Internet Message Board Activity and Market Efficiency: A Case Study of the Internet Service Sector using RagingBull.Com

Robert Tumarkin, Stern MBA Class of 2000

with assistance and advisement from
Robert Whitelaw, Ph.D.

Abstract

This paper examines the relationships between Internet message-board activity and abnormal stock returns and between Internet message-board activity and abnormal trading volume. This study focuses on RagingBull.com and Internet service sector stocks. I choose RagingBull.com because its format enables me to measure investor opinion objectively. I find that on days with abnormally high message activity changes in investor opinion correlate with abnormal industry-adjusted returns. Additionally, days with abnormally high message activity coincide with abnormally high trading volume both that day and the following day. However, I find that, in general, message-board activity does not predict industry-adjusted returns or abnormal trading volume.

Introduction

The Internet is clearly playing an ever-increasing role in financial markets and personal finance. Six large Internet brokerages, Ameritrade, DLJdirect, E*Trade, NDB, Schwab, and TD Waterhouse, cumulatively boasted over 12 million accounts in 1999 and are expecting account growth of 45% in 2000.[1] While the Internet revolution may have initially only facilitated security transactions, investors now benefit from a wide assortment of financial information available online. All official SEC filings can easily be found on the World Wide Web. Most established companies host web sites that provide investors with greater 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. Web sites like The Motley Fool (Fool.com), SiliconInvestor.com, and RagingBull.com have facilitated this discussion among thousands of investors.

Valuation of Internet stocks is currently a hot topic in the academic community. Trueman, Wong, and Zhang (2000), for example, try to find relationships between Internet company stock prices and accounting information. In their research, they find a significant association between gross profits and valuation. Hand (2000) discovers a non-linear relationship between accounting data and stock pricing. In another paper, Rajgopal, Kotha, and Vehkatachalam (2000) find that web traffic helps determine the value of Internet companies, after controlling for some accounting measures. Wysocki (1999) examines 3,000 stocks listed on Yahoo! message boards and finds Internet message-posting volume predicts changes in next-day trading volume and returns. Specifically, he finds that a doubling of overnight message postings relative to the average leads to a 0.18% average abnormal return.

This research represents the first academic foray into Internet stock pricing. These papers attempt to answer two key questions: (1) What are the determinants of Internet stock prices? and (2) Are these prices consistent with market efficiency? The analysis presented in this paper is similar in spirit, but takes a very different perspective. Instead of using accounting data, web traffic, or message-posting volume to determine value, this paper looks at the opinions contained in Internet financial forums. Recently, the press has sensationalized the activity in these forums, linking it to egregious examples of stock-price manipulation. For example, in February 1999, the stock price of a small Milwaukee-based toy company, Alottafun Inc., soared 382% based on speculation started in Internet chat rooms.[2] 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% in one morning.[3] While these examples demonstrate the excesses of Internet-forum abuse, the vast majority of the discussion involves investors honestly expressing their opinions on securities markets.

The analysis presented in this paper evaluates the relationship between Internet service company valuation and investor opinions quantitatively using a specific Internet forum, RagingBull.com. This site

[1] Scott W. Appleby, Robertson Stephens Inc., E*Trade Analyst Research, January 4, 2000
[2] Kathleen Gallagher, Milwaukee Journal Sentinel, Business Section, pg. 1, March 14, 1999

was selected not only because of its popularity, but also because it lets users post their opinions using a standardized message template, a feature that enhances the accuracy of message interpretation and analysis. The messages on Ragingbull.com will be used to answer the following question: Can message board activity help predict stock returns and/or trading volume? Message-board activity may help predict stock returns if a large number of investors follow the buy and sell recommendations of message board users. Furthermore, day traders may recognize the momentum generated by investors that use message boards and create an inefficient increase in stock price. Such a phenomenon may vary by sector and market capitalization. While the analysis presented here will be very focused, it can easily be extended to any Internet forum and to any sector of the stock market.

This paper presents both event study and a vector autoregression (VAR) analysis of the data. The event study looks at abnormal stock returns and trading volume around days with abnormal message-board activity. For this study, event days are defined as days when the number of message postings exceeds the five-day average number of message postings by two standard deviations. The results show that days with strong positive message board opinions are preceded by a small, abnormal increase in stock price. Furthermore, message board opinion and abnormal returns on the event day are related. However, there is little or no evidence that opinion predicts future returns. Trading volume increases significantly on the event day and generally remains high for one day thereafter. The VAR analysis examines if daily returns, trading volume, the number of messages posted, and opinion can be used to predict these variables one-day in the future. Consistent with the results from the event study, in general, it is not possible to predict returns using any of the variables. As is well known, trading volume is positively related to the previous day's trading volume. Furthermore, trading volume, number of messages, and opinion help predict the next day's number of message postings and the opinion in those messages.

The paper first introduces Internet forums in greater detail so that the reader can understand the limitations created by analyzing a subset of financial forums. The paper then turns to the RagingBull.com site specifically and discusses how the site's configuration aids in accurate analysis of Internet discussion. The paper then presents descriptive statistics regarding the postings on RagingBull.com. An event study examining the effect of message group discussion follows. Finally, the paper will present a general VAR analysis of the data and draw conclusions regarding the quality of discussion in Internet forums.

Overview

Internet Financial Forums

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

[3] Jonathan Gaw, Los Angeles Times, Part A, pg. 1, April 8, 1999

market trends. Chat rooms do not have historical archives of conversation 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 may do so and reply to specific posts.

Both chat rooms and bulletin boards can be further subcategorized into public and private sites. While public sites draw from the largest number of users, private sites may be home to most of the wild stock speculation associated with the Internet. Private sites are typical hosted by Internet personalities with large followings. The users of private sites value the opinions of their hosts, with names like TokyoMex, WhizKid, and Lion Master, who have earned reputations for their ability to hype stocks on the Internet and create significant stock-price reactions.[4] In fact, users of TokyoMex's Society Anonyme web site pay $200 per year for access to his stock picks.[5]

For this research, only public bulletin board forums are considered and only a single forum is analyzed. Public bulletin boards are the only financial forums considered because only public bulletin boards make available a large enough volume of historical data for a true scientific study. However, the use of public bulletin boards may introduce a bias into the study. Because the private-board subscribers pay for the lead investor's opinion, they may be willing to speculate on recommended stocks. Public boards do not necessarily have investors whose opinion carries added weight. The users of these boards may scrutinize other user's opinions highly and be less likely to buy recommended stocks. Therefore, while the analysis presented below will draw a relationship between bulletin-board messages and stock performance, the relationship may be different for private Internet financial forums.

Sample Selection and Data Collection

The Raging Bull Site

It is difficult to understand the full scope of content available on the Internet. Web sites are relatively easy to establish. In fact, non-financial web "portals," like Yahoo! and AOL, have created financial discussion groups to attract and retain users. As financial discussion sites have proliferated, site format has been used as a means of differentiation. Some sites categorize posts by sector, while others organize posts by stock ticker. Still others group all messages into a single board and let users search for desired postings. Therefore, it has become nearly impossible to understand and compare the full spectrum of thought on the web.

