News or Noise? Internet Postings and Stock Prices

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The anecdotal evidence is growing that postings in Internet financial forums affect stock prices, either because the postings contain new information or because they represent successful attempts to manipulate stock prices. From an investment perspective, knowing whether this phenomenon is pervasive is important. We examined the relationship between Internet message board activity and abnormal stock returns and trading volume in the period from mid-April 1999 to mid-February 2000. Our study focused on the RagingBull.com discussion forum, an extremely popular site whose format permits the construction of an objective measure of investor opinions. For stocks in the Internet service sector, we found that on days with abnormally high message activity, changes in investor opinion correlated with abnormal industry-adjusted returns. These event days also coincided with abnormally high trading volume, which persisted for a second day. However, we found that message board activity did not predict industry-adjusted returns or abnormal trading volume, which is consistent with market efficiency.

The Internet is clearly playing an ever-increasing role in financial markets and personal finance. Six large Internet brokerage firms—Ameritrade, DLJ*direct* (now CSFB*direct*), E*Trade Securities, National Discount Brokers Corporation, Charles Schwab & Company, and TD Waterhouse Investor Services—cumulatively boasted more than 12 million accounts in 1999 and were expecting account growth of 45 percent in 2000 (Appleby 2000). Although initially the Internet revolution may only have facilitated security transactions, investors now benefit from a wide assortment of financial information available online. All official U.S. SEC filings can easily be found on the World Wide Web, and most established companies host Web sites that provide insight into management and long-term corporate strategies. Moreover, the Internet has helped personal investors learn from others through open discussion in security market forums. Such Web sites as The Motley Fool (Fool.com), SiliconInvestor.com, and RagingBull.com have facilitated this discussion among thousands of investors.

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Given this explosion of interest and information, it is not surprising that researchers have been exploring both the valuation of Internet stocks and the effects of Internet activity on equity valuation. For example, Rajgopal, Kotha, and Venkatachalam (2000) found that, after controlling for some accounting measures, Web traffic helps determine the value of Internet companies. Wysocki (1999) examined 3,000 stocks listed on Yahoo! message boards and found that Internet message-posting volume predicts changes in next-day trading volume and returns. Specifically, he found that a doubling of overnight message postings relative to the average leads to a 0.18 percentage point average abnormal return. Rau, Dimitrov, and Cooper (2000) found that announcements of company name changes to Internet-related names generate large positive abnormal returns.

Other studies have taken a more traditional approach to the valuation of Internet stocks. Trueman, Wong, and Zhang (2000) tried to find relationships between Internet company stock prices and accounting information. In their research, they found a significant association between gross profits and valuation. Hand (2000) discovered a nonlinear relationship between accounting data and stock pricing.

These papers represent the first forays into analyzing Internet stock pricing and, more generally, into examining the effects of the Internet on

the valuation of more traditional companies. In general, the authors attempted to answer two key questions: (1) What are the determinants of stock prices? (2) Are these prices consistent with market efficiency? The analysis we present is similar in spirit but takes a different perspective. Instead of testing the importance of accounting data, Web traffic, or message-posting volume in determining value, we examined opinions expressed in Internet financial forums as a determinant of stock price.[1]

Specifically, we evaluated the relationship between the valuation of Internet service companies and investor opinions expressed in a specific Internet forum, RagingBull.com. We selected this site not only because of its popularity but also because it lets users post their opinions in a standardized message template, a feature that enhances the accuracy of message interpretation and analysis. As a result, we could construct a straightforward and quantitative measure of investor opinion on a daily basis. We focused specifically on Internet service companies because, as a group, they are natural candidates to be most affected by information in Internet forums. In principle, however, the analysis presented here can easily be extended to any Internet forum and to any sector of the stock market.

We attempted to answer a straightforward question: Can message board activity help predict stock returns and/or trading volume? First, such activity may help predict stock returns if the message board contains new information. For example, experts in a company or sector may use messages on these boards to disclose private information or conclusions from proprietary analyses, perhaps after placing trades themselves. Second, the boards may contain no new information but may still provide a better indication of general market sentiment than is already contained in the trading record. Third, even in the absence of any valuation-relevant information, large numbers of investors may follow the buy and sell recommendations of message board users, thereby inducing deviations in prices from their efficient levels. Fourth, day traders may recognize the momentum generated by investors who follow message boards, thus exaggerating this effect. In addition, even in the absence of price effects, it is still interesting to see whether Internet forums generate trading activity.

To examine these issues, we carried out both an event study and a vector autoregression (VAR) analysis of the data. The event study examined abnormal stock returns and trading volume around days with abnormal message board activity. The VAR analysis examined whether daily returns, trading volume, the number of messages posted, and changes in opinion can be used to predict these variables one day in the future.

Overview

Internet financial discussion forums can be divided into two main categories—chat rooms and bulletin boards. Chat rooms are live forums in which participants discuss stock market developments. Patrons of Internet chat rooms are typically investors who wish to discuss "hot" stocks and transitory market trends. Chat rooms do not have historical archives of conversations and lack mechanisms by which an offline user can participate in the discussion.

