actual values should be used.

The variance ratio comparisons reveal patterns consistent with the information arrival situations hypothesized in H1 above. That is, as

Table 3
Tests on p and VR for Differing Bid Characteristics

	π (Medians)	Median Scores test Prob > Z	$\sigma^2_{\text{After}} / \sigma^2_{\text{Prior}}$ (Medians)	Median Scores test
Success vs. Failure	0.737 0.609	-2.33103 0.0099	0.186763 1.002499	5.07343 < 0.00001
Competition vs. No Competition	0.735 0.684	1.65320 0.04915	0.484283 0.301921	1.37766 0.08415
No Competition, Success vs. Failure	0.7375 0.541	-4.20756 < 0.0001	0.183548 0.969747	4.55819 < 0.0001
Competition, Suc- cess vs. Failure	0.719 0.743	0.238897 0.4056	0.228414 1.035251	2.62787 0.0043

The test statistics are as $p = \frac{P_T^A - P_T^B}{P_0 - P_T^B}$, where P_T^B = the target's price ten days before the announcement, P_T^A = the target's price on the day of the announcement, and P_0 = the offer price for the target's shares, and $VR_i = \sigma_i^2(\text{after})/\sigma_i^2(\text{prior})$, where $\sigma_i^2(\text{after})$ is the variance of daily returns for target i over the ten trading days after a bid announcement, while $\sigma_i^2(\text{prior})$ is the variance of daily returns for target i over a twenty-two day trading month six months prior to the bid. This table presents tests of differences on the medians of the variables. The samples are split based on success, which means the particular bid succeeds or fails, and on the basis of competition, which means the presence of competing bids at the time a bid is made. In columns two and four, the first number corresponds to the first category given in column one for that row. For example, in the first row, the first category is for success, so the first value in column two or four is associated with successful bids. Columns three and five present the median scores test that the samples are the same, and the probability of observing that value of the test statistic.

demonstrated for the whole sample, targets of successful bids have sharply lower variance ratios than targets of failed bids. Additionally, competitive bidding situations have higher ratios than non-competitive bids, as predicted in **H3**. A further split of success versus failure between competition and no competition exhibits the same patterns. Table 3 provides results of tests that the medians of the groups being compared are equal. In every case, the median scores indicate that there are significant differences in the variance ratios depending on the circumstances regarding competition, and the ultimate outcome of the bid.

H2 suggests that VR and π be negatively related, but the earlier discussion and example provides reason to question this. That is,

variance changes reflecting market (un)certainities about the outcome of an offer may be more strongly predictive of the bid's final outcome than π . This suggests direct tests of the correlation between VR and π or

$$H_0: \rho(\text{VR}, \pi) = 0$$

$$H_1: \rho(\text{VR}, \pi) \neq 0$$

Two methods are used to calculate the correlations. The Pearson correlation is calculated using the means of the two samples, while the Spearman's rank order correlation statistic is just that, a correlation measure based on the ranks of the data. The results are given in Table 2, panel C. The Pearson coefficient is negative, but not significantly different from zero. However, due to the non-symmetric nature of the variance ratio

distribution and the possible problems with the extreme values of π , the Spearman correlation may be more meaningful. It is significantly negative, but the magnitude of the correlation suggests the relationship is not very strong. This is consistent with the discussion about π and VR presented above, where high levels of the price response measure do not necessarily correspond to certainty and thus reduced variance.

This leads to one further question: what happens to these variables as the outcome date approaches? As bids come to their outcome date, quite different information arrival patterns may be occurring for different bids. That is, for the "certain" offers, very little valuation affecting information is likely to be arriving, so that the target's variance falls to (near) zero. However, for the contested bid, or for the bid that is not certain, the information arrival flow is still quite likely to contain valuation relevant news. Thus, as the outcome date approaches, examination of variances conditional on the outcome should reveal differences related to the information effects. This is the prediction of **H4**.