For the purposes of this study, a single financial site, RagingBull.com, is used. A single-site focus minimizes error by eliminating the need to group data from a variety of sources artificially. RagingBull.com is a leading Internet financial forum. It is extremely popular, with a large membership

[4] Gregg Wirth, TheStreet.com, Tech Stocks Section, March 12, 1999

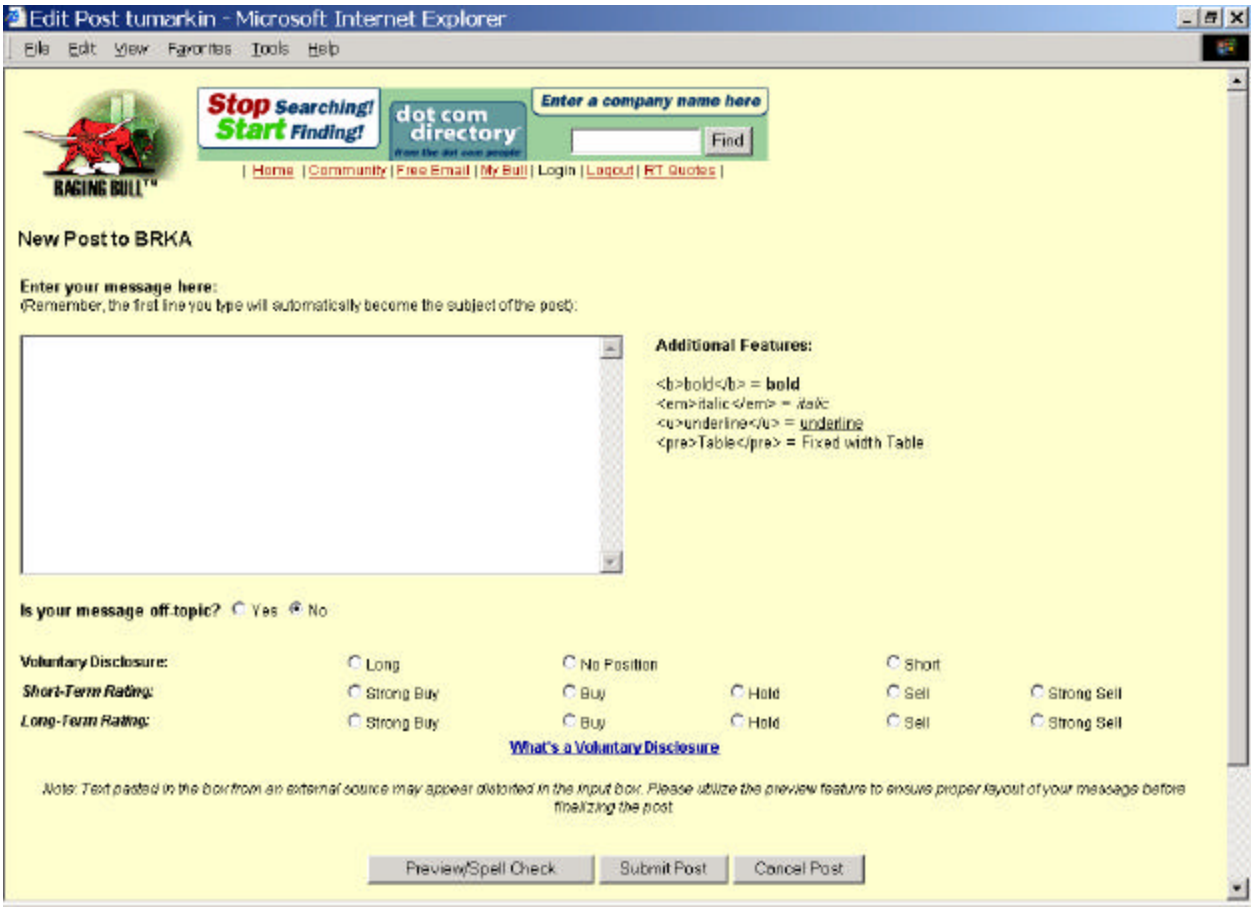
and a high number of page views per day. Between April and November 1999, the site membership tripled in size to 300,000, while averaging 6 million daily page views.[6]

Bulletin boards are only as useful as their users make them. As discussions in a particular board become off-topic, data relevant to an academic study becomes scarce. Screening out these off-topic messages is very difficult and would likely introduce error as potentially valuable messages are thrown out. Additionally, deciphering these messages can be very difficult. In some cases, postings do not explicitly state the user's opinion on a particular stock. Without this information, it is difficult to create a metric of user's opinions. The RagingBull.com site minimizes these errors because of its configuration. First, all bulletin boards are categorized by ticker symbol. This feature reduces the number of unrelated posts present in the study. Second, the site includes an "optional disclosure" feature. This feature is unique to the RagingBull.com site and lets users clearly indicate their opinion on the short and long-term prospects of the stock. Using radio buttons, RagingBull.com members can select from a number of preset stock opinions. They can select from long, short, or no position as their voluntary disclosure opinion. Similarly, users can issue strong buy, buy, hold, sell and strong sell ratings for both the short-term and the long-term. The screen capture in Figure 1 illustrates the message-posting system on RagingBull. 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. Of the 181,633 messages downloaded for this study, 43,794 (24.1%) had short-term opinions, 37,810 (20.8%) had long-term opinions, and 52,812 (29.1%) had a general "voluntary disclosure."

[5] Source http://www.tokyojoe.com/

[6] Raging Bull press release, November 16, 1999, http://www.ragingbull.com/community/press/11-16-99.html

Figure 1 : Screen Capture from RagingBull.com



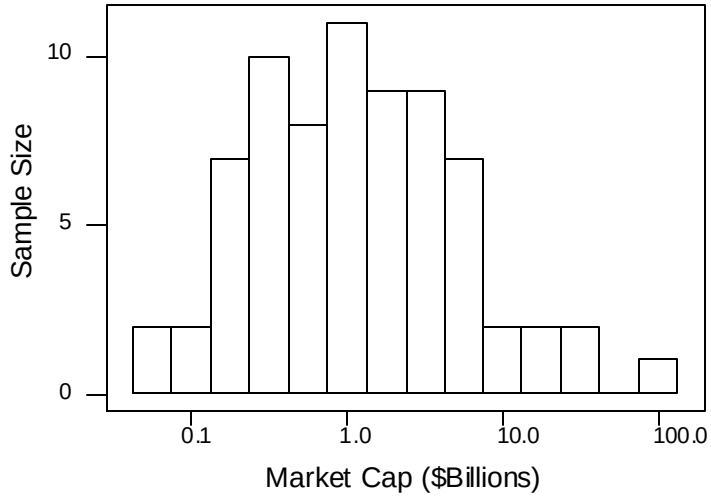
The Internet Service Sector

Popular conception holds that bulletin-board opinions can greatly affect the prices of Internet stocks. It is possible that investors, trying to find sources of trading momentum in a volatile sector, use message boards to find the next "hot" stock. To evaluate this belief, only Internet companies were used in this analysis. Zacks' Internet Services sector group was used to find an unbiased selection of 73 Internet service companies (see Table 1). This group not only includes well-known, large capitalization companies like Yahoo! and Prodigy, but also includes many small-capitalization, obscure firms. The sample sector had a median market capitalization of $1.12 billion as of January 11, 2000. The minimum market capitalization was $53.1 million (Biznessonline.com), while the maximum market capitalization was $114.8 billion (Yahoo!). A histogram demonstrating a relatively normal distribution of logarithmic market capitalization is shown in Figure 2.