Bulletin boards provide organized forums for users to discuss specific financial instruments. Bulletin boards are not live forums but, instead, allow users to post messages for retrieval by others at a later time. A typical site contains distinct bulletin boards for each market security that users can discuss. A person wishing to search through previous messages can do so and reply to specific posts.

Both chat rooms and bulletin boards can be subcategorized into public and private sites. Although public sites draw the largest number of users, private sites may be home to most of the wild stock speculation associated with the Internet. Private sites are typically hosted by Internet personalities with large followings. The users of private sites value the opinions of their hosts, who have names such as TokyoJoe, WhizKid, and Lion Master and who have earned reputations for their ability to pump up stocks on the Internet and create significant stock price reactions (Wirth 1999). Access to private sites is not cheap. In fact, users of TokyoJoe's Society Anonyme Web site pay $200 a month to find out his stock picks.[2]

For this research, we considered only public bulletin boards because only public bulletin boards make available a large enough volume of historical data for a true scientific study. The use of public bulletin boards may have introduced a bias, however, into the study. Because the private board subscribers pay for the lead investor's opinion, they may be more willing than public board participants to speculate on recommended stocks. Public boards do not necessarily attract investors whose opinions carry added weight. That is, the users of these boards may scrutinize other users' opinions closely and be less likely than users of private sites to buy recommended stocks. Therefore, although our analysis will draw a relationship between bulletin board messages and stock performance, the relationship with stock price may be different for private Internet financial bulletins.

Of the public bulletin board universe, we analyzed a single financial forum, RagingBull.com, to eliminate the need to artificially group data from a variety of sources. As financial discussion sites have proliferated, they have used site format as a means of differentiation. Some sites categorize postings by sector; others organize postings by stock ticker. Therefore, understanding and comparing the full spectrum of thought on the Web has become nearly impossible. We thus chose to focus on a leading Internet financial forum. RagingBull, with a large membership and a high number of page views per day, is extremely popular. Between April and November 1999, the site membership tripled in size, to 300,000, and the site averaged 6,000,000 daily page views.[3]

Focusing on RagingBull also reduced the likelihood that users' opinions would be "off topic" or be misinterpreted. Bulletin boards are only as useful as their users make them. When discussions in a particular forum go off topic, data relevant to an academic study become scarce. Screening out the off-topic messages is very difficult and is likely to introduce errors from potentially valuable messages being thrown out. Additionally, deciphering the off-topic messages can be difficult. In some cases, postings do not explicitly state the user's opinion on a particular stock. Without this information, creating a metric of users' opinions is difficult.

The RagingBull.com site minimizes off-topic discussions because of its configuration. First, all the bulletin boards on the site are categorized by ticker symbol.[4] This feature reduces the number of unrelated postings present in the study. Second, the site includes an "optional disclosure" feature. This feature, which is unique to the RagingBull.com site, lets members clearly indicate their positions in or ratings of the stock by using preset buttons. Members can select from preset stock positions—long, short, or no position. Members can also use buttons to give ratings of strong buy, buy, hold, sell, and strong sell for the short term and for the long term. These features make the RagingBull.com site attractive from an academic point of view, because the site eliminates the need to screen and decode messages. The site also, of course, offers space for a message.

Popular conception holds that bulletin board opinions can greatly affect the prices of Internet stocks. Investors, trying to find sources of trading momentum in a volatile sector, may use message boards to find the next "hot" stock. To evaluate this belief, we used only Internet companies (under the assumption that they would be the hot stocks in the period studied) in this analysis. We used Zacks' Internet Services sector group to find an unbiased selection of 73 Internet service companies, which are listed by ticker symbol and name in **Table 1**. This group includes not only well-known large-cap companies, such as Yahoo! and Prodigy Communications Corporation, but also many obscure small-cap companies. The sector had a median market capitalization of $1.12 billion as of January 11, 2000, with a minimum market cap of $53.1 million (BiznessOnline.com) and a maximum market cap of $114.8 billion (Yahoo!).

The Data

We used a PERL script to collect data from the RagingBull.com site. For each message on the site, the script recorded the stock ticker, the date of the posting, the body of the message, and the poster's opinion of the stock's short- and long-term prospects. These data were immediately fed into an SQL database for data aggregation and analysis. Message data were available on the weekend and after market close each day. Occasionally, message data were available before a company's initial public offering. The date of the first message posting for each ticker is given in Table 1. Data were collected from April 17, 1999, the day the voluntary ratings disclosure feature was added to RagingBull, until February 18, 2000. A total of 181,633 messages were downloaded, with 10,723 unique ticker-day combinations. Of the 181,633 messages downloaded for this study, 43,794 (24.1 percent) had short-term opinions, 37,810 (20.8 percent) had long-term opinions, and 52,812 (29.1 percent) had a voluntary ratings disclosure of some type. In addition, we extracted stock return and volume data from the Internet for 13,023 unique ticker-day combinations.