The tests of interest examine changes in the variance ratios, VR, leading up to the outcome date. From **H4**, the hypothesis to be tested is explicitly stated as:

H_0 : $VR_{fail} \leq VR_{success}$ in week t prior to outcome

H_1 : $VR_{fail} > VR_{success}$ in week t prior to outcome

These tests are summarized in Table 4. The median scores again are reported because of the non-symmetric nature of the VR distribution, and they reveal significant differences between successful and failed bids over the test period, with the difference growing larger as the outcome date approaches. This is consistent with the predicted information arrival behavior differences expected for these situations. That is, as the certainty of a bid's outcome increases, the rate of valuation relevant information arrival should slow, and consequently the target's variance should fall. Failed bids are likely not to have the reduction in valuation information ar-

iving, and thus are not likely to exhibit a drop-off in variance. The numbers in Table 4 confirm this. For successful bids, the median percentage change in the variance ratio is always at least an eighty percent decrease, and in the final weeks (weeks five on onward to the outcome) there is an at least ninety percent decrease. In other words, variances have dropped to near zero for the successful bids. For failed bids, the percentage change in variance is near zero but begins to increase as the outcome date approaches. For the week prior to the failure, the median variance increase is nearly 114 percent.

The failed bids are split again on the basis of the presence of competing bids. This follows Brown and Raymond (1986), who find that π varies for failed bids depending on whether or not competing bids are present. This is important for the tests here as well, because the information arrival patterns and thus variances of returns may be affected by whether or not the failure occurs with or without other bids for the target. It seems clear that bids that fail with other bids outstanding have a different information set than those bids that fail without other bids present. For the latter, the lack of an outstanding bid may make the targets again "potential" targets of new bids, and this brings about the possibility of pre-announcement information activity. The return variability of targets of bids that fail with other bids present should be driven by the uncertainties surrounding the remaining bids. That is, the information arrival rates may be different as failure approaches based on whether or not other bids are present. Table 4 also reports results of tests of the hypothesis that the VR's of failed bids are equal conditional on competition at the time of failure, based on the premise that information arrival patterns are different depending on the presence of competition. The results show that variances of failed bids behave differently depending on whether or not competing bids were present. The differences are not always significant, but the direction of the difference suggests that the presence of competing bids is a very important change in the information structure. Though both situations show increases in the variance ratio in the week of the

Table 4
Tests on VR Approaching the Outcome Date

A. For Success vs. Failure

VR (Median)	Week				Prior to		Outcome	
	-8	-7	-6	-5	-4	-3	-2	-1
Success	-0.86056 (n=308)	-0.84202 (n=323)	-0.82192 (n=329)	-0.81418 (n=366)	-0.86411 (n=379)	-0.89465 (n=375)	-0.90368 (n=373)	-0.90186 (n=354)
Failure	-0.1703 (n=83)	-0.05465 (n=91)	-0.04015 (n=110)	-0.24192 (n=128)	-0.06471 (n=148)	-0.19182 (n=181)	0.051905 (n=198)	1.136565 (n=233)
Signs test Prob> M	5.09033 <0.0001	4.86001 <0.0001	4.20806 <0.0001	4.92401 <0.0001	7.19316 <0.0001	8.59044 <0.0001	10.2213 <0.0001	12.7611 <0.0001

B. Failed Bids Only, Competition vs. No Competition

VR (Median)	Week				Prior to		Outcome	
	-8	-7	-6	-5	-4	-3	-2	-1
Competition	-0.38633 (n=29)	-0.57979 (n=35)	-0.34177 (n=46)	-0.4343 (n=50)	-0.33309 (n=61)	-0.1943 (n=73)	-0.12676 (n=78)	0.983196 (n=88)
No Competition	-0.03247 (n=54)	0.277514 (n=56)	0.509978 (n=64)	-0.1405 (n=78)	0.240291 (n=87)	-0.06751 (n=108)	0.203307 (n=120)	1.812615 (n=145)
Signs test Prob> M	-0.60658 0.5441	-1.84627 0.0649	-1.53934 0.1237	-0.72182 0.4704	-1.83074 0.0671	-0.39236 0.6948	-1.74091 0.0817	-1.02780 0.3040