Table 1 : Market Capitalizations and Start Dates for the Firms in the Sample

Ticker	Company	Market Cap ($Billion)	First Message	Ticker	Company	Market Cap ($Billion)	First Message
AKAM	Akamai Tech	26.11	11/2/99	ISLD	Digital Island	3.33	7/1/99
ASKJ	Ask Jeeves Inc	2.99	7/6/99	ITRA	Intraware Inc	1.69	4/19/99
ATHM	At Home Corp	15.26	4/19/99	ITVU	Intervu Inc	1.38	4/19/99
ATHY	AppliedTheory	0.52	5/5/99	JFAX	JFAX.com	0.2	7/27/99
BFRE	Be Free Inc	1.98	11/11/99	JPTR	Jupiter Comm	0.39	10/12/99
BIZZ	Biznessonline	0.05		JWEB	Juno Online Services	1.32	5/28/99
CAIS	Cais Internet	0.75	5/24/99	KOREA	Korea Thrunet		11/22/99
CBLT	Cobalt Grp Inc	0.38	8/9/99	LFMN	Lifeminders.com	0.88	11/23/99
CGLD	Cybergold Inc	0.32	9/27/99	MAIL	Mail.com Inc	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 Inc	2.57	10/26/99
CMGI	CMGI Inc	37.69	4/19/99	NBCI	NBC Internet	4.36	12/2/99
COVD	Covad Comm Grp	5.6	4/19/99	NCNT	Netcentives Inc	1.86	10/18/99
CPTH	Critical Path	3.21	4/27/99	NETZ	Netzee Inc	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 Inc	0.19	4/19/99	NZRO	NetZero Ince	2.7	9/28/99
DCLK	Doubleclick Inc	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	0.9	4/23/99
DIGX	Digex Inc	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 Network	1.42		PSIX	Psinet Inc	4.71	4/19/99
ENGA	Engage Tech	4.05	7/22/99	PXCM	Proxicom Inc	2.42	4/26/99
ENON	Euro909.com	0.28	4/19/99	SCNT	Scient Corp	4.95	5/18/99
EXDS	Exodus Comm Inc	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 Inc	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 Inc	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! Inc	114.8	4/19/99
INAP	Internap Network	5.17	10/1/99	ZIPL	Ziplink Inc	0.2	5/28/99
INIT	Interliant Inc	1.61	7/12/99				

Figure 2 : Histogram of Market Capitalization for the Firms in the Sample



Data Collection

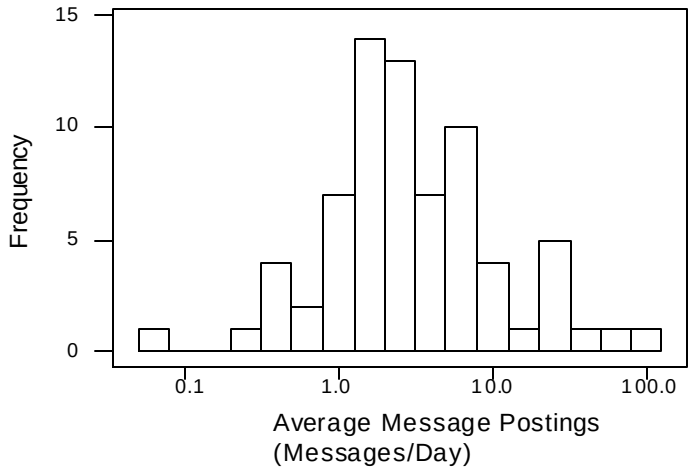
Data was collected from RagingBull.com using a PERL script. For each message on the site, the script recorded the stock ticker of interest, the date of the post, the body of the message, and the short, medium, and long-term opinion of the investor. This data was immediately fed into a SQL database for data aggregation and analysis. Message data was available on the weekend and after market close each day. Occasionally, message data was available before a company's IPO. The date of the first message posting for each ticker is listed in Table 1. Data was collected from April 17, 1999, the day when the opinion-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. In addition, stock return and volume data was extracted from the Internet, with 13,023 unique ticker-day combinations.

Message Board Statistics

Daily Average of Messages Posted

The average number of daily message postings was computed for each stock's message board. Averages were computed 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, while the median message board had 2.5 messages posted daily. The maximum average number of daily postings was 103.6 (CMGI Inc.). A histogram showing the distribution of average daily message postings is shown in Figure 3.

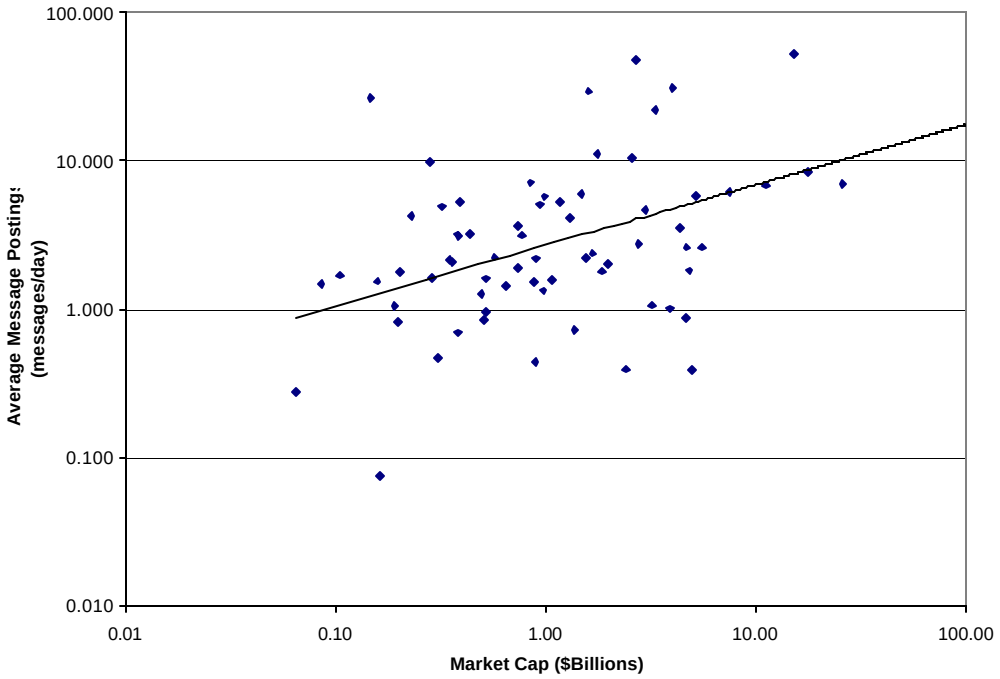
Figure 3 : Histogram of Average Daily Message Postings for the Firms in the Sample



The scatter plot below shows that daily average message postings and market capitalization are, at best, loosely correlated. Regressing the two variables using a log-linear relationship yields:

$$\log(\text{Average Message Postings}) = 0.4298 + 0.4072 * \log(\text{Market Cap})$$
$$R^2 = 21.93\%$$