We computed the average number of daily message postings for each stock's message board between the first day with a message and February 18, 2000. The mean stock message board had an average of 7.6 messages posted daily; the median message board had 2.5 messages posted daily. The maximum average number of daily postings was 103.6 (for CMGI Inc.). **Figure 1** provides a histogram illustrating the distribution of average daily message postings. The distribution was extremely skewed to the right, so average daily message postings were graphed on a logarithmic scale. Not surprisingly, we found daily average message postings and market capitalization to be positively related, with a correlation of 0.47 between the logarithms of the two variables.

Messages that included selection of a short-term opinion were used to calculate opinion measures for each message board/stock for each day.[5] Messages with short-term strong buy recommendations were assigned a value of +2. Messages with

Table 1. Internet Service Sector Studied, as of January 11, 2000

Ticker	Company	Market Cap (billions)	First Message	Ticker	Company	Market Cap (billions)	First Message
AKAM	Akamai Tech	$26.11	11/2/99	ISLD	Digital Island	$3.33	7/1/99
ASKJ	Ask Jeeves	2.99	7/6/99	ITRA	Intraware	1.69	4/19/99
ATHM	At Home Corp	15.26	4/19/99	ITVU	Intervu	1.38	4/19/99
ATHY	AppliedTheory	0.52	5/5/99	JFAX	JFAX.com	0.20	7/27/99
BFRE	Be Free	1.98	11/11/99	JPTR	Jupiter Comm	0.39	10/12/99
BIZZ	BiznessOnline	0.05	NA	JWEB	Juno Online Services	1.32	5/28/99
CAIS	Cais Internet	0.75	5/24/99	KOREA	Korea Thrunet	NA	11/22/99
CBLT	Cobalt Grp	0.38	8/9/99	LFMN	LifeMinders	0.88	11/23/99
CGLD	Cybergold	0.32	9/27/99	MAIL	Mail.com	0.74	6/22/99
CLAI	Claimsnet.com	0.06	4/19/99	MMXI	Media Metrix	0.89	5/11/99
CLKS	Click2learn.com	0.16	4/19/99	NAVI	Navisite	2.57	10/26/99
CMGI	CMGI	37.69	4/19/99	NBCI	NBC Internet	4.36	12/2/99
COVD	Covad Comm Grp	5.60	4/19/99	NCNT	Netcentives	1.86	10/18/99
CPTH	Critical Path	3.21	4/27/99	NETZ	Netzee	0.31	11/23/99
CTCH	Commtouch Software	0.52	7/15/99	NSOL	Network Solutions	7.51	4/19/99
CYBS	CyberSource Cp	1.17	6/28/99	NTCR	NetCreations	0.57	11/23/99
CYCH	CyberCash	0.19	4/19/99	NZRO	NetZero	2.70	9/28/99
DCLK	Doubleclick	11.24	4/19/99	ONEM	OneMain.com	0.36	4/19/99
DDDC	Deltathree.com	0.85	11/26/99	ORCC	Online Res&Comm	0.16	6/8/99
DGIN	Digital Insight	0.49	10/7/99	PASA	Quepasa.com	0.15	6/29/99
DIGI	Digital Impact	0.98	11/26/99	PCNTF	Pacific Internet	0.90	4/23/99
DIGX	Digex	3.92	8/3/99	PILT	Pilot Network	0.38	4/19/99
DRTN	Data Return Corp	1.77	11/1/99	PRGY	Prodigy Comm	1.48	4/19/99
ELNK	EarthLink	1.42	NA	PSIX	Psinet	4.71	4/19/99
ENGA	Engage Tech	4.05	7/22/99	PXCM	Proxicom	2.42	4/26/99
ENON	Euro909.com	0.28	4/19/99	SCNT	Scient Corp	4.95	5/18/99
EXDS	Exodus Comm	17.73	4/19/99	SOFN	Softnet Systems	0.44	4/19/99
FLAS	Flashnet Comm	0.11	4/19/99	TFSM	24/7 Media	1.08	4/19/99
FSHP	FreeShop.com	0.51	9/30/99	TGLO	theglobe.com	0.23	4/19/99
GBIX	Globix Corp.	1.56	4/19/99	USIX	USInterNetworking	2.79	4/19/99
GEEK	Internet America	0.09	4/19/99	VOYN	Voyager.Net	0.35	7/23/99
HEAR	HearMe	0.65	5/4/99	VRIO	Verio	4.65	4/19/99
HSAC	High Speed Access	0.99	6/8/99	WGAT	Worldgate Comm	0.94	4/20/99
IGLD	Internet Gold	0.39	8/10/99	XACT	Exactis.com	0.29	11/23/99
IIJI	Internet Init	4.84	8/6/99	YHOO	Yahoo!	114.80	4/19/99
INAP	Internap Network	5.17	10/1/99	ZIPL	ZipLink	0.20	5/28/99
INIT	Interliant	1.61	7/12/99				

NA = not available at time of writing.

short-term buy, hold, sell, and strong sell recommendations were assigned values of, respectively, +1, 0, –1, and –2. On each day and for each ticker, these opinions were summed to calculate the daily weighted opinion. This daily opinion measure was designed to center at zero for a neutral (hold) recommendation, with positive (negative) numbers indicating positive (negative) sentiment. Stocks with large numbers of recommendations could have scores that were large in magnitude, either positive or negative, because values were summed, but a large number of recommendations could also