The test statistic is $VR_i = \sigma^2_i(\text{after})/\sigma^2_i(\text{prior})$, where $\sigma^2_i(\text{after})$ is the variance of daily returns for target i over the five trading day week leading up to the bid's outcome date, while $\sigma^2_i(\text{prior})$ is the variance of daily returns for target i over a twenty-two day trading month six months prior to the bid. Success means the particular bid is completed, and competition means the presence of existing bids at the time a bid is made.

For each table, the cells provide the median value of the change in the variance ratio for two sub-groupings of the data. The last row provides the value of the signs test that the variance ratio changes are equal across the subgroups, along with the probability of observing that level of the signs test.

failure, if there were competing bids, the VR behaves more like that of a successful bid. This makes sense, because the market is looking not just at the failed bid, but at the likelihood that (one of) the competing bid(s) will be completed, as well. That is, at the time of failure, the variance reflects remaining uncertainty about the target's acquisition by some bidder, not just this bidder. When there are no other bidders present, there is more uncertainty about future events, and possibly a higher rate of valuation relevant information arrival than for the other situation. That is, the question of whether or not a new bid is forthcoming returns the target to the pre-announcement world, where variances increase with the information activities of those

actively looking for takeover candidates.

V. Conclusion

Does information arrival affect return volatility? This study examines situations where information arrival rates were predicted to be changing to see if variance changes occurred consistent with the information arrival changes. The work was based on a framework designed to tie the information arrival - variance relationship literature to the now standard event study literature. That is, the analysis follows the event study approach of centering the focus of the tests on "event dates," or releases or announcements of information, but looks at variance changes

rather than the traditional excess returns measures. Tests of the hypothesized relationships provide results that are consistent with a positive relationship between information arrival and return variances. That is, the results of this paper provide further empirical support for the information arrival - variance relationship put forth by French and Roll and others.

Targets exhibit variance changes after bid announcements that reflect the hypothesized relationships to information arrival and uncertainties about the bids. Variances proved to be significantly different for successful versus failed bids in the ten days just after the initial bid announcement, and this difference continued to grow as the outcome date approached. These differences support the contention that information arrival rates are different for successful versus failed bids. Additionally, variances were found to be quite different for targets conditional on the presence of competing bids, with the competitive situations exhibiting higher variability. The price response type measure and the variance measure exhibit only a low-level negative correlation, further supporting the differential information arrival hypotheses. All the results are consistent with the hypothesized information arrival differences the bid situations suggest.

VI. Implications for Future Research

The results of this paper are consistent with significant changes in the information arrival process over the life of acquisition bids. This suggests that micro-structure changes may be occurring as well. Thus, studies of changes in variables such as the bid-ask spread and its components, trading volume, and levels of institutional trading over the same period as examined in this paper could yield further insight into the process and effects of information arrival. The results also suggest that work like that in Berry and Howe (1994), combined with that of Jennings and Mazzeo (1990), looking at the actual rate of information flow (number and type of news stories) and the effects on volatility as the information arrives would also add to the un-

derstanding of the ways information is incorporated into prices.

Notes

1. Morck, Schliefer, and Vishny (1990), in discussing the target's share price after a bid announcement, point out, "(T)he target's value after the bid is announced is only a proxy for the acquisition price since the value may reflect only probabilistic success of the bid as well as the possibility of future higher bids."
2. I am grateful to them for allowing me to use this data set. For a more complete description of the construction of the set of bids than appears here, see the work referenced.
3. This does not mean 679 *unique* targets; it means 679 proposals have targets with CRSP data. That is, a firm may be a target of more than one bid.
4. Jennings and Mazzeo (1990) report that results in their tests are similar using prices from 5 or 20 days prior.

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