Figure 4 : Scatter Plot of Market Cap against Posting Average for the Firms in the Sample



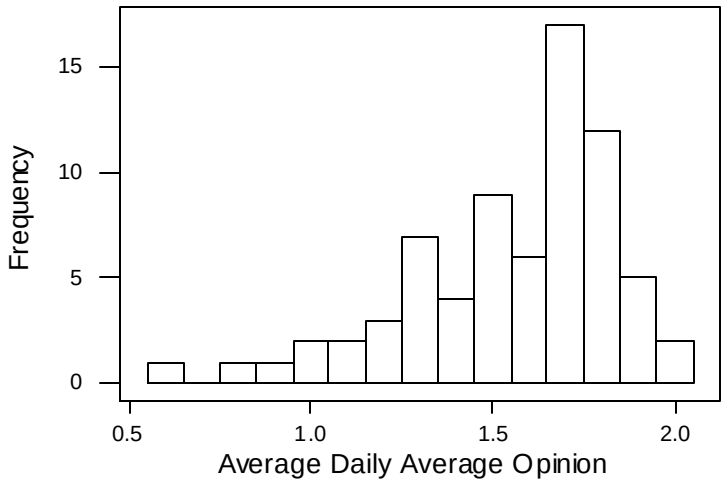
Average Short-Term Opinion

Messages that included a voluntary short-term opinion were used to calculate an average opinion measure for each message board. Messages with short-term strong-buy recommendations were assigned

a value of +2. Similarly, messages with short-term buy, hold, sell, and strong-sell recommendations were assigned values of +1, 0, -1, and –2, respectively. These opinion values were averaged on a daily basis to calculate the daily average opinion. For all average daily average opinion calculations, days without opinions were ignored.

For each ticker, the average daily average opinion was computed. The mean average daily average opinion was 1.56, while the median was 1.64. These figures represent average opinions between buy and strong buy. The standard deviation of the average daily average opinion was 0.287. A histogram showing the distribution of average daily average opinions is shown in Figure 5.

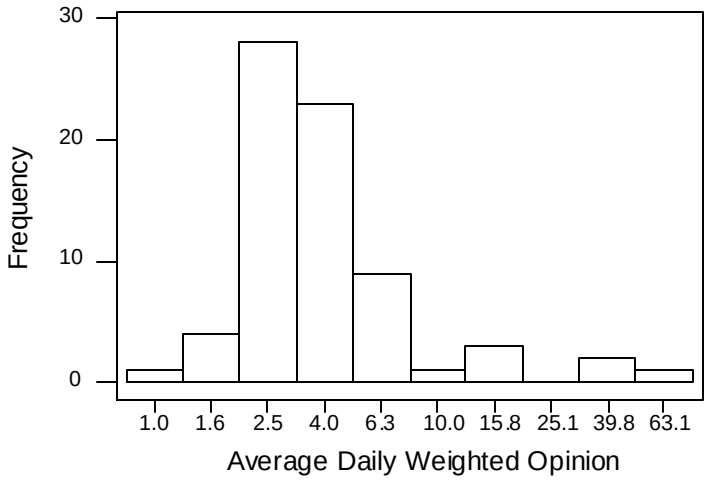
Figure 5 : Histogram of Average Daily Average Opinion for the Firms in the Sample



Weighted Short-Term Opinion

Weighted opinions for each ticker were also calculated on a daily basis. Each message with a short-term opinion was assigned a value according to the scale presented in the average opinion section. These opinions were added to calculate the daily weighted opinion. This daily weighted opinion was averaged for each stock. The mean average daily weighted opinion was 6.09, while the median was 3.44. The standard deviation of the average daily weighted opinion value was 9.49. The maximum was 56.64 (CMGI Inc.) while the minimum was 1.14 (TheGlobe.com). A histogram showing the distribution of average daily weighted opinions is shown in Figure 6.

Figure 6 : Histogram of the Average Daily Weighted Opinion for the Firms in the Sample



Stock Returns

The arithmetic average and standard deviation of daily returns were calculated for each stock during the sample period. The mean arithmetic average of daily return for the stocks was 0.677% and the median was 0.648%. The maximum average daily return was 2.53% (Be Free Inc) and the minimum was -0.58% (Flashnet Communications). The average standard deviation of daily returns was 7.59% and the median was 7.39%. The maximum standard deviation was 13.37% (Cobalt Group) and the minimum was 4.80% (Cybercash). Both the average return and standard deviation of returns are very high compared to average values in the stock market during the sample period. At the time of the study, the Internet sector was very volatile and generated exceptional ex-post performance. Histograms showing the distribution of average arithmetic daily returns and the distribution of the standard deviation of daily returns are shown in Figures 7 and 8, respectively.

Figure 7 : Histogram of Average Daily Returns for the Firms in the Sample

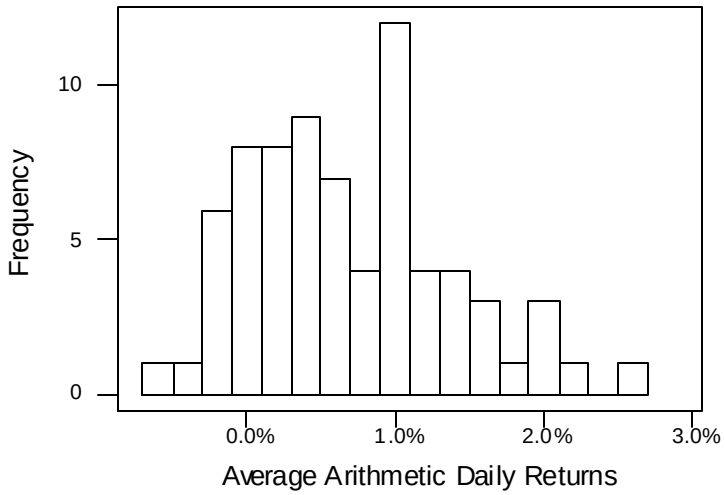
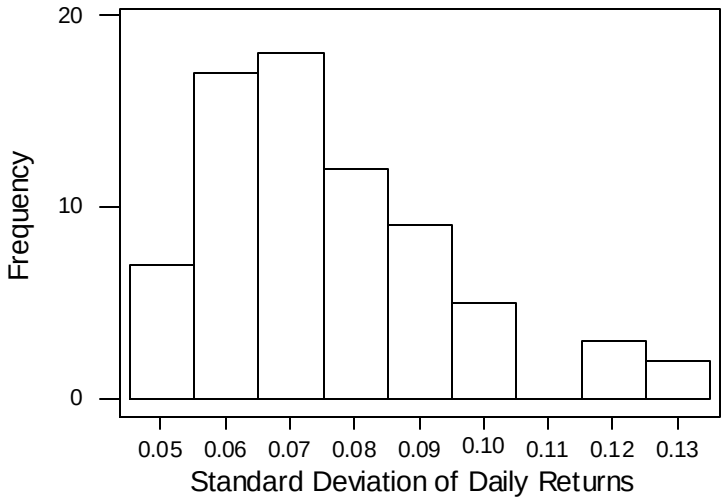