Figure 1. Distribution of Average Message Postings per Day, April 17, 1999, to February 18, 2000

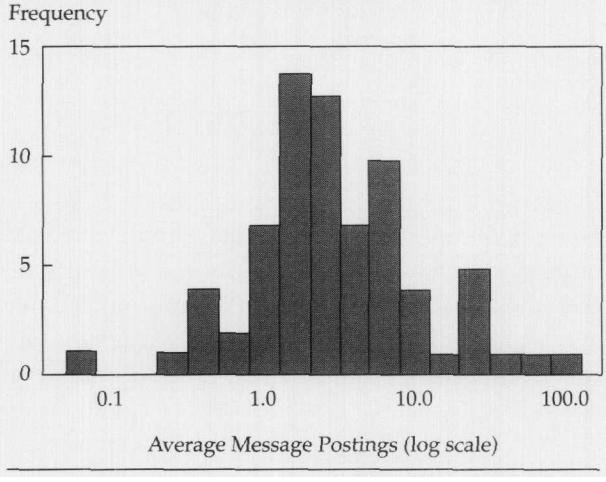
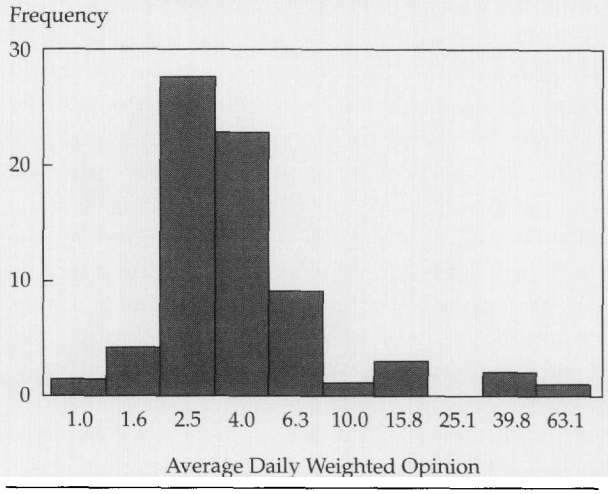


Figure 2. Distribution of Average Daily Weighted Opinions, April 17, 1999, to February 18, 2000



be associated with an opinion measure close to zero if there was a lack of consensus.

To get an understanding of the distribution of this opinion measure, we averaged the daily weighted opinion for each stock. The group mean of the average daily weighted opinion was 6.09; the median was 3.44. The standard deviation of the average daily weighted opinion value was 9.49. The maximum was 56.64 (for CMGI), and the minimum was 1.14 (for theglobe.com). **Figure 2** contains a histogram of the distribution of average daily weighted opinions. Perhaps surprisingly, average opinions for all the stocks in the sample were positive, although stocks did exhibit negative opinions on some days.

The magnitudes of these opinion measures are slightly difficult to interpret because they were heavily influenced by the number of messages. Consequently, for each ticker and each day, we also computed the average daily opinion. These daily averages were then averaged across days to produce a single average for each ticker. The mean across all stocks of this average daily opinion was 1.56, and the median was 1.64. These figures translate to opinions between buy and strong buy. Clearly, either the message board posters had generally positive sentiments about Internet stocks, which is understandable in light of the stocks' performance during the sample period, or the posters with negative sentiments were reluctant to disclose their opinions. The empirical analysis that follows is based on weighted opinions, but average opinions produced qualitatively similar results.

The mean arithmetic average daily return for the stocks in the sample was 0.677 percent, and the median was 0.648 percent. The maximum average daily return was 2.53 percent (Be Free Inc.), and the minimum was –0.58 percent (Flashnet Communications). The average standard deviation of daily returns was 7.59 percent, and the median was 7.39 percent. The maximum standard deviation was 13.37 percent (The Cobalt Group), and the minimum was 4.80 percent (CyberCash). Both the average return and the standard deviation of returns are high compared with average values in the stock market during the sample period. The Internet sector was very volatile during this time, however, and generated exceptional *ex post* performance.

During the sample period, the mean average trading volume was 857,000 shares and the median was 423,000 shares. The highest average daily trading volume was 8,765,000 shares (Yahoo!), and the minimum average daily trading volume was 75,000 shares (Claimsnet.com). Although trading volume varied significantly, even the least active stocks exhibited a reasonable amount of liquidity.

Event Study

We conducted an event study to determine the impact of high message volume on security prices and trading volume.[6] The study examined industry-adjusted returns and abnormal volume around days with abnormally high numbers of postings.

Methodology. For each day in the sample period, we computed the average number and standard deviation of the number of daily message postings over the previous five days. We defined an "event day" as a day with a number of message postings that exceeded the previous five-day average by at least two five-day standard deviations.