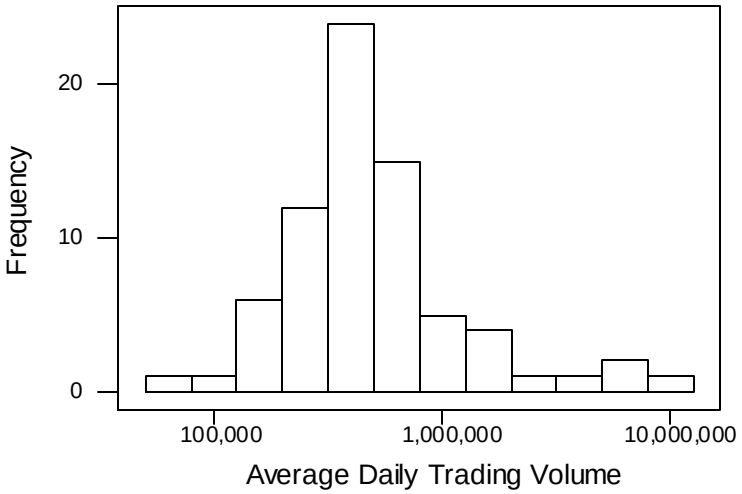
Figure 8 : Histogram of Return Volatility for the Firms in the Sample



Trading Volume

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). A histogram showing the distribution of average daily trading volume is shown in Figure 9.

Figure 9 : Histogram of Average Trading Volume for the Firms in the Sample



Event Study Analysis

Overview

An event study was conducted to determine the impact of high-message-volume days on securities prices and trading volume (Brown and Warner (1985); see also Campbell, Lo, and MacKinlay (1997) for a review of event study methodologies). The study looks at industry-adjusted returns and abnormal volume around days with abnormally high numbers of postings.

For each day in the sample period, the average and standard deviation of daily message postings over the previous five days was computed. Event days were defined as those with 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. This was done to reduce error introduced by stocks with small bulletin board followings.

Event-Day Classification

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 event study found a total of 293 event days. 47 of these had opinions lower than the previous five-day average. These days were grouped into the "Negatives" category in the analysis. 5 of these event days had opinion equal to the previous five-day average and were ignored. 241 of the 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 the remaining event days, i.e., those with the weakest positive opinion change. Table 2 presents descriptive statistics for the changes in opinion on the event days.

Table 2 : Descriptive Statistics for Investor Opinion on Event Days

	Raw Change in Weighted Opinion			Adjusted Change in Weighted Opinion		
Group	Strong Positives	Weak Positives	Negatives	Strong Positives	Weak Positives	Negatives
Average Value	27.97	3.11	-2.85	1.57	0.70	-0.76
Maximum	177.60	6.00	-0.33	2.00	1.14	-0.08
Minimum	6.00	0.25	-12.00	1.18	0.08	-1.81

Adjustment of daily returns is necessary because of the high and volatile returns in this sector. A constant-mean-return model could be used to adjust returns, but many of the stocks in the study do not have enough data to calculate accurate historical mean returns. Adjusting returns using the CAPM and the S&P 500 as the market index is another possibility. However, beta calculations using the S&P 500 would have large errors due to the volatility of the stocks. Moreover, the CAPM may not be the correct model for normal returns of firms in the Internet sector. The final option, adjusting returns using an industry index, is both feasible and free of estimation error because beta estimates are not needed.

To find the correct index, an equally weighted portfolio of the 73 sample stocks was constructed. Daily returns for this portfolio were compared to the daily returns of the Philadelphia Stock Exchange Internet Index, the Amex Internet Index, the Chicago Board Options Exchange Internet Index, the Philadelphia Stock Exchange Semiconductor Index, the NASDAQ Composite Index, and the S&P 500 Index. The correlations between these portfolios are given in Table 3.

The equally weighted portfolio is highly correlated with all three Internet indices. In addition, the three Internet indices are highly correlated to one another. The PSE Internet Index has a correlation coefficient of 0.906 and 0.934 with the AMEX Internet Index and the CBOE Internet Index, respectively. The correlation coefficient between the AMEX and the CBOE Internet Index is also high, 0.920. The PSE's Internet Index was the most highly correlated with the equally weighted portfolio returns and was chosen as the industry index for the study. The adjusted-return calculations should be insensitive to which of the Internet indices is used because of the high correlation between indices. As expected, the equally weighted portfolio was not as correlated with the market indices as it was with the Internet indices.

Returns were adjusted for industry returns. Each ticker was assumed to have a beta of 1 relative to the Philadelphia Stock Exchange Internet Index. Therefore, industry adjusted return was defined as a stock's daily return less the return on the Internet Index.