Event days in which fewer than 10 messages were posted were excluded from the sample.[7]

Two opinion metrics were examined to determine the strength of opinion changes on the event day. The first opinion metric, the raw change in weighted opinion, was calculated as the difference between the event-day weighted opinion and the average weighted opinion over the previous five days. The second opinion metric, the adjusted change in weighted opinion, was calculated as the raw change in weighted opinion divided by the standard deviation of weighted opinion over the previous five days. The metrics produced similar results, so for brevity, we report only the first, the raw change in weighted opinion.

We found a total of 293 event days, 47 of which had opinions lower than the previous five-day average. These days were grouped into the "negatives" category in the analysis. Five of the event days had opinions equal to the previous five-day average and were ignored. Of the total, 241 event-day opinions were greater than the previous five-day opinion average. These events were split in half. The "strong positives" category contained the half of the event days with the strongest opinion change. The "weak positives" contained those with the weakest positive-opinion change. **Table 2** presents descriptive statistics for the changes in investor opinion on the event days. The "weak positives" and the "negatives" appear to be roughly symmetrical, with the "strong positives" showing a substantial swing in opinion.

To analyze the relationship between changes of opinion and returns to these stocks, adjustment of daily returns was necessary because of the high and volatile returns in this sector. A constant mean return model could have been used to adjust returns, but many of the stocks in the study did not have enough data to calculate accurate historical mean returns. Adjusting returns by using the capital asset pricing model (CAPM) and the S&P 500 Index as the market index was another possibility. Beta calculations from the S&P 500 would have had large errors, however, because of the volatility of the stocks. Moreover, the CAPM may not be the correct model for normal returns of companies in the Internet sector. The final option, adjusting returns by using an industry index, was both feasible and, because it does not require beta estimates, free of estimation error.

Table 2. Raw Change in Weighted Opinion on Event Days, April 17, 1999, to February 18, 2000

	Strong Positives	Weak Positives	Negatives
Average	27.97	3.11	–2.85
Maximum	177.60	6.00	–0.33
Minimum	6.00	0.25	–12.00

To find the correct index, we constructed an equally weighted portfolio of the 73 sample stocks. We compared daily returns for this portfolio with the daily returns of the Philadelphia Stock Exchange (PSE) Internet Index, the Amex Internet Index, the Chicago Board Options Exchange (CBOE) Internet Index, the PSE Semiconductor Index, the Nasdaq Composite Index, and the S&P 500. The correlations between the portfolio and the indexes and between indexes are in **Table 3**.

As expected, the equally weighted portfolio was not as correlated with the market indexes as it was with the Internet indexes. The equally weighted portfolio was highly correlated with all three Internet indexes. In addition, the three Internet indexes were highly correlated with one another. Table 3 shows the PSE Internet Index having a correlation coefficient of 0.906 with the Amex Internet Index and 0.934 with the CBOE Internet Index. The correlation coefficient between the Amex and the CBOE indexes is also high, 0.920. The PSE Internet Index was the most highly correlated

Table 3. Correlations between Candidate Indexes and the Sample Portfolio, April 17, 1999, to February 18, 2000

	Equally Weighted Portfolio	PSE Internet Index	Amex Internet Index	CBOE Internet Index	PSE Semiconductor Index	Nasdaq Composite
PSE Internet Index	0.849					
Amex Internet Index	0.791	0.906				
CBOE Internet Index	0.820	0.934	0.920			
PSE Semiconductor Index	0.400	0.454	0.586	0.455		
Nasdaq Composite	0.690	0.789	0.903	0.775	0.743	
S&P 500	0.524	0.585	0.715	0.574	0.622	0.838

with the equally weighted portfolio returns, so it was chosen as the industry index for the study.[8]

We adjusted returns for industry returns; each company was assumed to have a beta of 1 relative to the PSE Internet Index. Therefore, the industry-adjusted return was defined as a stock's daily return less the return on the Internet Index.

For each ticker and each day during the sample period, we computed abnormal trading volume, defined as the percentage change in trading volume on a given day compared with the average trading volume. A 20-trading-day period preceding the day in question was used to calculate the average trading volume.

Empirical Results. In all cases, the results presented in this section are for portfolios of strong positives, weak positives, and negatives formed on the basis of raw changes in weighted opinion. **Table 4** provides the industry-adjusted returns and abnormal volume for these portfolios for the five days preceding and five days following the event day, and **Figure 3** graphs these data in Panel A (returns) and Panel B (volume)

From Table 4, the raw changes in weighted opinion indicate that stocks with strong-positive-opinion events experienced a statistically significant positive drift up in returns prior to the event day. Cumulative abnormal returns in the prior five-day period were more than 3.5 percent. As shown in Panel A of Figure 3, returns for stocks with weak-positive-opinion events were basically flat leading up to the event day, although they did exhibit an anomalous negative and significant return on Day –2. Stocks with negative-opinion event days experienced a slight downward drift up to the event day, but the phenomenon is not statistically significant. On the event day, stocks with both strong and weak-positive signals had statistically significant, positive industry-adjusted returns. Stocks with negative-opinion event days had a slightly negative industry-adjusted return that is not statistically significant. Notably, returns for stocks within all the opinion groups were statistically flat after the event day.