Table 3 : Correlations between Candidate Indices and the Sample Portfolio

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

Abnormal Trading Volume Calculations

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

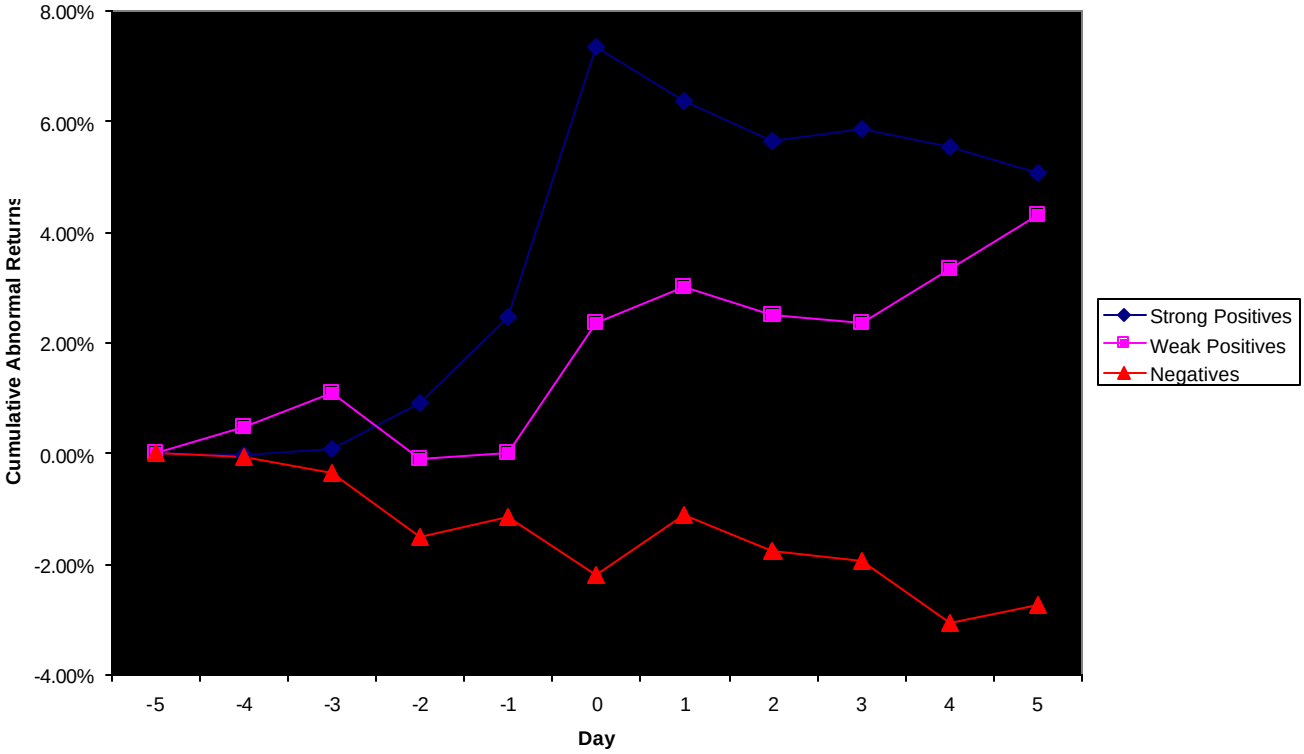
Empirical Results

Figures 10, 11, 12, and 13 show the industry-adjusted returns and abnormal volume for a five-day period surrounding the event day. It is apparent that only strong-positive-opinion events classified using the raw change in weighted opinion show a statistically significant positive drift up to the event day (see Figure 10). Returns for weak-positive-opinion events are statistically flat leading up to the event day. Negative-opinion event days seem to show a downward drift up to the event day, but the phenomenon is not statistically significant. On the event day, both strong and weak positives have statistically significant, positive industry-adjusted returns (see Figures 10 and 11). Negative-opinion event days have a slightly negative industry-adjusted return, which is not statistically significant. Returns for all the opinion groups are statistically flat after the event day.

Similarly, trading volume is normal leading up to the event day. On and one day after the event day, there is a sharp increase in trading volume (see Figures 12 and 13). The strongly positive raw change in weighted-opinion group shows the most significant increase in trading volume. For that group, approximately 160% more shares are exchanged on the event day than on the previous 20 days. Trading volume retreats to more normal levels approximately two days past the event day.

The results show that message board activity is linked to stock price movements. However, 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 showed 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. Using this methodology, it is impossible to determine whether activity on the message boards causes or is the result of abnormal returns on the stock. Under market efficiency, message board activity may respond to abnormal stock returns. However, it is possible that the phenomenon represents market inefficiency. Message postings may influence stock prices as investors try to find momentum indicators on Internet message boards. Further study examining the intra-day relationship between message posts and stock returns would be necessary to determine causality.

Figure 10: Abnormal Returns Around the Event Day
(Categorized by Raw Weighted Opinion)

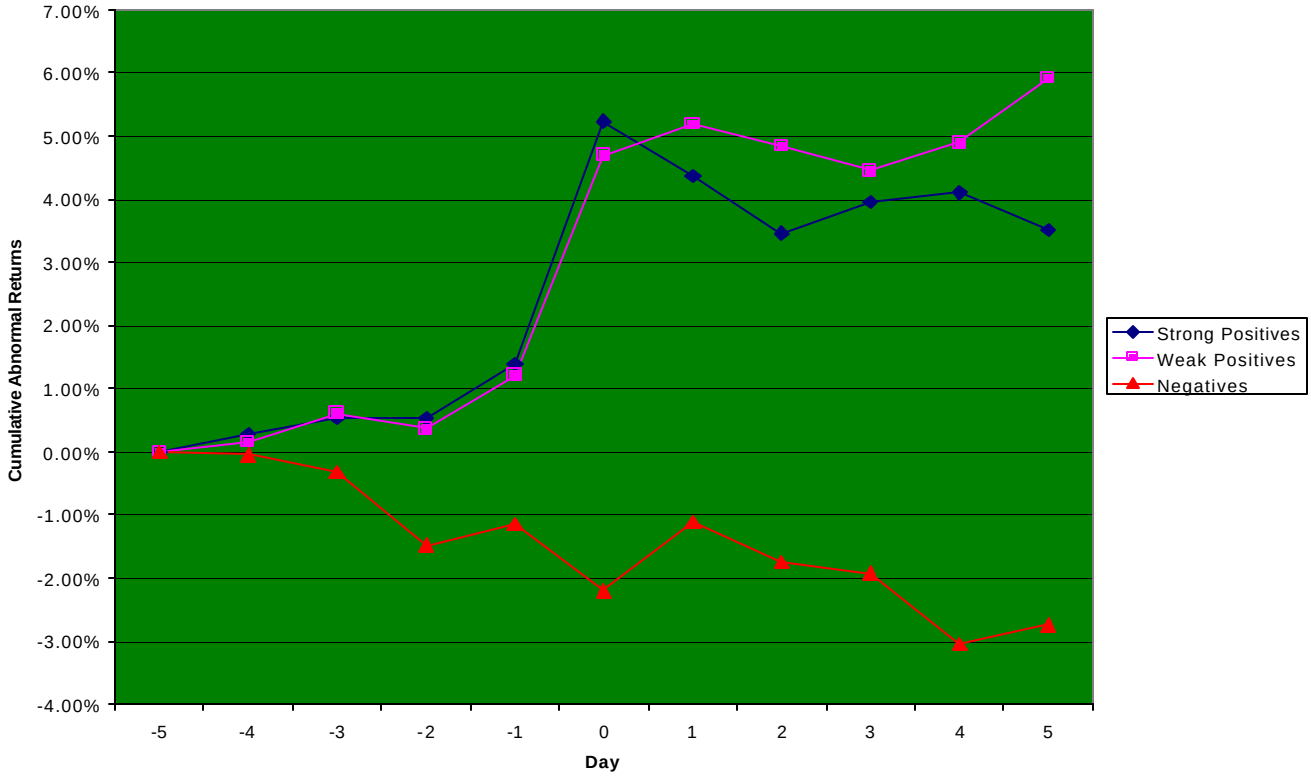


Day		-5	-4	-3	-2	-1	0	1	2	3	4	5
Strong Positives	Return	0.91%	-0.01%	0.10%	0.82%	1.55%	4.75%	-0.89%	-0.69%	0.21%	-0.32%	-0.44%
	Standard Error	0.62%	0.45%	0.45%	0.53%	0.65%	1.32%	0.64%	0.45%	0.53%	0.53%	0.56%
	Statistic Significance					★★	★★★					
Weak Positives	Return	-0.23%	0.47%	0.64%	-1.18%	0.10%	2.37%	0.62%	-0.49%	-0.14%	0.96%	0.93%
	Standard Error	0.44%	0.46%	0.66%	0.40%	0.67%	1.06%	0.79%	0.51%	0.49%	0.57%	0.51%
	Statistic Significance				★★★		★★					
Negatives	Return	0.19%	-0.05%	-0.28%	-1.16%	0.34%	-1.07%	1.12%	-0.64%	-0.18%	-1.15%	0.32%
	Standard Error	0.80%	0.93%	0.56%	0.59%	0.83%	1.16%	0.80%	0.75%	0.63%	0.67%	0.68%
	Statistic Significance				★★							

Day		Cumulative Prior 5 day Abnormal Returns	Cumulative Post 5 day Abnormal Returns
Strong Positives	Return	3.54%	-2.07%
	Standard Error	1.29%	1.27%
	Statistic Significance	★★★	
Weak Positives	Return	-0.22%	1.72%
	Standard Error	1.19%	1.18%
	Statistic Significance		
Negatives	Return	-1.09%	-0.72%
	Standard Error	2.29%	1.51%
	Statistic Significance		

Key:
★★ - Denotes 95% confidence that return is statistically different from 0.
★★★ - Denotes 99% confidence that return is statistically different from 0.

Figure 11 : Abnormal Returns Around the Event Day
(Categorized by Adjusted Weighted Opinion)

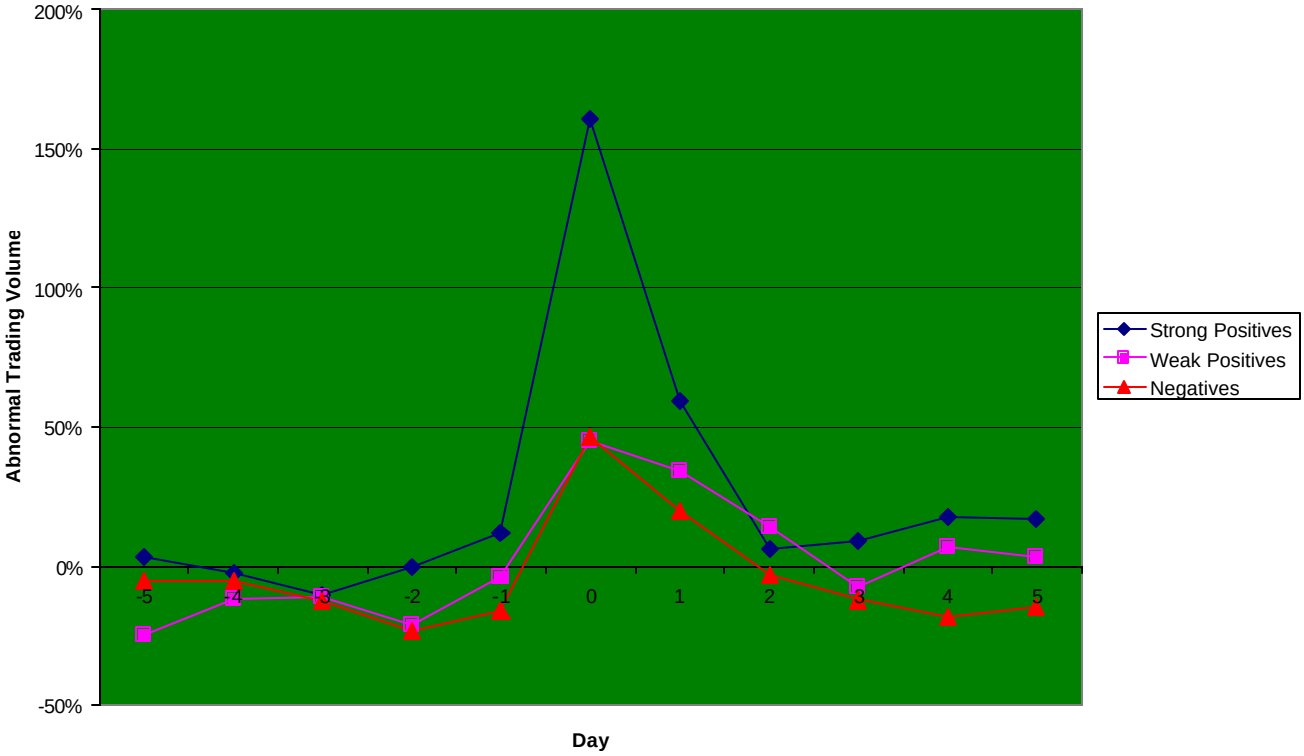


Day		-5	-4	-3	-2	-1	0	1	2	3	4	5
Strong Positives	Return	0.61%	0.28%	0.26%	-0.03%	0.87%	3.79%	-0.82%	-0.87%	0.48%	0.15%	-0.57%
	Standard Error	0.65%	0.45%	0.48%	0.54%	0.60%	1.30%	0.64%	0.49%	0.55%	0.59%	0.46%
	Statistic Significance						★★★					
Weak Positives	Return	0.13%	0.16%	0.45%	-0.25%	0.85%	3.44%	0.47%	-0.32%	-0.38%	0.43%	0.97%
	Standard Error	0.43%	0.47%	0.62%	0.42%	0.72%	1.13%	0.77%	0.47%	0.46%	0.52%	0.59%
	Statistic Significance						★★★					
Negatives	Return	0.19%	-0.05%	-0.28%	-1.16%	0.34%	-1.07%	1.12%	-0.64%	-0.18%	-1.15%	0.32%
	Standard Error	0.80%	0.93%	0.56%	0.59%	0.83%	1.16%	0.80%	0.75%	0.63%	0.67%	0.68%
	Statistic Significance				★★							

Day		Cumulative Prior 5 day Abnormal Returns	Cumulative Post 5 day Abnormal Returns
Strong Positives	Return	2.19%	-1.64%
	Standard Error	1.32%	1.25%
	Statistic Significance		
Weak Positives	Return	1.31%	1.07%
	Standard Error	1.19%	1.22%
	Statistic Significance		
Negatives	Return	-1.09%	-0.72%
	Standard Error	2.29%	1.51%
	Statistic Significance		

Key:
★★ - Denotes 95% confidence that return is statistically different from 0.
★★★ - Denotes 99% confidence that return is statistically different from 0.

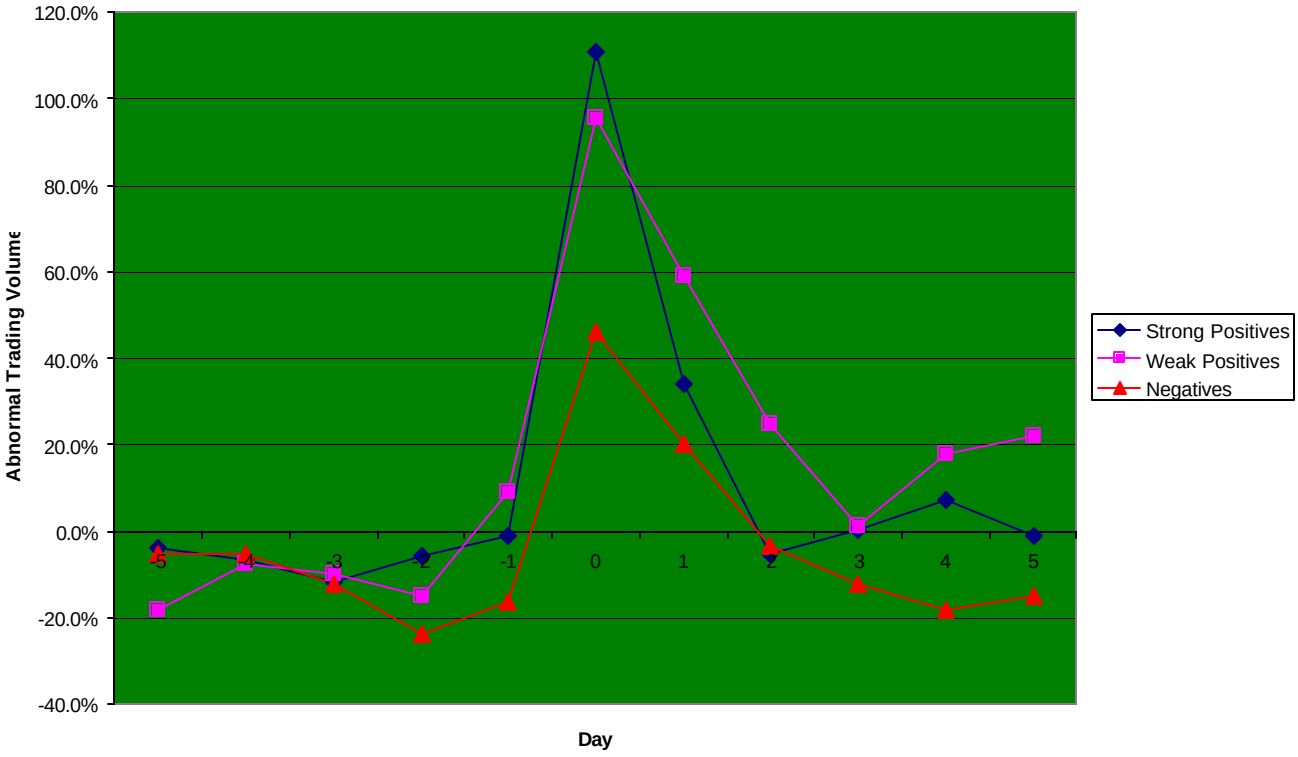
Figure 12 : Abnormal Trading Volume Around the Event Day
(Categorized by Raw Weighted Opinion)