Trading volume was relatively normal leading up to the event day (see Table 4 and Panel B of Figure 3). The study produced sporadic negative and significant abnormal volume on several days, but the magnitudes of these effects were generally smaller than 20 percent, which indicates a potential absence of economic significance. In contrast, on the event day and on Day +1, a sharp increase in trading volume occurred, with magnitudes commonly reaching 50 percent and sometimes exceeding 100 percent. Stocks subject to strongly positive changes in weighted opinion showed the most significant increase in trading volume, but the other groups exhibited a similar pattern. Trading volume retreated to more normal levels approximately two days past the event day.

The results show that message board activity is linked to stock-price movements but abnormal message board activity does not help predict future stock-price movements over a one-day or five-day window in the future. Each event-day classification experienced statistically insignificant changes in value after the event day. This observation is consistent with market efficiency. On the event day, strong-positive and weak-positive event days showed statistically significant returns in excess of the industry index. Therefore, abnormal message board activity is coincident with abnormal stock returns. Unfortunately, our methodology does not allow a determination of whether event-day activity on the message boards caused or was the result of abnormal returns to the stock. Further study examining the intraday relationship between message postings and stock returns would be necessary to determine causality.

The evidence on message board activity and volume is similar. In this case, however, volume did not return to normal immediately after the event day. Given this evidence, one could speculate that message board activity is generating trading, but this evidence must also be evaluated in the context of the existing result that volume is positively autocorrelated. The VAR analysis addresses this issue.

Vector Autoregression Analysis

We performed a VAR analysis to study the general relationships among stock returns, trading volume, message postings, and weighted opinion.

Methodology. The analysis was performed on a stock-by-stock basis rather than over a pooled sample of all the stocks because of potential non-stationarity across securities. Specifically, because trading volume, number of messages, and weighted opinion differed in scale across stocks, we had no reason to believe that VAR coefficients would be the same across stocks.[9] Stocks with fewer than 30 observations were also eliminated from the dataset. Rather than examining the coefficients themselves, we calculated *t*-statistics, again to avoid interpretation problems associated with scale effects.

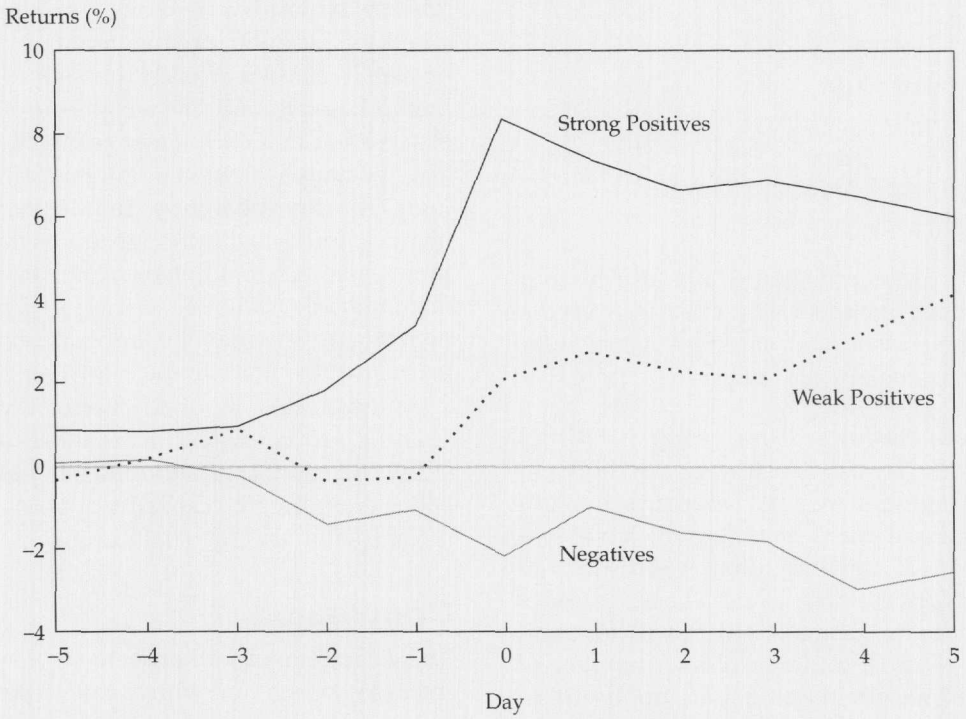
Table 4. Abnormal Returns and Volume, April 17, 1999, to February 18, 2000

	Prior Five Days							Post Five Days					
Portfolio	–5	–4	–3	–2	–1	Cumulative	0	1	2	3	4	5	Cumulative
A. Returns													
Strong positives													
Return	0.91%	–0.01%	0.10%	0.82%	1.55%**	3.54%***	4.75%***	–0.89%	–0.69%	0.21%	–0.32%	–0.44%	–2.07%
Standard error	0.62	0.45	0.45	0.53	0.65	1.29	1.32	0.64	0.45	0.53	0.53	0.56	1.27
Weak positives													
Return	–0.23	0.47	0.64	–1.18***	0.10	–0.22	2.37**	0.62	–0.49	–0.14	0.96	0.93	1.72
Standard error	0.44	0.46	0.66	0.40	0.67	1.19	1.06	0.79	0.51	0.49	0.57	0.51	1.18
Negatives													
Return	0.19	–0.05	–0.28	–1.16**	0.34	–1.09	–1.07	1.12	–0.64	–0.18	–1.15	0.32	–0.72
Standard error	0.80	0.93	0.56	0.59	0.83	2.29	1.16	0.80	0.75	0.63	0.67	0.68	1.51
B. Volume													
Strong positives													
Abnormal volume	3.3	–2.4	–10.5**	–0.1	11.9		160.6**	59.0***	5.9	9.0	18.0	17.2**	
Standard error	7.4	7.0	4.5	6.3	6.8		65.9	12.6	5.7	7.3	10.1	8.6	
Weak positives													
Abnormal volume	–25.1***	–11.9	–10.8	–20.7***	–3.7		45.3***	34.0***	14.2	–7.2	6.8	3.5	
Standard error	5.3	7.6	6.5	5.3	12.6		10.9	13.1	17.1	7.1	16.6	11.5	
Negatives													
Abnormal volume	–5.2	–5.0	–12.3	–23.5***	–16.2**		46.4**	20.1	–3.3	–12.1	–18.0**	–14.7**	
Standard error	18.2	12.8	9.1	6.7	7.6		22.0	13.8	9.1	7.5	7.7	6.5	

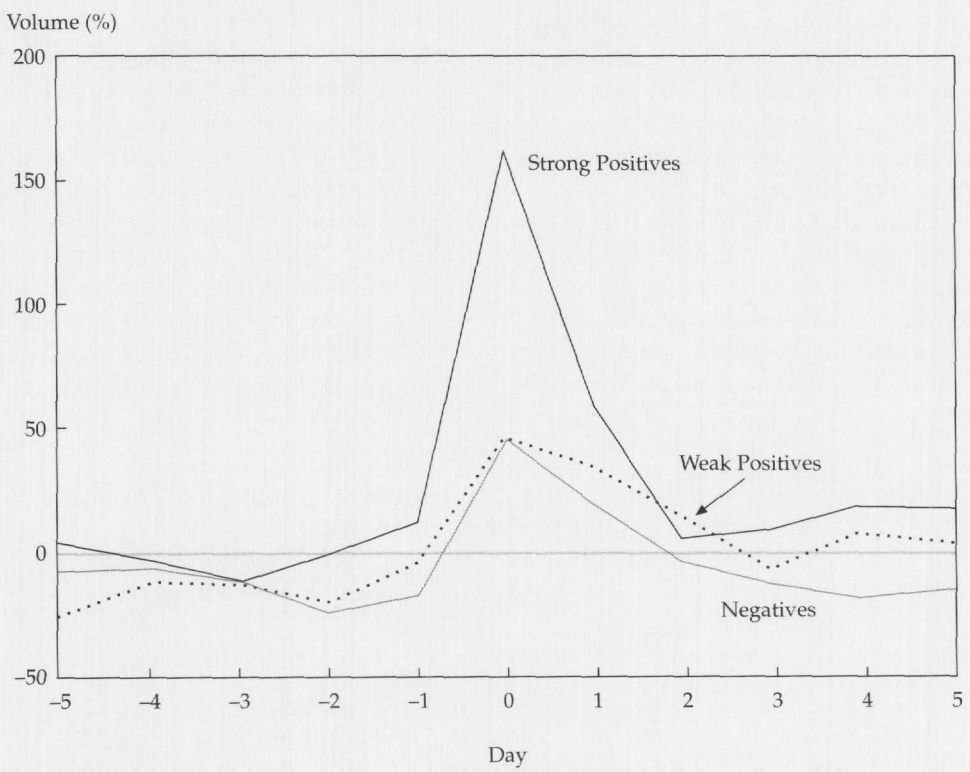
**Significant at the 5 percent level
***Significant at the 1 percent level.

Figure 3. Cumulative Abnormal Returns and Volume around Event Days, April 17, 1999, to February 18, 2000

A. Cumulative Abnormal Returns



B. Abnormal Trading Volume



We used a linear one-day-lagged time-series model. The vector of variables of interest on day t was defined as follows:

$$\mathbf{Z}_t = \begin{bmatrix} \text{Return}_t \\ \text{Volume}_t \\ \#\text{ of messages}_t \\ \text{Weighted opinion}_t \end{bmatrix}.$$

The corresponding VAR(1) model was

$$\mathbf{Z}_{t+1} = \mathbf{A} + \mathbf{B}\mathbf{Z}_t + \varepsilon_{t+1},$$

where **A** is a vector constant, **B** is a four-by-four matrix of coefficients, and **å** is the error-term vector. **A**, **B**, and their associated standard errors were calculated on a stock-by-stock basis.