Day		-5	-4	-3	-2	-1	0	1	2	3	4	5
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%
	Statistic Significance			★★			★★	★★★				★★
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%
	Statistic Significance	★★★			★★★		★★★	★★★				
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%
	Statistic Significance				★★★	★★	★★				★★	★★

Key:
★★ - Denotes 95% confidence that return is statistically different from 0.
★★★ - Denotes 99% confidence that return is statistically different from 0.

Figure 13 : Abnormal Trading Volume Around the Event Day
(Categorized by Adjusted Weighted Opinion)



Day		-5	-4	-3	-2	-1	0	1	2	3	4	5
Strong Positives	Abnormal Volume	-3.5%	-6.8%	-11.6%	-5.7%	-1.1%	110.7%	34.3%	-4.9%	0.6%	7.2%	-1.0%
	Standard Error	7.8%	7.1%	5.0%	6.6%	6.3%	64.9%	11.9%	5.9%	7.8%	10.2%	7.5%
	Statistic Significance			★★				★★★				
Weak Positives	Abnormal Volume	-18.3%	-7.5%	-9.7%	-15.0%	9.4%	95.5%	58.9%	25.1%	1.3%	17.7%	21.9%
	Standard Error	4.9%	7.5%	6.2%	5.1%	12.9%	17.7%	13.7%	16.9%	6.7%	16.6%	12.1%
	Statistic Significance	★★★			★★★		★★★	★★★				
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%
	Statistic Significance				★★★	★★	★★				★★	★★

Key:
★★ - Denotes 95% confidence that return is statistically different from 0.
★★★ - Denotes 99% confidence that return is statistically different from 0.

VAR Analysis

Overview

A VAR analysis was performed to analyze the general relationship among stock returns, trading volume, message postings, and weighted opinion. The analysis was performed on a stock-by-stock basis rather than over a pooled sample of all the stocks due to potential non-stationarity across securities. Specifically, since trading volume, number of messages, and weighted opinion differ in scale across stocks, there is no reason to believe that VAR coefficients should be the same across stocks. The alternative approach of normalizing these variables was rejected due to problems in formulating the correct normalization. Stocks with less than 30 observations were also eliminated from the data set. Rather than examining the coefficients themselves, t-statistics were calculated, again to avoid interpretation problems associated with scale effects.

Specification

Define the vector of variables of interest on day t as follows:

$$Z_t = \begin{bmatrix} return_t \\ volume_t \\ \#\,of\,messages_t \\ weighted\_opinion_t \end{bmatrix}$$

Then, the corresponding VAR(1) model is:

$$Z_{t+1} = A + BZ_t + e_{t+1}$$

where A is a vector constant, B is a four by four matrix, and e is the error term. A, B and their associated standard errors were calculated on a stock-by-stock basis using ordinary least squares regression.

Empirical Results

The average and median t-statistics across stocks for each coefficient are shown in the Tables 4 and 5, respectively. Meaningful average t-statistics are in bold text. These represent coefficients for which a significant fraction of the individual t-statistics are significant at conventional levels. The magnitudes of the t-statistics for the majority of coefficients are not meaningful. Stock returns, trading volume, number of messages, and weighted opinion were not useful in predicting stock returns one day

into the future. This result is consistent with market efficiency. Trading volume shows an auto-regressive 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. The number of messages posted on a given day on RagingBull.com is highly dependent on the number of messages posted on the previous day. In addition, days with high trading volume and positive weighted opinions are followed by days with greater message activity. Finally, weighted opinion is dependent on the number of messages and opinions posted on the previous day. Positive opinion days tend 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.

Table 4 : Average T-Statistic

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

Table 5 : Median T-Statistic

		Independent Variable			
		Return	Trading Volume	# of Messages	Weighted Opinion
Dependent Variable	Return	-0.161	0.006	0.043	-0.045
	Trading Volume	-0.084	**3.703**	0.180	0.097
	# of Messages	-0.486	**0.778**	**2.121**	**0.581**
	Weighted Opinion	-0.036	0.123	**1.154**	**0.962**

Note: *Bold* ***text denotes statistically significant results.***

Conclusion

It is fast becoming a truism that changes in information technology are ushering in a new age and, with it, a new economy. Although the larger implications of this are still being worked out, it is clear that Internet stocks are now, and will continue to be, a fundamentally important part of the financial landscape. Having recognized the importance of Internet stocks, financial theorists are now re-tooling their models to incorporate how financial markets value Internet companies. A number of valuable studies have begun this process by quantifying the effect of some accounting datum or other on Internet-stock valuation. This paper extends recent academic research by examining the effects of postings and opinions found on Internet message boards.

The VAR analysis shows that, in general, the returns of Internet service sector stocks are not predictable using message-board data and a linear one-day lagged time-series model. This observation is consistent with market efficiency. Instead, it is possible to predict the number of messages posted on Internet financial forums using the previous day's trading volume, number of messages posted, and weighted opinion. The event study shows that returns following abnormal Internet message-board activity are statistically insignificant and consistent with market efficiency. However, statistically significant positive returns 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 activity appear to be related. While this observation may be consistent with market efficiency, additional research is needed to see if this relationship reflects a market inefficiency and if changes in opinions precede movements in stock price.

These results are significant because they counter the conventional wisdom that Internet service stocks are valued irrationally. In general, message-board activity and opinion do not appear to impact stock prices in a significant, industry-adjusted fashion. Furthermore, abnormal message-board activity does not appear to predict significant abnormal returns. Therefore, the evidence presented in this paper shows that valuation of Internet service stocks is reasonable and consistent with market efficiency.

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