Empirical Results. The average t-statistics across the stocks for each coefficient are shown in **Table 5**.[10] Meaningful average t-statistics, in boldface text, represent coefficients for which a meaningful fraction of the individual t-statistics are significant at conventional levels. The magnitudes of the t-statistics for the majority of coefficients are small. Stock returns, trading volume, number of messages, and weighted opinion are not useful in predicting stock returns one day into the future. This result is, again, consistent with market efficiency.

Trading volume shows an autoregressive relationship. High-trading-volume days tended to precede days of high trading volume; low-trading-volume days tended to precede days of low trading volume. After this effect was accounted for, the number of messages and weighted opinion had no marginal explanatory power.

For the message board activity on RagingBull.com, we found the number of messages posted on a given day to be strongly positively related to the number of messages posted on the previous day. In addition, days with high trading volume and positive weighted opinions were followed by days with greater message activity. Finally, weighted opinion depended on the number of messages and opinions posted on the previous day. Positive-opinion days tended to follow days with positive opinions. The dependency of weighted opinion on the number of messages posted is consistent with the simple summation method used to calculate weighted opinion and the observation that each message board had positive average daily weighted opinions. Perhaps surprisingly, returns apparently do not predict message board activity at all, although (given the contemporaneous correlation between returns and activity documented in the event study) lagged message board activity may be subsuming this effect because of the noise in the return series.

Overall, results of the vector autoregression analysis are consistent with those of the event study. We cannot reject the efficiency of the market, and if anything, the causality appears to run from the market to the financial forums.

Conclusion

That changes in information technology are ushering in a new age, and with it, a new economy, is fast becoming a truism. Although the larger implications of this change are still being worked out, Internet stocks are clearly now, and will continue to be, a fundamentally important part of the financial landscape. This article extends recent academic research by examining the effects of postings and opinions about Internet service sector stocks found on Internet message boards.

The event study showed that returns following abnormal Internet message board activity are statistically insignificant and consistent with market efficiency. Statistically significant positive returns did, however, precede the days with strong positive opinions and abnormal message board activity. Furthermore, stock returns and message board opinions on days of abnormal message board activ-

Table 5. Average *t*-Statistics from a Company-by-Company VAR Analysis, Data for April 17, 1999, to February 18, 2000

	Independent Variable			
Dependent Variable	Return	Trading Volume	Number of Messages	Weighted Opinion
Return	–0.275	–0.076	0.112	–0.069
Trading Volume	0.064	**3.933**	0.480	0.213
Number of Messages	–0.395	**0.855**	**2.203**	**1.082**
Weighted Opinion	0.251	0.279	**1.825**	**0.929**

Note: Bold text denotes statistically significant results.

ity appear to be related. We found little or no evidence, however, that opinion predicts future returns. Trading volume increases significantly on the event day and generally remains high for one day thereafter.

The VAR analysis showed that, on the one hand, the returns of Internet service sector stocks are not predictable from using message board data and a linear one-day-lagged time-series model. This observation is consistent with market efficiency. On the other hand, the number of messages posted on Internet financial forums can be predicted by using the previous day's trading volume, number of messages posted, and weighted opinion.

The overall conclusion is that apparently no causal link exists from message board activity to stock returns and volume. In fact, we found the reverse—that market information influences message board activity. These results are completely consistent with market efficiency.

The results are significant because they counter the conventional wisdom that Internet stocks are valued irrationally. Specifically, they contradict the anecdotal evidence that stock-price manipulation via message board postings is rampant and widespread.

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Notes

1. Recently, the press has sensationalized the activity in these forums by linking it to egregious examples of stock-price manipulation. Examples the print press have cited include the following: In February 1999, the stock price of a small Milwaukee-based toy company, Alottafun Inc., soared 382 percent based on speculation started in Internet chat rooms (Gallagher 1999). In April 1999, a user of Yahoo! message boards posted a fraudulent Bloomberg.com press release that drove the stock price of PairGain Technologies up 31 percent in one morning (Gaw 1999). More recently, in September 2000, the U.S. SEC announced the uncovering of an Internet-based stock-price manipulation scheme by a 15-year old in New Jersey (see Schroeder, Simon, and Elstein 2000). Such examples demonstrate that excesses (or abuses) of Internet forums do happen, but the vast majority of discussions involve investors honestly expressing their opinions about securities.
2. See www.tokyojoe.com.
3. Raging Bull press release (November 16, 1999), www.ragingbull.com/community/press/11-16-99.html.
4. Reading or posting messages on the site requires that a user become a member, but membership is free. See www.ragingbull.com.
5. We also experimented with using long-term opinions to calculate an opinion measure for each stock, but the results were weaker and are, therefore, not reported.
6. See Brown and Warner (1985) and Campbell, Lo, and MacKinlay (1997) for a review of event-study methodologies.
7. These exclusions were made to reduce error introduced by stocks with small bulletin board followings.
8. The adjusted return calculations were relatively insensitive to which of the Internet indexes was used because of the high correlation between indexes.
9. The alternative approach of normalizing these variables was rejected because of problems in formulating the correct normalization.
10. Median *t*-statistics generated qualitatively similar results.

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